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NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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The Social Opportunity in the Special Areas

IN his presidential address to the British Association at Blackpool, Sir Josiah Stamp pointed out that society and its institutions should now be learning that change is a continuous function, and that meeting it requires the development of an appropriate technique. This passage in which Sir Josiah pleads for the development of social shock absorbers and accommodating mechanisms to assist in the transition and to minimize the disturbances to social relations and institutions arising from the application of scientific discoveries, is immediately recalled by the third report* of the Commissioner for the Special Areas (England and Wales), which has now been presented to Parliament.

The Chancellor of the Exchequer, when introducing the Special Areas Bill to the House of Commons, aptly described it as an experiment—and, we may add, in view of the recent gift by Lord Nuffield of £2,000,000 to form a trust the activities of which will supplement the action of the State, an experiment which begins in the happiest circumstances The Act may in fact be interpreted as an endeavour to determine the value to the Special Areas of providing special treatment, and to ascertain whether the results thereby obtained warrant a wide application. As such, it may indeed be regarded as an example of the machinery of social change and adaptation which Sir Josiah Stamp had in mind.

In the present report, the Commissioner reviews the progress made since December 31, 1935, in the economic development and social improvement of the Special Areas. In many directions good progress has been made. An auspicious start has been made with trading estate companies for the north-east coast and for South Wales, and their activities should be favoured by the operations of the recently formed Special Areas Reconstruction Association. Evidence that financial assistance is required for small industrialists in the Areas is increasing, and the Commissioner considers that if the objectives of his recommendations are to be attained, somewhat greater risks must be taken in granting loans than are usually accepted by bankers and financial houses.

The formation of trading estates marks a direct and practical effort to attract industry, especially the lighter industries, to the Special Areas. Their expansion is essential to secure a better balanced industrial production, and the Commissioner reiterates the view expressed in his first report. He urges that efforts to attract such industries to the Areas should not be diminished on account of the prospective improvement arising from the defence programme on which Great Britain is now embarked. It is hoped that trading estates will become centres from which increased industrial activities will radiate.

Of specific works initiated, the most important is the construction of the deep-water quays near Jarrow, but the Land Settlement Association, the

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* Third Report of the Commissioner for the Special Areas (England and Wales). (Cmd. 5303.) Pp. xii+210. (London: H.M. Stationery Office, 1936.) 3s. 6d. net.

Welsh Land Settlement Society and the Durham County Council are steadily progressing and the early results of these experiments in land settlement are regarded as satisfactory. They have demonstrated the adaptability and keenness of the settlers, whose general improvement in health and physique is remarkable. It is not generally realized how far below the standard strength and health of the ordinary active working man are those who have been long out of work, and how severely they suffer both physically and mentally from the loss of habit of work. A period of reconditioning is essential.

It is clear from the report that the Commissioner is far from satisfied with the results so far achieved, even if no more could be done with his comparatively limited powers. He repeats the criticism and recommendations of his first report, and especially stresses the importance of the Severn Bridge scheme as a gateway to South Wales, for which he was unable to make a grant. Similarly, to open up western Cumberland for industrial development and tourist traffic, he recommends the improvement of communications from the south and the construction of an arterial road, involving the construction of a bridge across the Duddon estuary. Improved communications between the north and south bank of the Tyne, east of Newcastle, are also recommended, as well as the institution of steps to prevent Maryport harbour from becoming closed and derelict.

Other specific recommendations in this field which have strong claims for State support are the erection of plants for the production of oil from coal in the Special Areas, the installation of a factory in South Wales for the manufacture of calcium carbide, and encouragement of the use of Welsh smokeless coal for domestic purposes. In the same category falls the proposal for the establishment and development on modern lines of a national park in South Wales. The development of the production of oil from coal in the Special Areas is recommended in the interests of national defence, and on the same grounds the Commissioner directs attention to the advantages of relative safety offered by some districts in South Wales and Cumberland in regard to the decentralization of the production of aircraft. For the same reason attention is directed to the value of South Wales, and West Cumberland as sites for the storage of grain and of oil.

The development and attraction of industry, however, is only one of the two main methods envisaged by the Commissioner for dealing with the problem of unemployment within these areas. Equal stress is laid upon the adoption of measures to decrease unemployment generally, thereby making easier a reduction of its intensity in the Special Areas. In dealing with this question the Commissioner again refuses to dissociate the particular problem of the Special Areas from that of unemployment generally. The effects of transference are being increasingly felt, and he reiterates his recommendation that an impartial and independent authority, with whom the trade unions should be associated, should conduct a survey to ascertain as scientifically and accurately as possible what are the relative prospects of industrial revival in the different districts of the Special Areas. Transference should be concentrated on these districts which obviously offer the least prospect of recovery.

Once again the Commissioner emphasizes the seriousness of the position in regard to unemployment among young persons. Pointing out that more than two thirds of the young men who were interviewed refused training at a Government constructional centre or failed to attend after acceptance, he reluctantly concludes that too large a number of young men in the Special Areas are content to live in idleness as State pensioners and are unwilling to make any effort to find work. The danger involved both to the young men themselves and to society as a whole leads the Commissioner to recommend, first that the proportion of men from the Special Areas who satisfactorily complete a course of training at the Ministry of Labour instructional centre should be greatly increased, and secondly, that such attendance on the part of young men from the Special Areas should no longer be on a voluntary basis but be subject to an approved measure of compulsion.

The scientific worker will be disappointed at finding among these specific recommendations no further reference to those suggestions regarding the application of science to industry which are being considered by the North East Development Board, although following the survey of the industrial facilities of the north-east coast published in April last, a technical advisory committee has been set up to provide for the further exploration of the economic potentialities of the Area. On the other hand, the further discussion of general principles contained in Part 1 of the report raises questions with which scientific workers are directly concerned. The very fact that the Commissioner, in restating principles previously outlined, finds it necessary to regret that they had not been recognized as a logical conclusion in debating his first report, indicates the need for closer attention to these questions.

As a means of increasing industrial activity in the areas, persuasion has definite limits and in fact is regarded as a failure by the Commissioner. On the other hand, compulsory location is regarded as unnecessary and dangerous ; the Commissioner finds an alternative in Government action to prohibit the location of industry in particular areas unless good cause can be shown His first recommendation is in fact that the further expansion of industry in Greater London should be controlled to secure a more evenly distributed production in which it is hoped the Special Areas would share.

The dangers attending the enormous post-War growth of Greater London, particularly in regard to adequate protection of food supplies in the event of a hostile attack, are cited in support of the Commissioner's argument that Government restraint on the further expansion of industry in the London area would indirectly benefit the Special Areas, and he refers to opportunities of exercising constraint at present available in the execution of the defence programme.

The Commissioner's recommendations involve the adoption of a definite plan to reduce unemployment in the Special Areas. He urges that if the Areas are to be given a reasonable chance of rehabilitation, industry must be attracted to them ; to start the movement the initial effort must be powerful. Moreover, although, as he repeatedly points out, the problems of the Special Areas cannot be dealt with entirely apart from the general problems and well-being of the nation, we must not be afraid of making a break with the traditions and practices of the past. The application of unconventional principles may well be called for, particularly in respect of preferential treatment, and the Commissioner's suggestion that the possibility of removing from the live register those who have been out of work for more than five years and are never likely again to obtain employment should be considered, deserves serious attention.

Once again, in fact, Mr. Stewart has made it apparent how closely this problem is linked up with that of rearmament, of health, education and industrial and social development generally. He firmly dismisses the idea that the defence programme offers any solution, and in fact directs attention to the dangers of armaments activity in the Special Areas if other measures are not simultaneously applied. Similarly, he directs attention to the dangers to health which are inherent in the conditions of the Special Areas, and his proposals for physical exercise and training as well as for instruction on relative food values, simple cooking and on the best way to distribute the portion of family income which is spent on foodstuffs, meet needs which are probably only more intense in the Special Areas but equally to be found elsewhere.

The scientific worker cannot but be impressed with the opportunity which many of the Commissioner's recommendations afford of gaining experience as to the value of numerous suggestions for social development which may well have a wide application if their efficiency is once proved. Action in this direction should not be thwarted by the opposition of vested interests, as is alleged by the Commissioner in regard to at least one of his earlier proposals repeated in the present report, and the attention which the report has already aroused in Parliament indicates that strong support for many of its recommendations should be forthcoming.

Undoubtedly the Commissioner's view of the position in the Special Areas is much less optimistic than that taken by Government spokesmen, and he is most emphatic on the need for definite action in accordance with widely developed and long-range plans. None the less, even when due account is taken of some tragedies of the Special Areas in regard to juvenile unemployment and disintegration of morale, the dominant impression created by the report is that of opportunity and hope. The task of rehabilitating and transforming these Areas and slowly reintegrating them into the national life is not insoluble. It makes big demands on vision and resourcefulness in planning, in research, and in redistribution of material sources and effort. Given the will and a vision of the social possibilities, success is assured, and the experiments may well prove of even greater value in the adaptation of national life as a whole to changed conditions. For this reason alone, apart from their incidental contribution in specific technical questions, the latest survey of the Special Areas claims the close attention of scientific workers as of other members of the community.

The Study of Mankind

L'Espèce humaine
Encyclopédie française, Tome 7. Pp. 574+40. (Paris: Comité de l'Encyclopédie française; Libr. Larousse, 1936.) 125 francs.

FOUR sumptuous volumes of this encyclopædic work have already appeared within a year under the general direction of Prof. Lucien Febvre. A total of twenty-one volumes is projected, including one of bibliography and one of indexes. The previous volumes are entitled "L'Etat Moderne", "Litteratures et Arts Contemporaines"; and the present one, "L'Espèce Humaine", is edited by Dr. Paul Rivet with the collaboration of M. Paul Lester and the aid of fourteen contributors. It has been issued in fifty-five fascicles, the complete quarto volume having a heavy black leather binding case.

The volume under notice is a discussion of anthropology in the widest sense, its three parts being devoted to (1) humanity to-day; (2) the question of peoples or races, including the notion of race, human palæontology, race crossing and the problem of classification; (3) population statistics and demography. Part I is richly illustrated with figures of human types and their activities, and begins with a historical discussion of what ethnology is. The various methods by which primitive implements were produced are described and illustrated in detail, as well as the uses of agglutinants, fibres, barks, fluids, etc. Other chapters are concerned with the social structure and supernatural beliefs of primitive peoples as well as their languages.

A chapter of twenty pages is devoted to the evolution of the idea of race, with illustrations from fossil skulls as well as from modern man. In another chapter, the biological phenomena of race are considered at length, and an attempt is made to introduce genetical conceptions. But although some French writers give Naudin credit equally with Mendel for the discovery of Mendelian inheritance, yet French investigators of heredity have always been few, and the bearing of genetical principles has not yet been widely grasped, especially in anthropology. In the present account the view still survives that mutations apply only to superficial characters, and that segregation in racial crosses frequently fails to occur, for example in negro-white crosses. The conception of duplicate factors and of linkage are conspicuous by their absence, the 15 : 1 ratio is regarded as contrary to Mendel's laws, and the significance of the numerous 1 : 1 ratios for a dominant abnormality crossed with the normal condition is not clearly stated. It is to be hoped that anthropologists will soon recognize more fully that genetical principles apply to man as extensively as they apply to animals and plants. In this connexion, the short account of the blood groups might have been greatly extended to indicate their racial significance.

The white Indians of San Blas are recognized as of mutational origin, but the author hastens to add that he uses the term in a very different sense from the geneticists. The latter, on the contrary, regard these Indians equally as an excellent example of mutation.

The chapter on fossil men contains many interesting views. The Australian aborigines are regarded as the most archaic of living peoples and are classified as belonging to the same species as Neanderthal man; but since the Australians cross with other modern peoples, it is suggested that Neanderthal and modern man must all be merged into one species—an extreme example of the application of the interfertility rule, which modern botanists and zoologists have dispensed with as a necessary criterion of species.

Aurignacian culture is regarded as represented by three races in Europe—Cro-Magnon, Grimaldi and Chancelade—which are all believed to have left modern descendants and to show affinities respectively with the white, black and yellow divisions of living man. A surviving Cro-Magnon type is seen not only in the Guanches on the Canary Islands but also in south-western France, especially the Dordogne, whence it may be traced across the Iberian peninsula. Similarly a modern Grimaldi type is recognized in various parts of northern Italy and the Rhone valley.

Two chapters on miscegenation are followed by a section on the problem of racial classification in which the views of Deniker and of Haddon receive fullest consideration.

Part III is a consideration of population and demographic questions from practically every point of view, including numerous statistics clearly set forth, with discussion of many problems relating to the present and past population of the earth.

The general reader, as well as the specialist, will find in this work ample material, whatever his special interest in man may be or whatever the point he wishes to elucidate. The abundant pages (72) of illustrations include several coloured plates.

R. RUGGLES GATES.

Structural Theory: Investigation and Rule

Final Report of the Steel Structures Research Committee
Department of Scientific and Industrial Research. Pp. xxvii+572+16 plates. (London: H.M. Stationery Office, 1936.) 12*s*. 6*d*. net.

BRITISH technical research has been, in the past, rather contemptuously treated by practitioners at home. The younger technicians have generally been carried away by the apparent profundity of Continental discussion, and the older industrialists have been only too happy to accept information of foreign origin without question. The same idea is displayed in the readiness to take up licences for developments elsewhere. This common and persistent attitude reflects a doubt as to the capacity of home efforts in inquiry and research to provide adequate guidance in design and development.

There may be reasons in some directions, but they can scarcely be held to apply in structural work. Several publications by the Department of Scientific and Industrial Research in recent years have shown that the powers of comprehension and compromise that properly constituted British committees can exercise are of the highest order. This was notably established by the Bridge Stress Committee Report in 1929; and has been maintained by the sequence of reports issued by the Steel Structures Research Committee, the final report of which concludes a line of investigation that is marked throughout by range, insight and decision. By describing this report as final, the Committee probably desires to indicate that it has concluded its work. There is, however, no finality in a study of this kind. Theory may be pursued to finer issues, investigation may lead to clearer data, and rules of design may reflect a fuller comprehension and a surer judgment; but the essential result is a compromise that denies finality since the theory and investigation are both, and separately, necessary and are drastically simplified in the process of rule making.

This final report presents rules for design, after lengthy study and experiment. The first report (1932) did very much the same thing after brief consideration and no experiment. The first report was an essay in creating order out of the chaos of building regulations. The final report is an effort to establish rules that rest upon rational bases elucidated by systematic inquiry. That the inquiry has upset preconceived notions as to the actions and interactions of the elements and connexions of building frames is an achievement of the Committee that may reduce the value of its own first attempt, but certainly leaves little merit in most other efforts.

The Bridge Stress Committee was almost wholly concerned with dynamic effects in bridge trusses. The Steel Structures Committee has concentrated almost entirely on static effects in building frames. The second report, issued in 1934, showed that in dealing with these, the problem of the characteristics of beam-stanchion connexions is complex and highly important. The work of the second report on this has been greatly extended. The honours in this line fall to Prof. C. Batho and his assistants, and the range and detail of the work now presented on the subject, embodying not only investigations on a wide variety of connexions and the factors influencing their actions, but also laboratory research on a full-scale frame, are remarkable for scope, experimental thoroughness and the manner in which design requirements are analysed. The investigations on bolted joints are strongly characterized by examinations of safe bolt torques, which make an important impression upon the ultimate issues of the report.

The other main experimental investigations presented in this voluminous report are concerned with measurement and analysis of stresses in actual structures. Prof. J. F. Baker and Dr. P. D. Holder are chiefly responsible, and the work marks new levels in large-scale research. Beam and column stresses in three classes of frames have been investigated. These frames are, respectively, for hotel, office and residential flat constructions, and mark the important continuation of the earlier work of this type by Dr. O. Faber on the framework of the Geological Museum, dealt with in the second report.

These measurements were undertaken to acquire information on the effects of workmanship under site conditions and to examine other factors that could, conceivably, influence stress distribution. The three types cover frame constructions with widely different connexion characteristics, the first having unusually rigid connexions, the second of normal order and the third of light construction. In the two latter the joint deformations were directly measured and, for the first, moment-angle diagrams are given as derived from the observed moments in beams and columns. The high degree of accuracy achieved is remarkable in view of the fact that testing was undertaken while actual construction was in progress. The discussion of the observations and the deductions therefrom are of great value. Such disturbing effects as beam torsion and the influence of unequal yields in the tension and compression cleats of connexions are duly commented upon; and the final review of the tests on the three buildings contains important remarks on the effects of casings and walls.

An analysis is presented of the effect of wind load moments, and attention is directed to the high values set up in the lower parts of the column when the stiffness ratio of beam to column is low. But the final recommendations for design only cover for stresses caused by vertical loads. It is to be accepted that in structures for which the design rules are used, the constructions must resist horizontal or wind forces by means of floor slabs and walls acting as bracing, or by special framing.

The design rules are presented with great clearness, and are the outcome of the rational lines of analysis developed in the various special studies on frames, stanchions and connexions. The rules are fully supported by tables and curves, and provide a relatively simple and straightforward procedure that is rather remarkable when the extraordinary range of data and detail study from which they emerge is viewed. In the structural trades, the rules will be the ready measure of the Committee's achievement; but to those who understand the technique of data accumulation, analysis and reduction in large-scale work, the labours that lie behind them, and lead to them, will be significant and highly impressive.

Foundations for Animal Painting

Animal Painting and Anatomy
By W. Frank Calderon. (The New Art Gallery, Second Series.) Pp. 336. (London: Seeley, Service and Co., Ltd., n.d.) 21*s.* net.

MR. CALDERON'S high reputation and the acknowledged influence he has exerted on the work of other distinguished animal painters guarantee that this new work from his hand will prove a trustworthy guide to the presentation of animal form in art. The first part of the manual is devoted to the general principles of picture-making and will repay perusal by the student of any branch of art, for here the author gives, from a ripe experience, much useful guidance in picture-making, combining a wealth of general principles with many useful hints about the handling of technical details—even to such minor points as the farm-hand with a switch who may be employed to prevent flies from disturbing the pose of a restive model! The second and much the larger part consists of detailed studies and descriptions of the anatomy of several animal types and the influence of anatomical detail on posture and surface form.

Both parts are profusely illustrated by pencil and charcoal drawings of admirable clarity, with the names of structures clearly indicated on the plates themselves—a method much to be preferred to numerical references, at the foot of the plates, so often to be found in manuals of this kind. Several useful reproductions of well-known pictures are added, to illustrate anatomical accuracy in observation or, in some instances, the absence thereof.

While the salient blood-vessels, which form such important features at many points in surface anatomy, are well described in the text, these are not so distinctly differentiated from the deeper structures in many of the plates; it would appear to have been worth while to have devoted some plates expressly to showing the prominent lines of these structures on the surface. With later editions in view, it should also be noted that in PL. 58 the skin-muscle is made to look like a bifurcation of the sterno-maxillaris instead of being shown on the more superficial plane to which it belongs. As one concerned to some extent in the correct delineation of human anatomy, the reviewer would also point to the unsatisfactory view of the shoulder girdle in PL. 63, the absence of the coraco-brachialis in PL. 124B and the exaggerated representation of the platysma in PL. 138.

These, however, are but minor points to cavil at in a work of supreme excellence, which is strongly recommended not only to the art student but also to all animal lovers, who will enjoy its *facile* and faithful drawings. No better advice could be given to any student, desirous of acquiring efficient technique in this branch of art, than that he should make careful copies of Mr. Calderon's plates on separate cards and then study those of anatomical detail in juxtaposition with those of surface form; it is certain that his own work will greatly profit in accuracy and natural semblance through the influence of these distinguished drawings.

ALEX. MACPHAIL.

The Excavation of Verulamium

Verulamium, a Belgic and two Roman Cities: By Dr. R. E. M. Wheeler and T. V. Wheeler. (Reports of the Research Committee of the Society of Antiquaries of London, No. 11.) Pp. xii+244+120 plates. (London: Society of Antiquaries, 1936.) 15*s*.

THE fame of the excavations at Verulamium, by St. Albans, has been widespread. They were visited by many thousands, and accounts were constantly disseminated by the lay Press, as well as by technical journals. Dr. and Mrs. Wheeler have done more than anyone else to create a great and genuine popular interest in the archæology of Great Britain. They have proved once and for all that English people do not need the enchantment of Egyptian or Mesopotamian distance to stimulate their enthusiasm for the unearthing of the past. Under the care of the Office of Works, and, in the case of the theatre, through the generosity of Lord Verulam, the remains of important buildings on the site are now permanently open to view, and the enlightened action of the St. Albans Corporation in initiating the whole enterprise will doubtless be maintained and extended in the future. The success of the work has been a fine example of co-operation between local and national authorities, private owners, archæologists, volunteer students, and the general public. Now the official report, worthily published by the Society of Antiquaries, is before us as the abiding record of the whole four years' campaign. It is no less an abiding reminder of the irreparable loss that we have sustained a few months since in Mrs. Wheeler's grievously premature death.

The very wording of the title, "A Belgic and Two Roman Cities", would have seemed almost impossible seven years ago. It had indeed long been guessed that the pre-Roman stronghold of the Belgic King Cassivellaunus, stormed by Julius Cæsar in 54 B.C., lay hereabouts, but its site had never been precisely localized. By their inspired refusal to rest content with exploring the later Roman Verulamium alone, Dr. and Mrs. Wheeler have not only identified and outlined the history of a pre-Roman town, but also have come as near as possible to giving Cassivellaunus' *oppidum* a well-certified location five miles away in the great earthworks at Wheathampstead. They have shown, too, that the earthwork known as the 'Fosse' is the rampart of an early Roman Verulamium, in great part distinct from the recognized site of the later Roman city.

The historical sequence thus revealed is broadly speaking as follows: In the decades before Cæsar's invasions, Belgic conquerors from northern Gaul appeared in the Hertfordshire district, establishing their greatest stronghold at Wheathampstead, and fortifying their north-west frontier with the immense barrier of the Beech Bottom Dyke between the Rivers Lea and Ver. Forty years or more after Cæsar had come and gone, the first Verulamium came into being on the Prae Wood hill above the ford of the Ver opposite the Beech Bottom alignment. Here King Tasciovanus, the father of the greater Cunobeline, had his capital and mint.

After the Roman Conquest of A.D. 43, this site was abandoned, and the early Roman city was settled on the slopes below leading down to the all-important ford; through it ran the Imperial road from London to Chester, our Watling Street. This *municipium* was still without defences when it was sacked by Queen Boudicca's rebels in A.D. 61, but when restored thereafter it was furnished with the rectilinear defensive 'Fosse'.

In the second century, a further downhill move was made, and a new Roman city was laid out on an ambitious scale along the Watling Street beside the river, and dignified with the massive masonry-faced ramparts and deep ditches in part still to be seen. These tremendous walls, their towers and gates, two triumphal arches, a forum, shops, temples, a theatre unique in Britain, and many comfortable private houses, all attest "an age of colonial enterprise" when "the dignity of a distinguished provincial municipality demanded expression", and furthermore, "reflect an epoch when imperial and private speculators were investing their wealth in the British province to an extent which, in fact, the issue failed utterly to justify". A hundred years later, all was in decay, and the revival which under Constantius ushered in the fourth century was indeed accompanied by much rebuilding, but ended with that century in the shrunken decline of economic failure.

For the pre-Roman phases, this historical framework is mainly based on mutually helpful studies of fortifications and of pottery, though the excavations could not be extended over much of the actual areas of settlement. This handicap is graver in the case of the first Roman city, where the confident handling of the evidence from the defensive 'Fosse' makes one almost forget that the interior remains absolutely unknown. With the second Roman city the position is in a measure reversed:

from inside it, information is abundant, but the walls, towers, and gates have not been too generous of material, and their chronology has required some rather anxious argument from negative evidence.

The built-up areas within have provided the most uniformly successful sections of the report; probably no excavation on a Romano-British town site has ever been more laborious yet more superbly conducted and brilliantly described. It is impossible to go into detail here, but the section on the 'Triangular' temple demands especial mention, while the peculiarly interesting theatre has called for publication at greater length in *Archæologia* by its excavator, Miss Kathleen Kenyon. The plans and drawings, mostly by Dr. Wheeler himself and Mr. A. W. G. Lowther, are everywhere splendid, and the coloured reproductions of the mosaic pavements by Mrs. Wheeler and others are as beautiful as their text is illuminating.

To historians, and especially economic historians, this work should above all be commended; the archæological method is now an essential instrument of their science, and seldom can a single excavation report have carried so much matter for thought so far beyond the circle of archæological specialists. C. F C. HAWKES.

Illustrations of Weeds

Weed Plates

By Prof. Dr. E. Korsmo. Series 2, Plates 31–60: Comprising 44 Species of Weeds on Cultivated Soil. 33in. × 25in. With explanatory Booklet of 92 pp. (Oslo: Norsk Hydro-Elektrisk Kvaelstofaktieselskab; Leipzig: Koehler und Volckmar A.-G. und Co., 1935.) Paper, 22 gold marks; Leather paper, cloth edges, eyeletted, 38 gold marks.

THIS second series of illustrations of farm weeds fully maintains the high standard of execution and reproduction of the preliminary set (see NATURE, 135, 937; 1935). The presentation of each weed provides an education in its life-history and in many cases demonstrates in a most striking manner why any particular species is peculiarly difficult to eradicate.

The plates reveal the variety of methods of reproduction of individual weeds, many of which are frequently overlooked by the trained botanist as well as by the casual observer. For example, *Ranunculus ficaria* produces seed, bulblets in the leaf axils, and 'root tubers', all capable of withstanding a variety of adverse conditions and thus insuring the safety of the species. The great range of subterranean systems of weeds often remains unsuspected, as the aerial parts give little hint of what is happening below ground. The variety of morphological development in this direction may be indicated by *Mentha arvensis*, which possesses an amazing underground range of tubers, *Campanula rapunculoides* which forms an extensive creeping underground system with storage roots, *Bunias orientalis*, a crucifer with an exceptionally deep root and great basal leaves which may be two feet long, while *Polygonum bistorta* gains its name of 'snakeweed' from its fantastically twisted and curved rhizome.

A valuable feature of the illustrations is the help they give in distinguishing closely allied species, such as *Bromus secalinus* and *Bromus mollis*. For teaching purposes, also, many details are brought out which usually escape observation. Most students regard a poppy capsule as a partitioned box filled with numerous loose seeds, as it actually is when ripe, while the systematic attachment of the young seeds on the walls of the loculi is seldom realized. Another point is the wide range of variation in the size of the fruit of such species as *Atriplex patula*, which at first sight appears accidental, but is in reality a feature of the species. Yet again, special notice is taken of characteristic forms of hairs, which are often valuable aids in the determination of species, as the stellate hairs found in *Berteroa* (*Alyssum*) *incana*. Examples of this kind might be multiplied indefinitely, all pointing to the expert knowledge of teaching requirements which inspired the preparation of the plates.

Throughout the series, each weed is recognized as an individual, and no stereotyped form of treatment has been attempted. In each case the particular points of interest have been worked out, and the development of a single detail is often illustrated by a whole series of drawings. Of special value are the sketches of the early stages of such weeds as *Galeopsis*, which are not usually at all well known by botanist or student.

A third series of plates is due to appear, and on their publication the botanical world will be in possession of a work on the morphological details of farm weeds which is outstanding in the accuracy of its workmanship. These charts, together with Prof. Korsmo's recent book on weed seeds, with its beautiful coloured illustrations and detailed letterpress, will undoubtedly become a classical work of reference for many generations to come.

Sex

By Dr. B. P. Wiesner. (Home University Library of Modern Knowledge, No. 180.) Pp. 256. (London: Thornton Butterworth, Ltd., 1936.) 2*s*. 6*d*. net.

It is not surprising to find that this book departs in some ways from the tradition set by others on scientific subjects in this well-known series. In the first place, the subject itself is not restricted by the formal confines of academic curricula, and Dr. Wiesner has had to draw on such diverse branches of knowledge as physiology, anatomy, endocrinology, genetics, general biology and psychology. In so doing, the author has revealed a second feature of his departure from Home University Library orthodoxy, by showing himself an original thinker and by asking the lay reader to consider hypotheses, to weigh evidence and, in short, to puzzle things out for himself, instead of merely accepting *ex cathedra* statements about scientifically established 'facts'.

The nature of Dr. Wiesner's subject has doubtless in part dictated his technique of exposition, but a reading of this concise survey suggests that temperamental influences may also have played their part. However that may be, he has produced a book that is packed with information and interest; this may make it less easy reading for the layman than the conventional popular exposition of a technical subject, but will give it a special appeal to the scientific worker.

Apart from a few minor oversights in typography and phraseology, the actual presentation of Dr. Wiesner's matter calls for little criticism, for it lacks neither clearness nor elegance—if, indeed, any distinction whatever is to be made between the two. The drawings and diagrams add to the general lucidity of exposition. To the technician, the most controversial, and therefore the most attractive, part of the book will probably be the discussions on the relation between sexuality and reproduction (especially Chapter v) and on the evolution of sexuality.

A. L. B.

Tables annuelles de constantes et données numériques de chimie, physique, biologie et technologie

(Annual Tables of Constants and Numerical Data; Chemical, Physical, Biological and Technological). Données numériques sur le pouvoir rotatoire (Numerical Data on Rotatory Power). Par Prof. E. Darmois. Années 1931 à 1934. Pp. 68. (Paris: Gauthier-Villars; New York: McGraw-Hill Book Co., Inc., 1936.)

This is a collection of data obtained on optical rotatory power between 1931 and 1934, and is an advance paper from vol. 11 of the well-known "Tables annuelles". The matter is grouped in seven sections: specific rotatory powers; influence of temperature, concentration and solvent; rotatory dispersion; resolution of racemic compounds; mutarotation; effect of additions; and general theories. Of these the largest section is that on rotatory dispersion, which occupies more than half the volume. Among the interesting results recorded in this section one may note in passing the work of Lowry and Gore on the vapour of camphor and camphorquinone, and that of Levene on a number of aliphatic compounds in which the rotatory dispersion is followed through an absorption band. Section 4 includes a number of resolutions of theoretical interest such as Mann's purely inorganic compound $Na[Rh(SO_2N_2H_2)_2(H_2O)_2]$, and on the organic side Pope and Whitworth's resolution of *spiro*-5 : 5-dihydantoin and Backer and Schurink's work on *spiro*-heptane dicarboxylic acid.

The numerous workers in the field of optical activity will be grateful to Prof. Darmois for this valuable summary of recent work.

Technische Kunstgriffe bei physikalischen Untersuchungen

Von Prof. Dr. Ernst von Angerer. (Sammlung Vieweg: Tagesfragen aus den Gebieten der Naturwissenschaften und der Technik, Heft 71.) Dritte Auflage. Pp. ix+201. (Braunschweig: Friedr. Vieweg und Sohn, 1936.) 9.80 gold marks.

Prof. von Angerer was entrusted with the preparation of the volume on experimental technique for the Wien-Harms "Handbuch der Experimentalphysik", and the present publication represents the third edition of his "Kunstgriffe", so that it must from the outset command attention. Indeed, it is a most interesting little book in which every experimenter is bound to find something which will appeal to him personally.

It is obvious that the author has taken considerable pains to keep himself thoroughly up to date with modern advances in laboratory arts and technique, and it is clear, too, that in many instances he has tested them for himself. Omissions, so far as the reviewer has been able to judge, are very few, although it is surprising that no mention is made of Hulett's method of purifying mercury, and also to find that two constant-temperature baths instead of three are shown in thermo-couple diagrams. However, such details detract but little from the excellence of the work as a whole, and it can be heartily commended.

L. F. B.

Experimentelle Grundlagen der Wellenmechanik

Von Dr. S. Flügge und Dr. A. Krebs. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 38.) Pp. x+236. (Dresden und Leipzig: Theodor Steinkopff, 1936.) 16 gold marks.

The collaboration of a theoretical physicist with a colleague who is an experimenter naturally results in a book of wide appeal, even if both authors feel it necessary to deal with many important branches of modern physics in a small space. It provides a ready guide for readers who wish to know the present state of wave mechanics theory, its experimental basis, and how far the theory is able to provide new and more adequate explanations for the results of fundamental experiments. It is an interesting compilation. The reviewer, however, would scarcely term Schopper's experiment for the direct measurement of e, a method for finding e/m.

The Oxford University Arctic Expedition, 1935-36

By A. R. Glen

THE plans of the Oxford University Arctic Expedition, 1935–36, were briefly outlined in an article which appeared in NATURE of April 20, 1935, p. 604. The Expedition returned to England in September last after a stay of fourteen months in the barren North-East Land. The country, which is somewhat larger than Wales, has the greater part of its interior covered by ice cap; its coasts are broken up by many deep fjords which are divided one from the other by rocky promontories from which the ice covering has long since disappeared. The north coast, which fringes the Polar Ocean, was practically unknown, while there was also little knowledge of the east coast, which is made up of an almost continuous stretch of ice cliffs—these being the largest expanse outside the Antarctic.

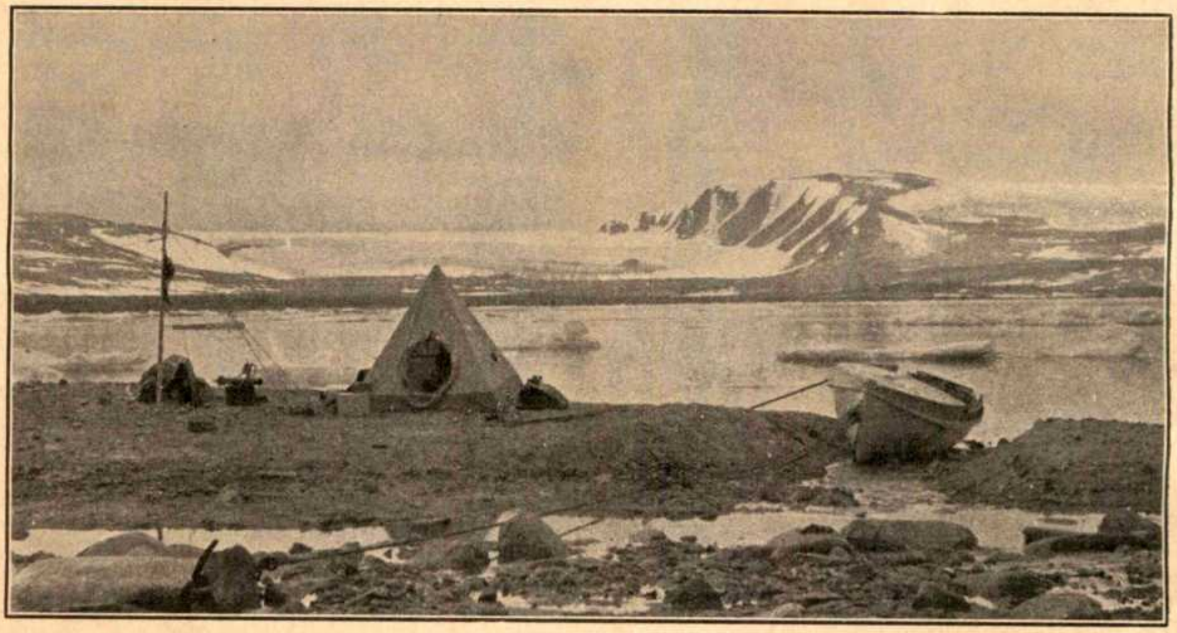
Fig. 1.
A CAMP ON THE NORTH COAST OF NORTH-EAST LAND DURING THE BOAT SURVEY JOURNEY IN THE FIRST SUMMER.

The personnel of the Expedition consisted of ten members who were as follows: A. R. Glen (leader and glaciologist), N. A. C. Croft (photographer), A. Dunlop Mackenzie (organizer), J. W. Wright (surveyor), A. S. T. Godfrey (surveyor), R. M. Moss (physicist), R. A. Hamilton (physicist), A. B. Whatman (in charge of radio research), D. B. Keith (biologist), K. J. Bengtssen (trapper).

The biological work of the Expedition will be dealt with in another article. For the remainder of the research, it may first be said that the whole programme of the Expedition was successfully achieved. Climatic conditions did nothing to facilitate this, for although the temperature never fell so low as had been anticipated nor were the gales so severe as had been feared, yet prevailing blizzard and predominant fog much complicated survey and geological investigations. During the summer of 1935, the western part of the north coast was surveyed in the course of a boat journey made by Wright, Keith and Bengtssen. The polar ice retreats from the coast during the summer, allowing the use of small boats until the bays begin to freeze again in September, and this party only returned to the base before the autumn gales began. In the following spring, Wright and Mackenzie started off with a dog team to sledge along the eastern part of the north coast so as to complete the survey and if possible to continue it down the east coast. In the previous autumn and winter, journeys had been made in the darkness to lay depots at three strategic points, Cape Leigh Smith, Palander Bay and Wahlenberg Bay, which should be used by this spring survey party. What had not been allowed for, however, was the weather; continuous fog and low cloud made survey quite out of the question except on one or two days during each month. The result was that by the time the bay ice was beginning to break up in early July, a considerable part of the north coast still remained to be mapped. Wright and Mackenzie therefore returned to the base in Brandy Bay after a narrow escape from disaster when crossing Rijps Bay in an improvised boat. A second party was quickly fitted out, and a few days later Wright and Hamilton set off for Cape Leigh Smith, which they reached after nine days hard travelling. The weather suddenly became good, and in a fortnight's work the mapping of the north coast was completed (Fig. 1). The greater part of the survey of the rest of the country was also carried out by other sledge parties, and North-East Land must now be considered as one of the best mapped countries in the Arctic.

The main problem of the geological investigations was in connexion with the relation between the Hecla Hoek rocks and the granites and gneisses which are found around North Cape and also form the eastern part of the north coast. The eastern arcs of the Caledonian folding have affected this region, and although the absence of a full-time geologist greatly hindered this work, a considerable amount of research was carried out on these problems. The geological structure of the western part of the north coast was mapped in detail and some interesting discoveries were made in the little metamorphosed rocks of the younger Hecla Hoek series.

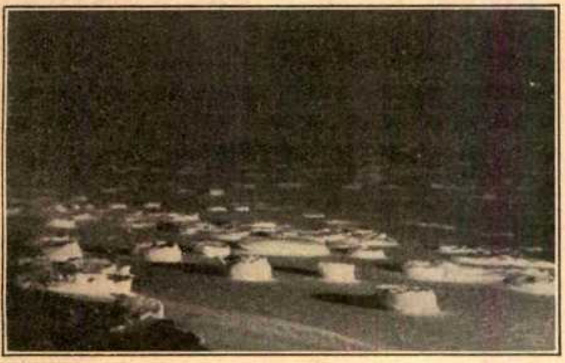

Fig. 2.
RAISED FOOTSTEPS ON THE SNOW SURFACE DURING THE WINTER. FOOTSTEPS ARE PACKED DOWN AND THE SOFTER SURROUNDING SNOW IS REMOVED BY WINDS, LEAVING THE FOOTSTEPS RAISED ABOVE THE REST OF THE SURFACE. TAKEN AT MIDDAY IN DECEMBER AT THE NORTHERN ICE CAP STATION DURING THE FOUR MONTHS WINTER DARKNESS.

Perhaps the most interesting work of the Expedition was in connexion with the glaciological investigations. In order to carry these out, it was planned to establish two stations on the inland ice, each of which should be maintained by two men over the winter. The only previous work of this nature was accomplished by the German expedition under the late Alfred Wegener, when their station Eismitte was set up in the centre of the Greenland ice cap. Difficulties of transport resulted in only the barest minimum of food and equipment being brought to Eismitte, and in appalling circumstances the Germans succeeded in producing a wonderful harvest of scientific results. Our problem was simpler in so far as distances were shorter, and we had the guidance of previous experience; but there were the same difficulties to be overcome in the way of blizzards and low temperatures, while four months darkness was a further complication. A solution was found in having the stations cut out of the ice, and amazing warmth and comfort was attained in this troglyditic existence. Moss was in charge of the central station for ten months, during three of which he was alone, while Glen and Dunlop Mackenzie formed a wintering party at the northern station (Fig. 2). Meteorological investigations were taken

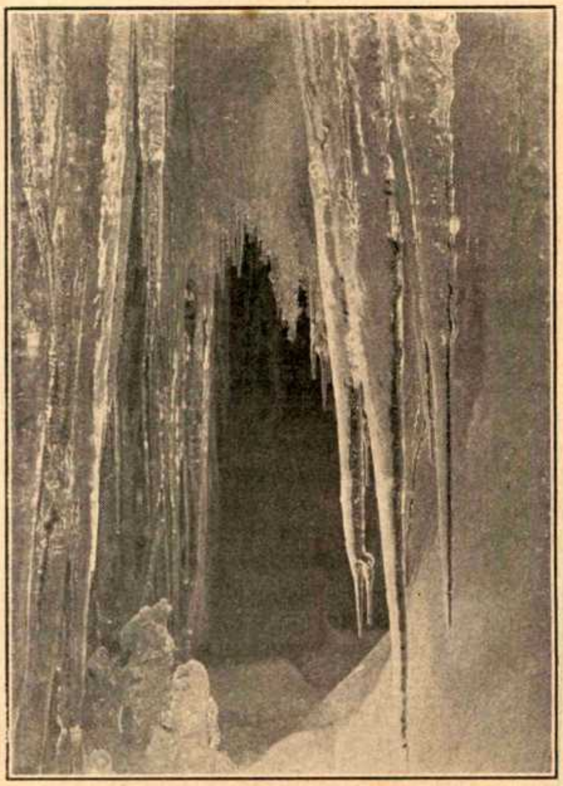

Fig. 3.
CREVASSE DISCOVERED AT THE CENTRAL ICE CAP STATION WHILE A SHAFT WAS BEING DUG TO 40 FT. BELOW THE SURFACE. A DEPTH OF 70 FT. WAS REACHED IN THE CREVASSE, BEING ONLY A FEW FEET FROM THE LAND BELOW.

three times daily at each station at the same hours as at the base, whence results were sent by wireless after each reading to Norway.

The net balance of the ice cap—that is to say, the ratio between the factors of accumulation and ablation—was determined for the west ice over the year, and preliminary discussion of the results obtained indicate that the northern part of the ice cap is probably both shrinking and retreating. The different factors obtaining both in accumulation and ablation were separately measured and their relative proportions assessed, while research was also made on various physical questions connected with the ice itself and with the change of snow into ice. The temperature gradient was measured down to a considerable depth, and it was found at the central station that the temperature remained at a fairly constant 0·0° C. at a depth of 70 ft. Certain indications of the thickness of the ice were obtained indicating that at least the west ice is very much thinner than had been thought. A crevasse was discovered while digging a shaft at the central station, and through it we were able to penetrate to a depth of more than 70 ft., where an unfrozen ice lake was found (Fig. 3). The walls of the crevasse were covered with a glittering array of ice crystals while magnificent icicles across the passages formed curtains which had to be cut down before a way could be found along them (see also NATURE, Nov. 7, p. 803).

At the base in Brandy Bay, Whatman and Hamilton were stationed practically continuously throughout the whole expedition. They were in charge of the important research on the ionosphere which was being carried out for the first time north of the auroral belt. Before departure from England, it had been feared that the severe climatic conditions would make it impossible successfully to accomplish this work, but so efficient was the whole apparatus and the Petter electrical generating unit, that not a single serious breakdown occurred over the entire year. The results are now being examined by investigators at the Radio Research Station at Slough, in co-operation with which, and also with the Norwegian Government Station at Tromsö, the records were taken. Special studies were also made of the aurora, and measurements were made of the atmospheric ozone.

By the end of August the scientific programme had been accomplished and the M.S. *Heimland* arrived in Brandy Bay on August 21. The base hut has been bought by the Norwegian Government, and after it had been inspected and the stores and equipment loaded on to the ship, we left Brandy Bay on the following evening.

Scientific Centenaries in 1937

By Eng.-Capt. Edgar C. Smith, O.B.E., R.N.

WHEN reference was made in these columns a year ago to the scientific centenaries in 1936, the first man of science to be recalled to mind was the famous German mathematician Johann Müller, or Regiomontanus, who was born in 1436. In reviewing the centenaries which will fall this year the first name to be included is that of Christopher Clavius (1537–1612) whose birth occurred a century later. Born at Bamberg, in Germany, he entered the Society of Jesus, taught for many years in Rome—earning for himself the appellation of "the Euclid of the 16th Century"—was employed by Pope Gregory XIII on the reformation of the calendar, and in 1604 published his most important book, "Geometria Practica". He died February 6, 1612. Another mathematical worthy of the sixteenth and seventeenth centuries was Henry Gellibrand, who was born in London in 1597 and died as Gresham professor of astronomy in February 1636 (O.S.) or 1637 (N.S.). It was Sir Henry Savile who turned Gellibrand's attention to mathematics, and at the Gresham College he became the close friend of Henry Briggs.

> "Mr. Gellibrand's situation at the College, free Converse with the Lovers of Mathematical Studies, and diligent Enquiries, gave him," wrote Benjamin Martin, "an Opportunity of contributing much to the Improvement of Navigation, which probably would have owed more to him had he lived longer: But he was taken off February 9, 1636, in the 40th Year of his Life, and was buried in the Church of St. Peter the Poor, without any Inscription to his Memory".

The year 1637 also saw the birth of another English mathematician who had but a short life, William Neile, who died at the age of thirty-four years. He had been elected a member of the Council of the Royal Society at the age of thirty, and according to the antiquary Hearne, his powerful genius for mathematical studies was such "that had he not been cut off in the prime of his years in all probability he would have equalled, if not excelled, the celebrated men of that profession".

Whatever interest is to be found in the lives of Clavius, Gellibrand and Neile, however, is far surpassed by that which surrounds the activities and strange ending of the great Dutch naturalist Jan Swammerdam (1637–80). He imbibed a love of natural history from his father, and was trained for medicine. He became famous both as an anatomist and as a microscopist.

> "Swammerdam," said Prof. Miall, "treated the microscope as an instrument of continuous biological research. In his eyes it was a sacred duty to explore with the utmost faithfulness the minute works of the Creator. Insects yielded him an inexhaustible supply of natural contrivances, in which closer scrutiny always brought to view still more exquisite adaptations to the conditions of life. He was able to throw a beam of steady light upon the perplexed questions of insect-transformation, and swept from his path the sophistries with which the philosophy of the schools had obscured the change of the caterpillar into a moth, or of the tadpole into a frog. . . . He bequeathed to his successors many noble examples of the way in which life-histories ought to be investigated."

About 1672, Swammerdam came under the influence of that strange religious visionary, Antoinette Bourignon, and, already of feeble constitution, he slowly sank into an early grave through overwork and the melancholy engendered by mysticism. Under the pressure of indigence he had sold many of his writings and drawings. These came into the possession half a century later of Boerhaave, who caused them to be published under the title "Biblia Naturæ", in 1737.

Passing from the men of science who laboured in the seventeenth century to those who belong to the eighteenth century, the outstanding name is that of Aloisio Galvani, the bicentenary of whose birth falls on September 9. Born at Bologna, he was educated, and practised and lectured there, and it was there he made his discoveries on animal electricity which his countryman Volta referred to as "a great and luminous discovery which forms an epoch in the annals of physical and medical science". His death took place in 1798; the centenary of which event was marked by suitable ceremony at Bologna. Of other men born in 1737, mention may be made of Dr. Richard Watson (1737–1816), Bishop of Llandaff, who lectured at Cambridge on chemistry; Guyton de Morveau (1737–1816), whose career is noticed in another column (p. 18); Jean-Nicolas Ceré (1737–1810), who as director of the Royal Botanical Garden at Mauritius earned the gratitude of European naturalists by his gifts of plants; Alexander Dalrymple (1737–1808) who, in his early days a writer in the East India Company's service, rose to be hydrographer to both the East India Company and the Admiralty; William Bayly (1737–1810), the astronomer who accompanied Cook on some of his voyages; William Forsyth (1737–1804), the Scottish horticulturist, whose name is recalled by one of our most beautiful of early flowering shrubs; Colonel H. Watson (1737–86), who translated Euler's work on the construction and manœuvring of ships and practised naval architecture with great success; and Dr. Charles Hutton (1737–1823). Hutton began life with few advantages, but by unremitting labour gained for himself a prominent place among British mathematicians. For thirty years he was a professor at the Royal Military Academy, Woolwich, and in 1779 he became the foreign secretary to the Royal Society. He was editor of the *Ladies' Diary*, made the calculations in connexion with Maskelyne's experiments on the density of the earth, carried out experiments on gunnery, and in 1795 published a valuable mathematical and philosophical dictionary.

Of those whose lives began in the eighteenth century but who died a hundred years ago, the one with, perhaps, the highest reputation was Karl Ernst Adolf von Hoff (1771–1837), the German geologist to whom a tribute was paid in NATURE for June 8, 1905. "Von Hoff's position as an original thinker," it has been said, "is at least equal to that of Lyell." A diplomatist and immersed in the international confusion of the Napoleonic era, he yet found time to establish a geological journal in 1801 and carried on those studies which led to the writing of his great work, "The History of the Changes in the Surface of the Earth". Other men of science who died in 1837 include Edward Turner (1798–1837), professor of chemistry in University College, London, who did important work on the atomic weights of the elements; William Ritchie (1790–1837), a student under Gay Lussac and Biot, who in 1829 became professor of natural philosophy at the Royal Institution; Domenico Scina (1765–1837), a learned Sicilian physicist who became chancellor of the University of Palermo; Martin van Marum (1750–1837), a Dutch physicist who made many electrical experiments and was secretary to the scientific society of Haarlem; and John Latham (1740–1837), the ornithologist, who at eighty years of age began his "General History of Birds" (1821–28). To engineers the name of Arthur Woolf (1766–1837) recalls many important improvements in the steam engine, while that of Claude-Pierre

Molard (1758–1837) will always be associated with the foundation in Paris of the Conservatoire des Arts et Métiers. Early in his career, Molard was brought into contact with Vaucanson, and was placed in charge of the collection of models which Vaucanson gave to France. It was only natural that when the Government, on the report of the Abbé Grégoire, decided to found the Conservatoire, Molard should be appointed its first director. When elected to the Paris Academy of Sciences, Molard was given the seat vacated by Napoleon.

During the last hundred years, through various causes science has engrossed the attention of so many workers that the list of men eminent for one reason or another who were born in 1837, a century ago, is a long one. The list given below does not claim to be complete, but the notes given will suffice to recall some of the activities of the nineteenth century. Among the ranks of the physicists, Eleuthere Elie Nicolas Mascart (1837–1908) was certainly one of the most widely known scientific men of his day. As successor to Regnault at the Collège de France, as director of the Central Bureau of Meteorology in Paris, and as president of the Paris Academy of Sciences, he rendered notable service to science in France, while as president of various international gatherings he had a wide reputation as an organizer. He died on August 26, 1908, and was buried with military honours in the cemetery of Montparnasse, in which rest the remains of Regnault, Biot, Foucault, Dumas and Ampère. Another eminent French physicist born in 1837 was Emile Sarrau (1837–1904), a professor in the Ecole Polytechnique and for many years director of the laboratory of the Ecole des Poudres et Salpêtres. He wrote on light, heat, gases and ballistics, and was a collaborator with Berthelot on investigations on explosives. The year 1837 also saw the birth of the German meteorologist Wilhelm von Bezold (1837–1907), director of the Meteorological Institute in Berlin; of Admiral Carl Koldeway (1837–1908), the commander of two arctic expeditions and an authority on magnetism; of Johann Diderik van der Waals (1837–1923), the eminent Dutch physicist; and of the Belgian Jesuit Eugène Lafont (1837–1908), a pioneer in scientific education in India. Sent to St. Xavier's College, Calcutta, in 1865, Lafont erected a meteorological and astronomical observatory and a physical laboratory, and afterwards took an active part in the work of the University of Calcutta, and was a founder of the Indian Association for the Cultivation of Science.

What Lafont did for physics in India, Edward Divers (1837–1912) did for chemistry in Japan. In 1873, at the invitation of the Public Works Department of that country, he with ten other Englishmen went to Tokyo to found a college of engineering. For twenty-six years he laboured there, and to-day a bronze statue of him stands in one of the courtyards of the Imperial University. In 1905–6 he was president of the Society of Chemical Industry. The chemist, John Alexander Reina Newlands (1837–98), was also born a hundred years ago. As a young man of twenty-three years of age he fought under Garibaldi for Italian freedom, and it was soon after his return home and while practising as an analytical chemist in London, that he sent a letter to the *Chemical News* containing his earliest views on periodicity among the chemical elements; views which were regarded at first as fantastic but which afterwards gained for him the Davy Medal of the Royal Society.

The ranks of astronomers have ever been recruited from many sources, some of the most eminent workers in this science beginning their careers in circumstances which were little likely to lead them to the computing room and the observatory. This is exemplified by the lives of several men whose centenaries fall this year. Richard Antony Proctor (1837–88), one of the most popular lecturers and writers on astronomy, and one of the keenest observers, began life as a bank clerk in London; Ralph Copeland (1837–1905), who was Astronomer Royal for Scotland in 1889–1905, spent his early years on the sheep-runs and amid the gold diggings of Australia, while Frank McClean (1837–1904), as well known for his generous gifts to astronomy as for his own work on the spectra of the stars, was originally a civil engineer. William Harkness (1837–1903), too, who was born at Ecclefechan, Scotland, and who became director of the Naval Observatory at Washington, was a medical man before he became an astronomer, while his American contemporary Henry Draper (1837–82), in whose honour the United States Government struck a transit of Venus medal, was a professor of physiology. On the other hand, Edmund Weiss (1837–1917), assistant and successor of Littrow at the Vienna Observatory, began life as an astronomer. Another name of interest in connexion with these centenaries of astronomers is that of the American financier Charles Tyson Yerkes (1837–1905), who, with funds accumulated through his railway enterprises in Chicago, founded the Yerkes Observatory of the University of Chicago.

In conclusion, passing reference may be made to a few men distinguished for their work in various other branches of science or industry whose centenaries fall this year. Henry Hicks (1837–99), the president of the Geological Society in 1896–98, was a surgeon by profession, and it was his contact with J. W. Salter which made him a devoted student of geology and palæontology; Raphael Pumpelly (1837–1923) turned geologist on coming under the influence of Noeggerath at Freiburg, and so embraced a profession which brought him a life full of adventure in many lands, while Thomas Davies (1837–93), who edited the *Mineralogical Magazine*, followed in the footsteps of his father William Davies (1814–91) when in 1858 he entered the service of the British Museum. Among metallurgists, few in his day were known better than George James Snelus (1837–1906), who for his work on the elimination of phosphorus from molten pig iron, received in 1883 one Bessemer Gold Medal, while another was given to Sidney Thomas. In Germany, no man did more to establish the engineering industry on a sound basis than Ludwig Loewe (1837–86), the founder of a still famous firm, while American invention and engineering are recalled by the names of Robert McAlpine (1837–1911), a pioneer in the manufacture of paper from ground wood pulp, and Colonel Washington Augustus Roebling (1837–1926), to whom fell the task of constructing the Brooklyn Bridge at New York.

The Iguanodons in the Brussels Museum

WE are glad to record that the unique collection of skeletons of the Wealden dinosaur *Iguanodon* in the Royal Museum of Natural History at Brussels has now been installed for safe preservation in two air-tight glass cases, which are probably the largest exhibition cases hitherto placed in a museum. The twelve skeletons, which are mounted in their natural position on iron framework, occupy a case which measures 18 metres in length, 11 metres in maximum width, and 7 metres in height. Part of it is shown in the accompanying photograph (Fig. 1). The skeletons which still lie attached to masses of rock are covered with a case measuring 20·5 metres in length, 13 metres in width, and 7 metres in height. The cases were made by the Belgian branch of the English firm, Messrs. Fred. Sage and Co. Ltd., which has supplied cases to the British Museum and to other English museums.

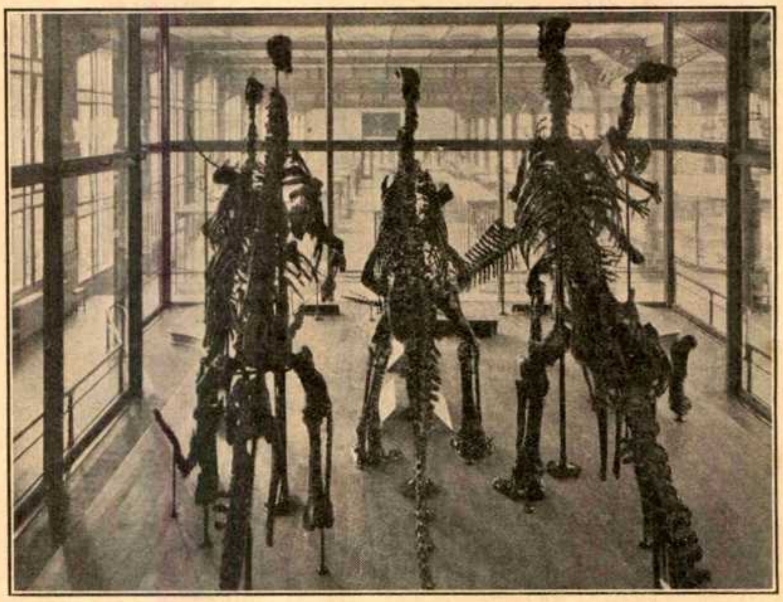

Fig. 1.
IGUANODONS IN THE ROYAL MUSEUM OF NATURAL HISTORY, BRUSSELS.
Photo by E. Sergysels, Brux.

When these fossil bones were first extracted from the rock and prepared for study between 1878 and 1900, they were hardened with an aqueous solution of gelatine. The treatment, however, proved to be insufficient to prevent the decay of the iron pyrites with which most of the specimens were permeated, and a few years ago it became evident that the collection could only be preserved by some other method of hardening the bones and by protecting them in future from contact with more or less damp air.

To devise a new treatment was difficult, because much of the gelatine still remained in the fossils and prevented the absorption of any other material. Experiments were therefore made, and it was decided to remove the gelatine so far as possible and replace it with shellac to be deposited from a solution in alcohol. The bones were washed with tepid soapy water to which a little carbonate of soda had been added, and after each washing they were rinsed with tepid water and carefully dried in a heated chamber. Immediately after drying, and while still at a temperature of 45° C., they were placed for twenty-four hours or more, according to size, in a bath containing shellac dissolved in alcohol, one part of shellac to three parts of alcohol at 94° C. When the bones were taken out of the bath they were washed with alcohol to remove the excess of shellac, and then they were left to dry in a current of air at the ordinary temperature while the solution completely impregnated them. The process was repeated once, and the bones were then ready for the preparators, who mended cracks and other deficiencies. Finally, a weaker solution of shellac, one part to four parts of alcohol, was driven by a compressed-air syringe into the surface of the bones, and they were again left to dry. This process was repeated three times, and the specimens were then re-mounted on their supports.

All the mounted skeletons of *Iguanodon* are now complete, and it is anticipated that all the bones exposed in the rock masses will be treated before the end of this year. The skeletons of the associated fossil crocodiles, *Goniopholis* and *Bernissartia*, will then be preserved from decay in the same manner. The Belgian Government and Dr. V. Van Straelen, the director of the Brussels Museum, and his staff, are to be congratulated on their success in an important scientific undertaking. A. S. W.

Obituary Notices

Sir Herbert Jackson, K.B.E., F.R.S.

SIR HERBERT JACKSON, whose death occurred on December 10 after a very brief illness, was born on March 17, 1863. After attending King's College School, he entered King's College, London, in 1879 as a special student of chemistry, and for a number of years he worked both as student and student-demonstrator in Prof. C. L. Bloxam's private laboratory. His association with King's College continued without interruption until 1918. He held successively the positions of lecturer, assistant professor (1902), and professor of organic chemistry (1905); he was elected a fellow of King's College in 1907, and was finally appointed Daniell professor of chemistry on the retirement of Prof. John Millar Thomson in 1914. He was regarded with affection by all the students of the College for the zest with which he participated in their social and athletic activities, which affection was enhanced among those who studied under him by their recognition of his admirable teaching capabilities.

During this period, Sir Herbert Jackson's research activities covered an extraordinarily wide range. He carried out a lengthy investigation into the production of phosphorescent materials, and made an extensive study of the phosphorescent and fluorescent phenomena produced in various materials by ultra-violet light or by electric discharge in low-vacuum and high-vacuum discharge tubes. In the course of his experiments with high-vacuum tubes he observed that in some instances phosphorescent materials in close proximity to the tubes gave a luminous response when the tubes were excited. This observation was not followed up immediately as it did not fall into the general line of investigation which was being pursued at the time, otherwise the discovery of X-rays, which was announced by Röntgen a few months later, might well have been made by Sir Herbert Jackson. Immediately Röntgen's discovery was published, Sir Herbert Jackson constructed an X-ray tube of the type described by Röntgen—the first X-ray tube to be produced in Great Britain—and thereafter he devoted a considerable amount of attention to a study of the effects which could be produced by the 'new' rays and to the development of X-ray tubes of improved forms. The 'Jackson' focus-tube, which he devised—and which he refused to patent—was a development of very great importance, since it provided practically a point source of X-rays and thus ensured sharp definition in X-ray photographs; the curved cathode which was its essential feature was adopted universally.

It is impossible to give any complete account of the many lines of investigation which Sir Herbert Jackson pursued while he was at King's College, but by way of contrast to the foregoing, mention may perhaps be made of two other items. He made a considerable study of the detergent action of alkalis, oils, soaps and chemical solvents, and of their behaviour on fabrics of different types. His work in this direction and the lectures and demonstrations which he gave to special classes for launderers are gratefully remembered by the laundry industry as a whole for their immense practical value. Sir Herbert also brought his scientific knowledge to bear on methods of protecting stonework against weathering action, and for many years devoted a good deal of attention to this important problem.

Sir Herbert Jackson was recognized as a microscopist of the first rank. In the widely varied types of scientific work which he had undertaken he had made very considerable use of his microscope, and he was, in consequence, familiar with the appearances presented under all available types of illumination, by bacilli, crystals, diatoms, fibres, gratings, powders, rulings, metals and all the more usual microscopic objects. He had also made a considerable study of the microstructure of porcelains, glazes, opal and coloured glasses, etc., and his observations, backed by his chemical knowledge, enabled him to draw important and far-reaching conclusions relating to the methods which had been employed in the production of Chinese and other ceramic wares, ancient beads, ancient glasses, etc. He was always ready to place his expert microscope technique at the disposal of others, whether to enable them to acquire some small measure of his skill or to help in the elucidation of problems on which critical microscopic observation might be able to throw some light. In his hands, the microscope was an all-revealing instrument, and it was at once a pleasure and an education to be allowed to join with him when there was microscope work to be done.

Very early during the Great War, Sir Herbert Jackson was asked to advise on a variety of urgent chemical problems, and as the extent of his knowledge and the value of the suggestions which he could invariably put forward became more widely known, his advice was increasingly sought. Chief among his many war-time activities must be counted his experimental work on glasses needed for chemical purposes and for X-ray tubes, and, later, his working out of the formulæ for many types of optical glasses not previously manufactured in Great Britain, but essential for such instruments as gun-sighting telescopes, and other optical munitions. In recognition of his valuable war-work, in particular of his work on glass, he was created Knight Commander of the British Empire in 1917, and was elected to the fellowship of the Royal Society in the same year.

When the British Scientific Instrument Research Association was in process of formation under the research association scheme of the Department of Scientific and Industrial Research, Sir Herbert Jackson was invited to become its first director of research. His versatility and his remarkable experimental ability, combined with his keenly analytical mind and quick grasp of essentials, fitted him admirably for this position. Under his guidance, the Association came to be regarded more and more as a source to which any matter concerning the development or manufacture of scientific instruments could be referred with the certainty that useful suggestions would be forthcoming practically at once, if, indeed, a complete solution of the particular problem submitted could not be immediately put forward. Sir Herbert Jackson filled this position with distinction from 1918 until he rètired in 1933; he afterwards acted as consultant to the Association, and served as a member of the Association's Research Committee up to the time of his death.

Sir Herbert Jackson held office as president of the Röntgen Society (1901–3) and as president of the Institute of Chemistry (1918–21), and was for some years a member of the senate of the University of London. He served as chairman or as a member of many scientific and advisory Committees, including the Adhesives Committee and the Building Research Advisory Committee of the Department of Scientific and Industrial Research, the Interdepartmental Committee on Optical Glass, the Advisory Committee on Research of the L.M.S. Railway, and others of equal importance.

His death removes one who has rendered valuable service in very many fields, and is deplored by all who were privileged to work with him and to be included in his wide circle of friends.

Captain Oscar Wisting

CAPTAIN OSCAR WISTING, the Norwegian arctic explorer, was born in 1871 and at the age of sixteen years went to sea and in 1892 joined the Norwegian navy. His tastes, however, led him to polar seas, and after a few voyages in whalers and sealers he joined the expedition of R. Amundsen in 1909.

This expedition was originally intended to be an arctic venture but on news of Peary's attainment of the Pole reaching Europe, Amundsen decided to change his plans and make for the Antarctic. The *Fram*, Nansen's famous old ship, carried the party to the Ross Sea and their base on the Ice Barrier. Wisting was one of the four men who reached the South Pole on December 14, 1914. Amundsen attributed not a little of their success to Wisting's careful work in making the sledges, clothing and tents for the journey.

Amundsen's next expedition, the exploration of the Arctic Ocean, was delayed by War conditions and the necessity of building a new ship, but when he sailed in 1917 Wisting was his second in command. After three winters in the ice, the *Maud*, making the North-East passage, reached Alaska, only to return for another winter on the Siberian coast, this time in charge of Wisting, who had only three other men with him. After refitting at Seattle, Wisting again took the *Maud* north in 1922 and returned five years later, having failed to penetrate the inner arctic seas.

In 1926 Wisting was one of the men who accompanied Amundsen in the airship *Norge* in its flight of 3,393 miles from Spitsbergen across the Pole to Teller, in Alaska. When Nobile's airship *Italia* came to grief in 1928, Amundsen flew to the rescue from Norway. On the disappearance of his aeroplane Wisting went to Spitsbergen to join the vain search.

In 1926 Wisting retired from the navy with the rank of captain and in recent years had been custodian of the *Fram*, which is now kept on land at Oslo as a polar museum. It was on board the *Fram* that he died on December 4. R. N. R. B.

Señor Don Juan de la Cierva

THE death of Señor Cierva in the accident to a Dutch air liner on December 9 is a grave loss to aeronautical science. Fourteen years ago he invented the main principles of the autogiro, and in the intervening years he was assiduous in working, chiefly in England, on schemes for its improvement. His very latest model, the direct lift type, after being successfully demonstrated, has now reached the point of being built in numbers. Hence its inventor may be said to have lived just long enough to see his invention reach the fullest development attainable by that type of aircraft.

Señor Cierva was born in 1895 at Murcia in Spain. He received his scientific training at the Civil Engineering School in Madrid, and four years later he began his work on rotating wing aircraft, being convinced from his experience of the fixed wing type that the danger of accident by stalling was irremovable by other means. In his new plans he arranged for the peripheral speed of his 'windmill' to be several times as great as the highest horizontal speed of the entire craft, and since this peripheral speed remained nearly constant, the craft could always count on adequate lift, however slowly the machine as a whole might be flying. In fact experiment soon showed that against a modest wind of twenty miles an hour or so, the autogiro could keep station in descent over a definite spot on the ground.

The autogiro could, however, not compete with a helicopter in vertical 'take-off', and it was to this point that Señor Cierva devoted the later years of his life. He devised a mechanism whereby the pitch angle of the rotating blades of the windmill could be changed, and he used this mechanism to change, from a zero pitch angle to a large one, the angle of attack of the rotating blades at the moment of starting flight. This caused the craft literally to jump into the air—as much as 30 feet—and then to climb on a gentle path free from ground obstructions. In this way, the inventor considered that he had added to his autogiro the main advantage claimed for the helicopter of being able to rise from a very small field.

At each stage in the development of his ideas, Señor Cierva gave an account of his work to the Royal Aeronautical Society, of which he was a fellow. From that Society he received its Silver Medal and later the Wakefield and Guggenheim Gold Medals. In his lifetime he always expressed himself warmly on the recognition he received from the Royal Aeronautical Society, as he did on the encouragement given to him by the Air Ministry and the Aeronautical Research Committee, from his earliest flying demonstration to an astonished assemblage at Farnborough until the day of his death.

We regret to announce the following deaths:

Dr. L. Gustave Binger, *correspondant* for the Section of Geography and Navigation of the Paris Academy of Sciences.

Prof. William Campbell, Howe professor of metallurgy in Columbia University, an authority on physical metallurgy, on December 16, aged sixty years.

Prof. Augustus H. Gill, emeritus professor of chemistry in the Massachusetts Institute of Technology, an authority on hydrocarbons, on November 11, aged seventy-two years.

Prof. Edouard J. B. Goursat, formerly professor of mathematics in the Sorbonne, on November 26, aged seventy-eight years.

Dr. Henry B. Hedrick, formerly ballistician in the U.S. Ordnance Department, known for his work on the preparation of mathematical tables, on October 6, aged seventy-one years.

News and Views

Louis-Bernard Guyton de Morveau (1737-1816)

THE bicentenary of the birth of Guyton de Morveau recalls the career of a man of science who was a prominent figure in what is, perhaps, the most interesting epoch in the history of science in France, if not in French history itself. Ingenious, versatile and courageous, he engaged in many enterprises and as a man of science had a wide reputation. Born at Dijon on January 4, 1737, Guyton de Morveau was the son of the professor of civil law in that city. He himself was educated for the law at Dijon and Paris, and after he had practised for a short time, his father procured for him at the price of 40,000 francs the appointment of advocate general to the local parliament at Dijon, which he held for twenty-three years. Always of an inquiring mind, he became attached to the Academy of Sciences in his native city, devoted himself to the study of chemistry—being assisted by Baumé—and in 1776 began to lecture on that subject. He also established on scientific principles a saltpetre factory which was conducted by Courtois, the father of the discoverer of iodine. He became acquainted with the men of science in Paris, and in 1780 he was induced by Panckoucke, the bookseller, to undertake the chemical section of the famous "Encyclopédie Methodique". Seven years later he joined Lavoisier, Berthollet and Fourcroy in the publication of the "Methode de Nomenclature Chimique", which revolutionized chemical nomenclature.

As with so many of his countrymen, at the outbreak of the Revolution, de Morveau's energies were diverted into another channel. He was chosen a deputy to the Legislative Assembly, of which he became secretary in 1791, and president the following year. In the Convention he was one of those who voted for the King's death; and in 1794 he accompanied the army into Belgium and made balloon ascents at the battle of Fleurus. With the return of more settled conditions he was made a professor in the newly founded Ecole Polytechnique, and in 1795 was chosen a member of the Council of Five Hundred, and also one of the forty-eight members of the National Institute which had arisen over the ashes of the old academies. He acted as director of the Ecole Polytechnique during the absence of Monge, who had accompanied Napoleon to Egypt, and he continued to lecture there until he was seventy-six years of age. He was made a baron in 1811, and died in Paris on January 2, 1816. The range of his writings can be seen from the list of more than 190 papers appended to the biographical sketch of him by Thomas Young in the earlier editions of the

"Encyclopædia Britannica". He was one of the first to be converted to Lavoisier's views on combustion, and did much to make known the advances made by French chemists. No great discovery is associated with his name, but his influence on the progress of chemistry was far reaching.

Mr. G. C. Robson

ZOOLOGISTS, especially those interested in the study of Mollusca, will learn with regret that Mr. G. C. Robson has been compelled by ill-health to resign from the scientific staff of the British Museum (Natural History). Mr. Robson went to the Museum from Oxford in 1911 as an assistant in the Department of Zoology, and devoted his attention to the Mollusca, studying more especially their anatomy and ecology. Among his more important works were his account of parthenogenesis in the gasteropod *Paludestrina* and his contributions to the systematics of the Cephalopoda, especially the Octopoda, on which he wrote a monograph published in two volumes by the Museum in 1929 and 1931. His interest in the more general aspects of biology is shown in his book "The Species Problem" (1928) and in the recent volume "The Variation of Animals in Nature" (1936), in which he collaborated with Dr. O. W. Richards. In 1931 he was appointed one of the two deputy keepers in the Department of Zoology. Mr. Robson's work at the Museum has brought him into contact with malacologists all over the world, and his many friends will hope that freedom from official responsibility will bring about his restoration to health and to scientific activity.

Messel Research Fellowship

DR. J. E. HARRIS, of Christ's College, Cambridge, has been awarded a Messel research fellowship in biology by the Royal Society as from January 1. Dr. Harris held a Commonwealth Fund fellowship at Columbia University and the Guggenheim School of Aeronautics in 1933–35, and has since been University demonstrator in zoology at Cambridge. He proposes to investigate how far current morphological views on the evolution of the fins of fish are substantiated by a study of the functions of these organs. From an analysis of the effect of the fins on an accurate model of the dogfish suspended in a wind tunnel, it has been found possible to draw fairly definite conclusions concerning the action of these fins on the static stability of the living fish. It seems likely that an extension of these methods to other types will throw light on the relationship between the form of the fins and the habits and possible course of evolution of the different groups. The work will be combined with a study of the neuromuscular mechanism and of the forces produced by actively moving fins, the methods available for such study having already proved adequate. It is hoped that time will also permit of the confirmation and interpretation of Dr. Harris's somewhat striking observation, that there exists in the nucleus of the unfertilized egg of echinoderms a physical polarity which can be demonstrated by observations on the rate of free fall of the nucleolus in the germinal vesicle. Dr. Harris will work at Cambridge and possibly also at the Tortugas Laboratory of the Carnegie Institution of Washington, and the Guggenheim School of Aeronautics, New York.

The British Broadcasting Corporation

THE present British Broadcasting Corporation was granted its first charter of incorporation on December 20, 1926, and a supplemental charter on August 14, 1931. The special Committee, which was set up by the Postmaster-General, has recently conducted an inquiry into the broadcasting service and has recommended that the service should continue to be developed and exploited to the best advantage and in the national interest. This action is very desirable on account of the widespread interest in broadcasting, as illustrated by the fact that more than seven and a half million persons in Great Britain and Northern Ireland now have licences to instal apparatus for the reception of broadcast programmes. Accordingly, the British Broadcasting Corporation will continue in being under a new charter which came into operation on January 1, 1937, the draft of which has recently been published by H.M. Stationery Office as Cmd. 5329 (4*d.* net). In this paper, the objects of the Corporation are described in some detail; briefly, they may be summarized as the development, exploitation and maintenance of a public utility service for broadcasting to the public by means of wireless telephony and television any matter of interest, which may be permitted within the terms of the licence and agreement between H.M. Postmaster-General and the B.B.C. The draft of this licence is also included in the White Paper referred to above. The charter outlines the organization of the Corporation by means of a chairman, vice-chairman and body of governors, and the chief executive officer of the Corporation is the director-general. The Corporation is authorized and empowered to receive and administer the funds granted annually by the legislative for the objects in view, and provision is made for the submission of an annual report and statement of accounts. To the lay mind, it is satisfactory to note from this paper that the broadcasting service in Great Britain will continue to maintain its unrivalled reputation, controlled and yet not hampered by Government administration, free to develop and exploit to the full the technique of broadcasting by both sound and vision.

Salvador Earthquake of December 20

FOR its size, the small republic of Salvador, containing only 7,225 square miles, has been visited by great destructive earthquakes more frequently than any other country. During the nineteenth century, there were at least fifteen such earthquakes, and Montessus records the ruin of San Salvador eleven times between 1538 and 1854. San Vicente, a town of 26,000 inhabitants and lying about 35 miles to the east of San Salvador, has suffered from earthquakes several times during the last century, and was almost ruined by a violent shock on the morning of December 20. With one exception, all the important buildings in the town have been thrown down, but, fortunately, without any outbreak of fire. The loss of life and property is not yet definitely known, as communications with the capital are almost destroyed, but, according to official estimates, 220 persons have been killed. It is feared that, as in 1835, there may also be an eruption of the neighbouring volcano.

Bushman Hybrids

IN another column of this issue of NATURE (see p. 37) a summary is given of a short paper by Dr. T. F. Dreyer of Bloemfontein on "The Significance of the Bushman Skull", of which the importance for the anthropologist, the sociologist and in the long run possibly also for the statesman, is by no means to be gauged by its brevity. It opens up a wide vista of further research and inference on the all-important question of miscegenation. Students of the effects of racial contact and admixture, from lack of positive and unequivocal evidence, have long hesitated to endorse the popular verdict that cross-breeds in man have the vices of both parent races and the virtues of neither. They prefer, or rather are forced, to attribute the observed defects in character of such hybrids, and especially of hybrids between white and coloured, to the environmental influence of the social conditions to which as a rule they are confined, rather than to any inherent hereditary weakness. Some, perhaps, would go so far as to concede the possibility that extreme diversity in physical make-up of two widely separated races in the parents may react unfavourably in the offspring; but on the whole, notwithstanding the results of a number of investigations, judgment has more or less remained in suspense.

DR. DREYER's study of the processes of growth which have produced the characteristic Bushman skull suggests a line of research, which, if it should yield results analogous to those observed in Bushman hybrids, will afford grounds for the conclusion that hybridization of certain types may produce specific modification of structure and function, which being abnormal, may be presumed to be unfavourable to the organism as a whole. The Bushman hybrids observed by Dr. Dreyer showed in their abnormal development in the direction of acromegaly or the reverse condition the result of a disturbance of the function of the pituitary—an inference supported by evidence that that body was either over- or under-developed. Should further research show this conclusion to be of general application, it will do much to remove at least one line of argument in the discussion of racial contact from the influence of racial prejudice.

Bronze Age Cemetery near Glasgow

AN important addition to the record of recent finds of prehistoric age in the neighbourhood of Glasgow is a bronze age cemetery site at Springhill Farm, Baillieston, identified and examined by Mr. J. Harrison Maxwell and other members of the Glasgow Archæological Society. The first indication of the site was the unearthing of two food vessels in May last by workmen, when excavating a hillock for sand and gravel. Of these two vessels, one, according to a description in *The Times* of December 21, was in perfect condition. It was hand-made and of reddish brown clay, with two zones of decoration made by string impression, the upper zone in horizontal, the lower in vertical or slightly oblique lines. The second vessel, unfortunately broken by the workman in digging, but now skilfully restored, is of a more elaborate and beautiful character. Its rim is bevelled inward, and for ornament it has an upper zone of decoration formed by horizontal rows of impressions of barley ears, while elsewhere are impressions or punch marks made by the end of a hollow bone, stick or reed. This discovery led to a careful watch on the progress of excavation, and a number of burials, seven cremated and two inhumed, were recorded. The most important discovery, however, was that of a bronze age cist of unusual type in that instead of two long and two short stones, it is built of a large number of small stones and is tongue-shaped, about four feet long and two feet broad at its greatest breadth. The cover consisted of two large stones, that to the south being very thick, while that to the north had an oblong cut-out on the east side. The floor was a pavement of water-rolled pebbles. There were two cremation burials on top of, and two inside the cist. Discoveries of bones and a burial were made in November and December, of which the latest has not yet been excavated. The bones are under examination. Two square-shaped pits containing iron slag point to the existence of a later 'bloomery' or forge.

Roman Sussex

A DISCOVERY of Roman remains, of interest for its topographical bearing, is reported from West Sussex. Workmen, while laying a water-main from Wickford Bridge, east of Pulborough, to Hurston Farm, discovered Roman walls of rough sandstone, and bonding courses of Roman tiles at a depth of 1–7 feet. They lay just north of Lickfold along the west side of the Wiggonholt Road. According to the account given by the workmen, as reported in *The Times* of December 24, two walls running parallel to the road and about fifteen feet in, formed a passage, at the end of which was a small square apartment. From the character of the red burnt sandstone and flue tiles thrown out, it is considered reasonable to infer that this had been a stoking chamber and hypocaust belonging to a house site, similar to one of which there are indications one hundred yards away. Surface finds of pottery belong to the turn of the first and second century. The importance of the find lies in the fact that it corroborates the identification of the modern road as being on the line of the Roman road from Stane Street at North Heath, Pulborough, by Wiggonholt to the South Downs north of Storrington. The great depth at which the remains were found is due, it is suggested, to the drift of light sandy soil on a down slope.

The Ministry of Health

THE seventeenth annual report of the Ministry of Health, recently issued, summarizes the work of the Ministry during 1935–36 (London : H.M. Stationery Office, 1936. 5*s.* net). The services administered by the Department involved expenditure amounting to £159,500,000. About one expectant mother in every two now makes use of local authorities' facilities for ante-natal examination, a steady increase on previous years. Maternal mortality was 3·93 per 1,000 births, the lowest figure since 1924. Infantile mortality, that is, deaths of infants less than one year of age, was 57 per 1,000 births, the lowest figure on record. The total deaths from all forms of tuberculosis fell below 30,000 for the first time on record. Of other infectious diseases, diphtheria showed some decline in 1935, only one case of smallpox was notified in that year, the deaths from pneumonia were nearly 1,000 fewer, and scarlet fever and measles were less prevalent. Much progress is reported in slum clearance, abatement of overcrowding, and in town and country planning. As regards public assistance, progress continues to be made in eliminating small and old-fashioned country institutions, and vagrancy appears to be steadily declining. Some 11 million men and 5¼ million women in England and Wales are now entitled to health insurance benefits, upon which £27,780,000 was spent in 1935. The annual State contribution for widows, orphans, and old age pensions grows automatically by one million a year until 1943, and is now (1936–37) £15,000,000. The section upon food gives information on new administrative measures, and details of the examination of 143,831 samples of food and drugs, of which 7,972 were given adverse reports.

The Nation's Health in 1935

THE seventeenth annual report of the Chief Medical Officer of the Ministry of Health, which was published on December 4, covers the year 1935. The deaths numbered 477,401, an increase of 591 over 1934, the principal certified causes of death at all ages being, in order, (1) diseases of the heart and circulatory system, (2) cancer, (3) bronchitis, pneumonia and other respiratory diseases. Attention is directed to the changing age-distribution of the population. Since the beginning of the century, the proportion of persons under twenty-five years has fallen by nearly twenty-five per cent, due to the fall in the birth-rate, and the fall in the general death-rate, which increases the proportion in the older groups. This increasing longevity of the population, together with more accurate diagnosis, probably accounts for the increase of the number of deaths from cancer, which is a disease of the later ages, from 63,263 in 1934 to 64,507 in 1935, and it is probably fallacious to assume that there is a real increase of cancer. For 1935, the incidence of scarlet fever, diphtheria, tuberculosis, venereal and rheumatic diseases has declined, and only one case of smallpox was notified. Attention is directed to the relation of food to health and disease, and to the extension of the maternity and child welfare services.

Was Sherlock Holmes a Drug Addict?

AN occasional correspondent contributes an amusing article to *The Lancet* of December 26 entitled "Was Sherlock Holmes a Drug Addict?", as his friend Dr. Watson represented him as being. The correspondent's reply is in the negative on the following grounds. In the first place, Holmes was a man of immense mental resource and initiative, being an expert chemist, an accomplished linguist, an assiduous student of Black Letter texts, a capable performer on the violin, a composer and an authority on medieval music. Nor was he of the stuff of which cocaine addicts are made, who are sociable, lacking in mental capacity and need the stimulus of a drug to rouse their interest in life. The continued use of cocaine leads to physical, mental and moral degeneration. Holmes, on the other hand, was the most unsociable of men and showed no deterioration in his mental powers, physical activity or character. The correspondent suggests that Holmes was playing a trick on Watson when he pretended to give himself an injection of cocaine and showed an arm dotted and scarred with numerous puncture marks.

Institute for the Study of Animal Behaviour

AN Institute for the Study of Animal Behaviour has been formed by a number of zoologists, naturalists, physiologists and psychologists with the object of promoting and encouraging research into animal behaviour. The Institute intends to act as a clearing-house for information regarding work that is being done upon animal behaviour in all its aspects, and to bring together field and laboratory workers for the discussion of their problems. A quarterly bulletin is being issued, and meetings for the transaction of scientific business are held. Those whose work is concerned with animal behaviour in any of its aspects will materially assist the work of the Institute if they will send offprints of their papers to the honorary secretary. Dr. J. S. Huxley is president of the Institute, and Mr. F. B. Kirkman is honorary treasurer. All information regarding membership and activities may be obtained on application to the honorary secretary, R. C. Oldfield, Psychological Laboratory, Downing Place, Cambridge.

The Making of Chemical Plant

THERE is a school of economics which lays stress on the importance of exports in order that Great Britain may pay for its imports. At the same time, the home manufacturers ask for some measure of protection so that they can supply the home markets and maintain a manufacturing plant of sufficient size to ensure reasonable costs. An industry which has progressed quite rapidly in Great Britain since the Great War is that of making chemical plant, about which the *Industrial Chemist* of November has published some interesting statistics. The export trade has gone up from a figure of 100 in 1933 to 131 in the first nine months of 1936. The plant exported goes to less highly industrialized countries and, therefore, is not of the same complexity and costliness of design which the home market demands :

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thus the average value this year is £67 per ton. Australia and South Africa are now the chief customers for British chemical plant. Great Britain also imports chemical plant, and since there is increasing activity in the chemical industry, the amount of this has increased more than three-fold since 1935, though there are now signs of abatement. The average value per ton this year is £143. Most of the plant, which is generally of a highly specialized nature, has come from Germany. These figures give no indication of the activities of the British plant manufacturers in the home trade, but the same number of the *Industrial Chemist* seeks to remedy this by several pages of pictures of actual plant and new equipment which has been delivered this year, featured under the heading of "Progress".

Forest Products Research

THE report of the Forest Products Research Board for the year 1935 has been issued by the Department of Scientific and Industrial Research (London : H.M. Stationery Office, 1936). The report includes the report of the director of the Research Laboratory at Princes Risborough for the same year. The Board itself met only once during the year, when various pieces of research work under investigation were considered, as also the possibility of establishing a sub-station of the Laboratory in Scotland. The Board noted with appreciation that there was direct evidence of interest by industries concerned in the manufacture of both wooden and fibre-board boxes, as well as by users of such boxes, of the facilities now available in the new box-testing laboratory. The investigations into the physical properties of timber which have a direct influence on its behaviour during seasoning and when in use have been advanced ; and the results, it is considered, promise ultimately to be of material importance to architects and others engaged in industries dependent upon timber. As a result of visits to the Laboratory by many representatives of firms engaged in the manufacture of timber and timber goods, and instructors in building science or woodworking at various technical schools, some of whom have spent periods of varying lengths at the Laboratory, a new departure has been instituted. To minimize the interference with the routine work which such visits involved, a short educational course of one week's duration was given in September of which full advantage was taken.

An Alchemical Manuscript

IN a reprint from *Osiris* (2, 220; 1936), W. J. Wilson, of the Library of Congress, Washington, deals with a treatise copied by Arnaldus de Bruxella at Naples between 1473 and 1490, and purchased by Lehigh University, Pennsylvania, in 1881 for the price of ten dollars. It is a compendium of chemical and alchemical recipes of a type fairly well known through other manuscripts of similar date in Paris and elsewhere. Mr. Wilson gives an account of the contents of the manuscript with extracts, which are translated, and an index of names and technical terms. He shows how its contents are related to other treatises, and deals in separate sections with the origin and development of alchemical tradition, the operations of alchemy, allegorical and mystical aspects of alchemy and its relations to magic and medicine. This commentary, which is the fruit of a careful study of texts and literature on the history of alchemy, is provided with an excellent bibliography and is of very considerable value in presenting an accurate and concise statement of the position of modern research into the origins of alchemy and early chemistry. The scholarly treatment is on a much higher level than many accounts in that it takes into consideration the Chinese and Indian sources, without which no modern study can be said to have any particular significance.

Decline in Malaria in Soviet Russia

As the result of the energetic measures adopted by the Soviet authorities, the incidence of malaria in the U.S.S.R. has greatly declined. According to Prof. Sergiyev, head of the Malaria Department of the Commissariat of Health and director of the Central Tropical Institute, during the first six months of 1936 there was a drop of about 35 per cent in the number of malaria cases and of 40 per cent in the number of deaths from malaria as compared with the corresponding period of 1935. With the object of destroying the malaria-carrying mosquitoes, two and a half million infested areas were sprayed with oil, partly by aeroplanes. Mosquito netting was introduced into the badly infested areas. 100 motor-cars and 260 microscopes were supplied to the malaria stations. During the summer, 500 doctors and senior students took part in the anti-malarial campaign, which was carried on by 1,800 permanent malaria organizations.

Tropical Pathology and Microbiology

OWING to the increasing number of papers in the field of special pathology and microbiology hitherto published in the *Chinese Medical Journal*, which is primarily intended for clinical contributions, this material will now be published in a Supplement to the *Chinese Medical Journal*, of which the first number was issued last February. It forms a volume of the same size and format as the *Journal*, and contains 500 pages of text with 70 plates, and is published by the *Chinese Medical Journal*, Peiping, China, price 10*s*. The contents are divided into the three subjects : (1) pathology, (2) bacteriology and (3) parasitology. In addition, there is a valuable paper by R. J. C. Hoeppi on "Methods of Illustrating Scientific Papers", in which the apparatus for, and technique of, drawing, and the main processes now used for reproduction of illustrations, are described.

Museum Exhibits *de luxe*

AT last the limit of the nature-group method of exhibiting museum specimens seems to have been reached, for Science Service announces that Prof.

A. A. Allen, of Cornell University, has constructed two life-groups of birds, in which by a combination of sound films and ingeniously contrived electrically driven mechanisms, the birds sing and go through natural, life-like movements. For example, in the group showing a nesting site of ruffed grouse, the turning of a switch causes the male to move his head and utter his characteristic hissing note, while the female moves to her nest and covers her eggs, and at the same time thrushes and song-sparrows in the trees and bushes sing, an owl hoots, a woodpecker calls and dives into its nesting hole, and a wedge of wild-geese honks as it flies away. These exhibits must be a revelation to the person who has not the opportunity or the flair for field observation, and, with Prof. Allen's assistance, the arm-chair naturalist will soon be able to record his impressions of life in the wilds from a museum exhibit.

Honey Research at Rothamsted

THE Agricultural Research Council has recently made a substantial grant to Rothamsted to permit beekeeping researches there to be broadened to include the investigation of various problems connected with honey. The appointment of Dr. C. R. Marshall to undertake this work has been approved, and Dr. Marshall has now taken up his duties. In view of the fact that beekeepers during the past three years have contributed towards the cost of the brood disease investigations, the Government is bearing the whole cost of this new work. The researches on honey will be physico-chemical in nature, and directed towards certain practical problems of quality and processing that affect the honey producer. Such problems are the granulation of honey, rapidity of granulation, texture of grain, 'frosting', etc., and fermentation. Dr. Marshall recently obtained the degree of Ph.D. at the University of Birmingham, where he has been working on chemical problems connected with the structure of mucilages.

International Congress on Testing Materials

THE next International Congress of the International Association for Testing Materials will be held in London on April 19–24, under the presidency of Sir William Bragg (see NATURE of October 24, p. 717). More than two hundred papers are promised from authorities in twenty different countries. The Congress will be divided into the following groups: metals (behaviour of metals as dependent upon temperature, particularly in regard to high temperatures; progress of metallography; light metals and their alloys; wear and machinability); inorganic materials (concrete and reinforced concrete; erosion and corrosion of natural and artificial stone; ceramic materials); organic materials (textiles; wood cellulose; timber preservation; ageing of organic materials; colours and varnishes); subjects of general importance (relation between results of laboratory tests and behaviour in use and service; bearing of recent advances in physics and chemistry on the knowledge of materials; properties of materials for the thermal and acoustic insulation of buildings). Further information can be obtained from the Honorary Secretary of the Congress, K. Headlam-Morley, 28 Victoria Street, London, S.W.1.

Exhibition of Scientific Instruments

IN connexion with the twenty-seventh annual Exhibition of Scientific Instruments and Apparatus to be held at the Imperial College of Science on January 5–7, the usual well-produced and substantial descriptive catalogue of exhibits has been prepared (Physical Society, 1 Lowther Gardens, Exhibition Road, S.W.7). Trade exhibits are separated from the Research and Educational Section: apparatus and instruments being exhibited for the first time are indicated by an asterisk. Reference is facilitated by the full list of contents and an index to the Trade Section. The Exhibition is open on January 5 (2.30–9), January 6 (2–4 for members only; 4–9) and January 7 (2.30–9); admission is by ticket obtainable from the secretary of the Physical Society. Evening discourses are being given at 7.45 on January 5 by Sir James Swinburne on electrical measurements in the 'eighties, and on January 6 by Dr. Harry Moore on the influence of industrial research on the development of scientific instruments.

Announcements

THE Electrodepositors' Technical Society has decided to sponsor an International Conference on Electrodeposition to be held in London on March 3–4. The provisional programme includes discussions on electrodeposition practice abroad, electrodeposition of base metals, properties of electrodeposits and electrodeposition of precious metals. Further information can be obtained from the Hon. Conference Secretary, Mr. H. Wynne-Williams, 12A Raleigh House, Larkhall Estate, London, S.W.8.

IN connexion with the Electric Illumination Exhibition now being held at the Science Museum (see NATURE of December 19, p. 1046, and December 26, p. 1107), a series of six lectures has been arranged to be given in the lecture theatre of the Museum at 5.30 p.m. on Tuesday, January 12, and thence on Mondays commencing January 18. Admission will be by ticket obtainable from the Secretary, Science Museum, London, S.W.7.

OWING to the conditions in Spain, the eleventh International Congress of Psychology which was to have been held in Madrid (see NATURE of July 4, p. 24) will be held in Paris. So far as possible, the programme will be the same as that previously arranged for the proposed meeting in Madrid. The Paris Congress will be held on July 25–31, under the presidency of Prof. Pierre Janet, formerly professor of psychology in the Collège de France. Further information can be obtained from M. Henri Pieron, Laboratoire de Psychologie de la Sorbonne, Paris 5.

THE announcements of forthcoming appointments will appear in future at the end of each issue (see p. 42).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 32.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

α-Particles from the Radioactive Disintegration of a Light Element

WHEN lithium is bombarded with deuterons, a radioactive substance is formed which has been found to emit β-rays with energies up to 10·5 Mev.[1]. We have recently found that this radioactivity is accompanied by the emission of α-particles.

The reactions proposed to account for the β-ray activity were:

$$^{7}\mathrm{Li} + {}^{2}\mathrm{D} \rightarrow {}^{8}\mathrm{Li} + {}^{1}\mathrm{H}\ ;\ {}^{8}\mathrm{Li}\ (\text{radioactive}) \rightarrow {}^{8}\mathrm{Be} + e^{-}.$$

From our knowledge of nuclear masses, the expected total energy release in these two reactions should be 14 Mev., but this has not all been accounted for hitherto.

The protons liberated in the first reaction were formerly supposed to have a range of 26 cm., but the group of this range has been shown by Rumbaugh and Hafstad[2] to be a product of the bombardment of the separated isotope ^{6}Li with deuterons. We had also independently obtained the same result. We have also found, in agreement with Rumbaugh and Hafstad, that the bombardment of ^{7}Li with deuterons gives rise to no group of protons of range greater than 8 cm. (2 Mev.). This means that the energy release in the first reaction must be less than 2 Mev., and taking this with the β-ray energy of 10·5 Mev., we have a maximum total energy of only 12·5 Mev., which is considerably less than the expected 14 Mev.

A possible explanation of this is that the ^{8}Be is formed in an excited state. Dee and Gilbert[3] have obtained evidence for such a process in the reaction

$$^{11}\mathrm{B} + {}^{1}\mathrm{H} \rightarrow {}^{8}\mathrm{Be} + {}^{4}\mathrm{He}.$$

They concluded that the ^{8}Be nucleus was often formed in an excited state having 3 Mev. excess energy, and Mr. Dee suggested that we should see whether we could obtain evidence of this excited ^{8}Be also being formed in the radioactive disintegration of ^{8}Li. The life-time of the excited ^{8}Be nucleus being negligible (10^{-21} sec.)[1], we should expect to observe α-particles resulting from its disintegration accompanying the emission of electrons from ^{8}Li and decaying with the same period.

This may account for the α-particles which we have observed, for we find that the period of the α-particle activity is identical with that of the β-ray activity and is 0·88 sec. ± 0·1 sec. There is a discrepancy between this figure and that (namely, 0·5 ± 0·1 sec.) given by Crane, Delsasso, Fowler and Lauritsen, who discovered the β-ray activity. Absorption measurements confirm, however, that we have observed the same β-ray activity.

We have observed both the α- and β-ray activity from a target of the separated isotope ^{7}Li kindly prepared for us by E. L. Yates.

Most of the observed α-particles have a range less than 1·5 cm. of air from the target, but a few (less than 0·3 per cent of the total number) extend to a range of 5 cm. The numbers, however, are small at the higher ranges, so that the limit of range has not been determined exactly. As an illustration of the order of magnitude of the effect, it may be noted that after bombarding a thick lithium target with a magnetically resolved beam of 20μa. of deuterons at 500 kv. we observe 50 α-particles of range greater than 1 cm. after switching off the beam.

From the range distribution of α-particles it appears that ^{8}Be is not always formed in the same excited state, but either in a number of discrete energy states or in a continuous distribution. Owing to the small number of particles it has not yet been possible to decide between these hypotheses.

The relative number of α-particles and β-rays suggests that if the interpretation be correct, the ^{8}Be is formed in an excited state in a large proportion of the disintegrations of ^{8}Li. Further, it may be noted that the energy of two α-particles of 5 cm. range amounts to 12·6 Mev. On the view put forward, the spread of α-particle energies cannot exceed the spread of β-ray energies, namely, 10·5 Mev., and it therefore follows that the minimum energy of the two α-particles is not less than 2·1 Mev. In other words, the minimum energy with which the ^{8}Be nucleus is left excited is not less than 2·1 Mev.

While this interpretation appears consistent, it is not the only possible explanation. In any event, it is clear that the distribution of β-ray energies must be interpreted with caution, as the radioactive disintegration is certainly not simple.

W. B. LEWIS.
W. E. BURCHAM.
W. Y. CHANG.

Cavendish Laboratory,
Cambridge.
Dec. 14.

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[1] Crane, Delsasso, Fowler and Lauritsen, *Phys. Rev.*, **47**, 971 (1935).

[2] Rumbaugh and Hafstad, *Phys. Rev.*, **50**, 681 (1936)

[3] Dee and Gilbert, *Proc. Roy. Soc.*, A, **154**, 279 (1936)

Longitude Effect of Cosmic Radiation and the Position of the Earth's Magnetic Centre

THE theory of the allowed cone of electrically charged primary cosmic rays, developed in a number of recent papers by Lemaître and Vallarta[1], is competent to account for the longitude effect if due regard is paid to the fact that the earth's centre does not coincide with its magnetic centre[2]. Assuming Schmidt's determination[3] of the latter and, with Clay, an exponentially decreasing energy distribution of primary charged particles, it has been shown that the longitude effect along the geomagnetic equator should be roughly sinusoidal with maximum at geographic longitude 12° W. and minimum at 168° E.;

the intensity difference between maximum and minimum is calculated to be about 8 per cent. More recent calculations of the position of the earth's magnetic centre (Bruins[4], Bartels[5]) have somewhat revised Schmidt's earlier result, but the theoretical longitude effect is not much affected thereby. The longitude of the maximum and minimum depends *only* on the co-ordinates of the earth's magnetic centre, particularly on its longitude; the intensity difference between the maximum and minimum is closely connected with the distance between the earth's centre and its magnetic centre, to a lesser extent with the energy distribution of primary particles.

In a recent important contribution, Hoerlin[6] concludes that the calculated intensity difference between the maximum and minimum equatorial longitude effect is in good agreement with experiment, but the calculated longitudes of the maximum and minimum are not. Instead of a maximum off the west African coast at 12° W., he suggests that it probably is off the South American coast in the Pacific Ocean at about 80° W., with a corresponding minimum near the Malay Peninsula at 100° E. He concludes in this sense not only from his own measurements, but also from an examination of Compton's chart of lines of constant total intensity[7] which, however, would locate the maximum still farther west.

That there are yet serious discrepancies between sea-level intensities measured by different observers becomes obvious if one compares Millikan and Neher's chart[8] with Compton's, and this disagreement persists if one compares the Pasadena results with either Hoerlin's or Clay's (and his collaborators)[9,11], although there seems to be fairly good accord between the last two. This state of affairs is forcibly brought to the fore if one attempts to fit a continuous curve to represent the experimental data along the geomagnetic equator and then proceeds to its harmonic analysis. In particular, the half-period harmonic, which one would expect if the quadripole component of the earth's magnetic field were important, comes out just about of the same amplitude as the higher harmonics which must be attributed to experimental errors.

There are two relevant experimental results which seem to militate against Hoerlin's conclusion. The first is derived from Bowen, Millikan, Korff and Neher's measurements[10] at altitudes up to 26,000 ft. in the Philippines and in Peru (essentially along the geomagnetic equator), which clearly indicate that the intensity difference between these two points is about 4 per cent and persists up to the highest altitude. The second is the existence of a minimum of intensity off the western coast of South America and somewhat to the north of the geomagnetic equator, shown by Clay, Bruins and Wiersma's measurements of the latitude effect[11] and by Johnson's counter measurements of vertical intensity[12]. These results agree with the theory of the longitude effect referred to above and therefore also with Schmidt's calculation of the earth's magnetic centre. Further, the former result, if confirmed, would establish the absence of photons in the primary radiation.

If, however, one accepts Hoerlin's suggestion, the conclusion seems inescapable that there is a serious discrepancy between the position of the earth's magnetic centre as determined from magnetic and from cosmic radiation measurements, particularly as regards its longitude. The former locate it at about 160° E., whereas the latter would tend to place it at not more than 100° E. Whether this discrepancy is real is a thorny question which we cannot risk to answer. The main purpose of this letter is to direct attention to the present evidence in the hope that further intensity measurements of cosmic radiation, particularly along the geomagnetic equator, and also perhaps a careful analysis of available experimental results, may help to solve the difficulty.

M. S. VALLARTA.

Massachusetts Institute of Technology,
Cambridge, Mass.
Nov. 11.

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[1] Lemaître, G., and Vallarta, M. S., *Phys. Rev.*, **43**, 89 (1933); **49**, 719 (1936); **50**, 493 (1936). Lemaître, G., *Ann. Soc. Sci. Bruxelles*, **54**, 162 (1934). Bouckaert, L., *idem*, **54**, 174 (1934).

[2] Vallarta, M. S., *Phys. Rev.*, **47**, 647 (1935).

[3] Schmidt, A., *Z. Geophys.*, **2**, 38 (1926).

[4] Bruins, E. M., *Physica*, **2**, 887 (1935).

[5] Bartels, J., *Terr. Mag. and Atmos. Elec.*, **41**, 225 (1936).

[6] Hoerlin, H., *Z. Phys.*, **102**, 666 (1936).

[7] Compton, A. H., *Rev. Sci. Inst.*, **7**, 73 (1936).

[8] Millikan, R. A., and Neher, H. V., *Phys. Rev.*, **50**, 24 (1936).

[9] Clay, J., van Alphen, P. M., 'T Hooft, C. G., *Physica*, **1**, 829 (1934).

[10] Bowen, I. S., Millikan, R. A., Korff, S. A., and Neher, H. V., *Phys. Rev.*, **50**, 579 (1936).

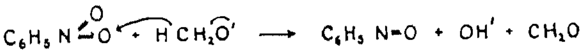
[11] Clay, J., Bruins, M. E., Wiersma, J. T., *Physica*, **3**, 746 (1936).

[12] Johnson, T. H., private communication to the author.

Correlation of the Yellow Oxidation Ferment with Warburg's Co-ferment

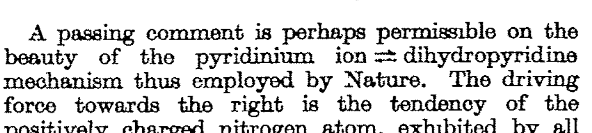
THE nature of the yellow oxidation ferment, and of Warburg's co-ferment, having been largely elucidated by the work of Warburg, Kuhn, Karrer, and others, it may be of assistance in completing their correlation if attention is directed to the precise nature of the changes in which they participate.

Some time ago[1], in a criticism of suggestions made by Haber and Willstatter, I emphasized that Wieland's dehydrogenation of alcohols and aldehyde hydrates frequently, if not always, consists in the removal, not of two hydrogen atoms, but of a proton and of a hydrogen atom associated with an electron. In illustration, the oxidation of the methoxide anion by nitrobenzene was cited:

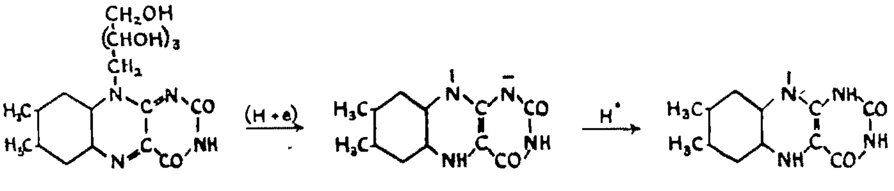


$$C_6H_5N(O)O + HCH_2O' \longrightarrow C_6H_5N{=}O + OH' + CH_2O$$

The ferment changes must evidently belong to this class since, in spite of references[2] to the absorption of two hydrogen atoms, the reduction of quaternary pyridinium cations to the neutral dihydropyridine derivative clearly requires addition of a hydrogen atom and an electron. The reaction between a hexose derivative and the quaternary nicotinium amide is to be formulated as follows:



A passing comment is perhaps permissible on the beauty of the pyridinium ion ⇌ dihydropyridine mechanism thus employed by Nature. The driving force towards the right is the tendency of the positively charged nitrogen atom, exhibited by all ammonium compounds, to revert to the neutral tervalent condition, whilst the resulting dihydropyridine tends to recover the aromatic condition by a return to the pyridinium state. This latter is achieved by transference of a hydrogen atom and an electron to the lactoflavin derivative, and there is a recognition of this by Karrer and his collaborators[3] in their formulation of the oxidation of the dihydro-derivative by potassium ferricyanide. But whereas the change studied by them appears to take place in two stages, the formula of the lactoflavin derivative readily accommodates a single-stage process, for it is well known that αβ-unsaturated ketones, $R_2C = \overset{|}{C} - \overset{|}{C} = O$, exhibit kationoid reactivity, for example, towards cyanide ions, at the β-carbon atom. Applying this to the $- N = \overset{|}{C} - \overset{|}{C} = O$, or, perhaps better, to the $- N = \overset{|}{C} - \overset{|}{C} = N - \overset{|}{C} = O$, grouping in lactoflavin, we have



The change is completed by addition to the 1-nitrogen atom of the proton from the original hexose hydrate.

These considerations also point to a possible interpretation of the function of the methyl groups in the lactoflavin molecule, which is so far not understood. For the grouping in question might also be expected to exhibit the familiar property of nitro-groups in promoting anionoid attack in the ortho- and para-positions of the benzene nucleus. On the other hand, methyl groups in the nucleus, and obviously especially so in the para-position, militate against such an attack, and thus tend to localize it on the nitrogen atom. Accordingly, whereas 9-*d*-1′-ribityl*iso*alloxazine itself exhibits no vitamin B_2 effect[4], its 7-methyl derivative does[5]. The influence of other alkyl groups or of methyl groups in other positions has not yet been recorded.

J. KENNER.

College of Technology,
Manchester.

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[1] *Ber.*, B, 65, 705 (1932).

[2] For example, Warburg and Christian, *Helv chim. Acta*, 19, E81, (1936).

[3] *Helv. chim. Acta*, 19, 811 (1936).

[4] Kuhn and Weygand, *Ber.*, B, 68, 166 (1933).

[5] Karrer and others, *Helv. chim Acta*, 18, 908 (1935).

Corticosteron, a Crystallized Compound with the Biological Activity of the Adrenal-cortical Hormone

IN 1929–30 it was found that the cortex of the adrenal gland produces a hormone essential for life[1]. Several attempts have since been made to isolate it in pure form.

Kendall *et al.*[2] announced (1934) the isolation of crystals (m.p. 210°) which were claimed to have the activity of the hormone. They later wrote[3] that the problem was more complex, that their earlier described crystals were a mixture, and that for complete hormonal activity at least two components were essential. In their latest communications[4] they report the isolation of several compounds (*A–E*) one of which (compound *E*, m.p. 201°–208°) "showed definite cortical hormone activity when tested on the rat (Ingle's method)" but that "the quantitative activity of compound *E* is much less than of cortin itself".

Wintersteiner and Pfiffner[5] described six different crystallized compounds (*A–F*), all of which were inactive when tested on adrenalectomized dogs by the method of Swingle and Pfiffner[6].

Reichstein[7] reported the isolation of nine substances (*A–I*), eight of which were found inactive in doses of 0·5–2 mgm. in rats (method of Everse–de Fremery[8]). Only the ninth, substance *H*, has in the meantime been found to be active. This substance, however, was not quite pure. After the elimination of a small amount of a new, high melting substance (substance *M*, m.p. 205°–208°), a pure compound in beautiful crystals was obtained from the remainder. It shows to a large extent the biological activity of the raw material and is called corticosteron (m.p. 180°–182° (corr.), $[\alpha]_D^{18} = +223°$, $c = 1·12$ in abs. alcohol). With the exception of a few details the chemical constitution has been elucidated; the formula will be reported in the near future.

Adrenalectomized rats require a daily dose of 0·5–1 mgm. corticosteron per rat (method of Everse–de Fremery). This amount represents the approximate rat unit and is the biological equivalent of 1 c.c. of commercial 'cortin' (corresponding to 50 gm. of fresh gland) for rats. The experiments on bilaterally adrenalectomized dogs gave similar equivalent values, but since the method of testing used was somewhat different than that of Swingle and Pfiffner, the activity cannot be expressed in terms of dog units.

The curative and preventive properties were tested on four dogs (body weight ranging from 11 kgm. to 18 kgm.) which had been adrenalectomized ¾–1½ years previously. During this period, they received a daily oral dose of 0·3–0·4 gm. sodium chloride per kgm. body weight and the necessary amount of commercial 'cortin' (2·5–5 c.c. per dog per day). Without the salt, about ten times as much 'cortin' was necessary. The complete withdrawal of 'cortin' caused the animals to fall into insufficiency, even if the salt dose were considerably increased. In the curative tests, three to six times the preventive doses of 'cortin' were necessary to bring the animals back to normality from their state of insufficiency. In the various experiments on dogs, an average range of 0·25–0·5 mgm. corticosteron was found to be equivalent to 1 c.c. of the standard 'cortin' solution.

These experiments show that corticosteron is a highly active cortical hormone, but the existence of other active or at least activating components is still possible.

P. DE FREMERY.
E. LAQUEUR.
T. REICHSTEIN.
R. W. SPANHOFF.
I. E. UYLDERT.

Amsterdam and Oss,
and
Zurich.
Nov. 28.

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[1] Rogoff, Stewart, *J. Amer Med. Assoc.*, 92, 1569 (1929) Swingle, Pfiffner, *Science*, 71, 321 (1930); *Medicine*, 11, 731 (1932); Hartman, Brownell, *Science*, 72, 76 (1930).

[2] *Proc. Staff Meet. Mayo Clinic*, 2, 245 (1934).

[3] *J. Amer. Med Assoc*, 105, 1486 (1935), see also ref. 4.

[4] *Proc. Staff Meet. Mayo Clinic*, 11, 351 (1936); *J. Biol. Chem.* 114, 613 (1936).

[5] *J. Biol. Chem.*, 111, 599 (1935); 114, lxxx (1936).

[6] Pfiffner, Swingle, Vars, *J. Biol. Chem.*, 104, 701 (1934).

[7] *Helv chim. Acta*, 19, 29, 1107 (1936).

[8] *Acta Brev. Neerl*, 2, 152 (1932).

Two New Chemical Plant Growth Substances

BENZOYL oxide and benzoyl peroxide, as I have found, can now be added to the list of chemicals which act on plant growth like the natural hormone, auxin. Benzoyl oxide, when applied in lanoline at concentration 1 in 200 to ten dark-grown decapitated oat coleoptiles along one side, caused negative curves the mean of which was 50° after 4½ hours at 19° C. The peroxide applied similarly caused negative curves the mean of which was 31°. Thus both substances accelerated growth strongly. At 1 in 2,000 in lanoline, the benzoyl oxide caused slight negative curves of about 5°, and comparison with the curves caused by very dilute hetero-auxin in lanoline showed that the activity of benzoyl oxide is very roughly equal to 1/400 of that of hetero-auxin. The oxide keeps well in lanoline, but the peroxide loses its activity in a few hours.

The results seem of interest since first, benzoic acid is quite inactive, and secondly, the benzoyl oxide and peroxide are scarcely soluble, if at all, in water. In spite of this, the oxide is not only active, but also is even transported downwards in coleoptiles, though much less rapidly than hetero-auxin. For when it was applied in lanoline near the tops of coleoptiles on one side, the curves extended for about 5 mm. below the lanoline after 5½ hours at 19° C. Carotene also, as Lazar[1] has shown, though insoluble in water, can produce effects which are distant from the part to which it is applied in plants.

I am indebted to Dr. E. Hope for help and advice concerning the substances tested.

R. SNOW.

Magdalen College,
Oxford.
Dec. 15.

Mém. Soc. Roy. Sci Liége, (4), 1, fasc 2–3 (1936).

Alkaloids from *Arundo Donax* L.

DONAXINE[1], $C_{11}H_{14}N_2$, is according to von Euler, Erdtman and Hellstrom[2], identical with gramine from certain strains of barley, and according to a paper by Th. Wieland and Chi Yi Hsing[3], to which my attention has just been directed, gramine has the constitution of β-dimethylaminomethyl-indole, $(CH_3)_2NCH_2.C_8H_6N$.

I have for some time been engaged in the study of the alkaloids of *Arundo Donax* L. from the shores of the Mediterranean, and find that, by joint action of alcoholic potassium hydroxide and methyl iodide in the cold, donaxine furnishes tetramethylammonium iodide and a (methoxy methyl)-indole; with ethyl iodide an (ethoxy methyl)-indole results and presumably also dimethyldiethyl ammonium iodide.

Besides donaxine, I have obtained a crystalline alkaloid, $C_{13}H_{16}O_2N_2$, and an amorphous phenolic base; both are indole derivatives. Their relationship to donaxine is being investigated.

J. MADINAVEITIA.

Department of Medical Chemistry,
University, Edinburgh.
Dec. 9.

[1] Orechoff and Norkina, *Ber.*, 68, 436 (1935).

[2] *Ber.*, 69, 743 (1936).

[3] *Annalen*, 526, 188 (1936).

Viscosity of Binary Mixtures

IN a recent communication[1], Mr. A. J. A. van der Wyk has presented a new formula for the calculation of viscosity of binary mixtures. I would point out that this problem has already been fully solved in two ways. On the base of thermodynamical considerations, the formula[2]

$$\log \eta = m_1 \log \eta_1 + m_2 \log \eta_2 - \int \frac{q_m}{4{\cdot}57T^2} \quad . \quad . \quad . \quad (1)$$

has been found, where η denotes the viscosity of the mixtures, m_1, η_1, m_2 and η_2 the mole fractions and viscosities of the two components, T the absolute temperature and q_m the molecular heat of solution. The latter may be also considered as the total change in energy caused by the interaction of both components. This change in the energy being rather difficult to determine experimentally, another method[3] based on the association of the molecules has been chosen. It has been found that the simple formula of Arrhenius

$$\log \eta = n_1 \log \eta_1 + n_2 \log \eta_2 \quad . \quad . \quad . \quad (2)$$

gives quite satisfactory results (as must be the case for 'ideal mixtures' where no change in energy takes place), when for the calculation of mole fractions the *physical* molecular weights instead of the *chemical* molecular weights are taken into consideration. If S denotes the number of molecules of the component 2, which in the mixture are associated, the equations

$$n_1 = \frac{m_1}{m_1 + m_2.S} \text{ and } n_2 = \frac{m_2.S}{m_1 + m_2.S} \quad . \quad . \quad . \quad (3)$$

must hold. (In the quoted paper S has been defined as "degree of solvation"; it is better defined as "degree of association".)

It has been shown in the above-mentioned paper that the value S may be calculated from the experimental data in a very simple manner, for it is easy to show that

$$n_1 = \frac{\log \eta - \log \eta_2}{\log \eta_1 - \log \eta_2}.$$

In previous papers the fitness of the above-mentioned formulæ has been shown for quite a number of examples. It will be perhaps sufficient to show it now on the mixture chosen by Mr. van der Wyk, that is, the system benzylbenzoate-toluene. The results calculated on the basis of the equation (2), where for S the value of 1·197 has been found, are shown in the accompanying table:

Viscosity of mixtures of benzylbenzoate and toluene ($S = 1,197$)

m_1	n_1	η obs. (K. and M.)	η calc (equ. (2))	Difference per cent
0	0	0·552	0·552	0
0·2367	0·2785	1·188	1·154	− 2·4
0·4261	0·4762	2·015	1·993	− 1·1
0·6502	0·6948	3·614	3·624	+ 0·3
0·7890	0·8208	5·080	5·104	+ 0·5
0·9002	0·9170	6·660	6·707	+ 0·7
1	1	8·450	8·450	0

The results agree with at least the same accuracy as the data found on the base of the complicated formula of Mr. van der Wyk. Besides, every constant used has a definite physical meaning. Further, with the aid of the equation (1) it is possible to determine also the relationship between viscosity and temperature which is missing in van der Wyk's formula. This relationship shows that the formula of Arrhenius holds better at higher temperatures according to the well-known fact that with increase in temperature 'real' mixtures approach in their properties to the 'ideal' mixtures. The formulæ (1) and (2) also lead to the following conclusions: in the solution of benzylbenzoate in toluene, from each six molecules of the first, four appear in the monomolecular and two in bimolecular form. The heat effect, that is, the total change in the energy of the mixtures, appears in the order 380, 318, 271, 237 and 208 calories, as presented in the table.

These results appear to show the better applicability of my formulæ, as compared with the formula of Mr. A. J. A. van der Wyk.

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[1] NATURE, 138, 845 (1936).

[2] Lederer, *Koll. Beih.*, 34, 330 (1931).

[3] Lederer, *Petroleum*, 28, Nr. 49 (1932). I P.K., Nr. 13664, World Petroleum Congress, London, 1933, No. 196, *Petroleum*, 31, Nr. 33 (1935).

Temperature Drop Effect in Relation to the Determination of the Molecular Heats of Gases

IT has been shown in a recent paper[1] by one of us (H.S.G.) that, in the absence of convection, the loss of energy (Q) from an electrically heated wire, compensated for end effects and suitably disposed in a gas, is given by

$$\frac{1}{Q} = \frac{\log_e r_2/r_1}{2\pi.K.J.l.\theta} + \frac{A}{p.\theta}\cdot\left\{\frac{\sqrt{T_1}}{r_1} + \frac{\sqrt{T_2}}{r_2}\right\} \quad . \quad . \quad (1)$$

where

$$A = \sqrt{\frac{2\pi.M}{R}}\cdot\frac{1}{2\pi.l}\cdot\frac{(2-a)}{2a.(\beta+1/2)} \quad . \quad . \quad (1a)$$

From the above equation, it is evident that measurements of Q and the corresponding pressure (p) over an appropriate range of pressure enable the values of the thermal conductivity (K) of the gas, and also A, to be calculated. Furthermore, it may be shown that if the observations are continued into the low-pressure region where the gas is rarefied, then the heat transfer is governed by the relation

$$Q = \frac{r_1}{2A}\cdot\frac{(T_1 - T_2).p}{\sqrt{T_2}}\cdot\frac{(2-a)}{J \times 10^7} \quad . \quad . \quad . \quad (2)$$

If the temperatures T_1 and T_2 are maintained constant throughout the whole range of pressure, then assuming independence of the accommodation coefficient a upon pressure, its value can be deduced directly from equations (1a) and (2), and hence $\beta.R$, the molecular heat of the gas, can also be determined by substitution in (1a). We have carried out measurements in the case of hydrogen, and the value of β at 283° abs. was found to be 2·448 and that of the accommodation coefficient 0·31.

It should be noted that for a monatomic gas at ordinary temperatures, β has the value 3/2, and hence by using such a gas in the experimental apparatus a method is provided of checking the indications of the McLeod gauge in the region of rarefied pressure, since equation (2) may now be utilized to calculate the pressure, since β and a are known. In this manner the apparatus can be employed as an absolute low-pressure manometer, and this procedure was successfully adopted in the case of pure helium. Incidental to this calibration of the gauge, the value of the accommodation coefficient obtained in terms of the experimental data and the assumed value of β was found to be 0·35. This result is in excellent agreement with that obtained by Mann[2], and the experiments have thus substantiated the use of equation (1) as an accurate method for the determination of accommodation coefficients.

H. S. GREGORY.
R. W. B. STEPHENS.

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Nov. 26.

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[1] *Phil. Mag.*, 22 (Aug., 1936).

[2] *Proc. Roy. Soc.*, A, 146 (Oct., 1934)

Origin of Uni-Polar Electrical Conductivity of Carborundum

THE *volume* rectification in carborundum, which is quite independent of any point action, has been observed by many experimenters[1]. An attempt is made here to explain some features of this effect.

When a certain voltage is applied to the carborundum crystal, it causes a displacement of the photo-electrons embedded in the lattice from their positions of equilibrium. When the binding force on the photo-electrons is overcome by the applied field, these photo-electrons are set free. A certain minimum potential difference must then be necessary for any appreciable current to flow in a certain direction in the carborundum crystal. Since all the photo-electrons are not set free at a definite voltage, there must be a certain range of voltage within which all the photo-electrons are released. This will naturally cause a bend in the current-voltage characteristic curve. Beyond the bend, the curve will be a straight line, since the current through the crystal is proportional to $(V - e)$ where V is the applied voltage and e the minimum E.M.F. necessary to liberate the photo-electrons embedded in the crystal lattice. This linearity of the current-voltage curve beyond the bend has been substantiated, when the crystal is held between two electrodes of large contact area. The deviation from linearity is generally found at higher voltages and is due to the Joule heating, which reduces the resistance of the crystal.

Our experiments with carborundum crystal placed between metal electrodes of large contact area have shown that the values of the minimum voltage for any appreciable current to flow are different for the two opposite directions. Thus beyond the bend in the current-voltage curve, in one direction the current is given by

$$i_1 = k_1\,(V - e_1),$$

while the current in the opposite direction is given by

$$i_2 = k_2\,(V - e_2),$$

where e_1 and e_2 are the values of the E.M.F. necessary to liberate the electrons for the two opposite directions, and k_1 and k_2 are constants determining the slopes of the characteristic curve on the positive and the negative sides. The values of the rectification ratio for different voltages as determined from the ratio of the difference in the values of the currents in the two opposite directions to the larger value can then be calculated, provided we know the values of e_1 and e_2, and k_1 and k_2. From one typical current-voltage characteristic curve for the carborundum crystal mounted between electrodes of large contact area, the slopes of the curve beyond the bends are given by

$$k_1 = \tan 83° = 8{\cdot}0 \text{ and } k_2 = \tan 72° = 3{\cdot}0.$$

Putting $e_1 = 0{\cdot}4$ volt and $e_2 = 0{\cdot}8$ volt, we have calculated the values of the rectification ratio for voltages beyond the minimum voltage where the bends appear. The calculated values are shown in the accompanying table side by side with the values obtained from the same characteristic curve for which $k_1 = 8$ and $k_2 = 3$. The observed value for $v = 6$ volts has been made equal to the calculated value of the rectification ratio at that voltage.

Voltage	Rectification ratio	
	observed	calculated
2 volts	0·70	0·71
4 ,,	0·68	0·67
6 ,,	0·65	0·65
8 ,,	0·60	0·64
10 ,,	0·57	0·63

The experimental and the calculated values of the rectification ratio agree well considering that the values given for e_1 and e_2 are only approximate. The current-voltage curve constructed from the calculated data does not, however, fit well with the experimental curve.

That the values of the minimum potential difference are different for the two opposite directions of the current-flow seems theoretically plausible in a crystal having no centre of symmetry.

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Nov. 15.

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[1] Tissot, *L'Electrician*, 39, 331 (1910). Pierce, *Electrician*, 69, 66 (1912), Khastgir, NATURE, 135, 148 (Jan. 26, 1935) Khastgir and Das-Gupta, *Ind. J. Phys.*, 9, Part III, p. 258. Deaglio, *Atti. R. Acad. delle Scienze*, 70.

Some Polarization Data of the Solar Corona

THE polarization of the solar corona was determined from plates obtained in the 1932 and 1934 total solar eclipses. These eclipses were observed under perfect atmospheric conditions. Polarigraphs, equipped with quartz Wollaston prisms and colour filters of narrow transmission ranges, were used. Intensity squares were printed on each corona plate for photometric reduction. The plates were measured with the Hartmann microphotometer of the Lick Observatory and the Zeiss microphotometer of the Physics Department, University of California.

Fig. 1 shows the polarization values obtained at wave-lengths 420, 447, 482, 668 mμ. These curves represent the polarization in the eastern part of the 1934 corona. The curves are the result from the reduction of plates obtained by two polarigraphs. The curve in the green region is of less weight than the other curves because of the use of non-backed plates.

It is very interesting to note that the slope of the polarization curves in the red is much steeper than it is at smaller wave-lengths. The violet curve passes through a maximum and then decreases. The curves intersect at about 4′ distance from the sun's limb. The polarization in the red reaches very considerable values, going up to 57·5 per cent at 6′ distance from the sun's limb.

The results obtained indicate that scattering of sunlight in the corona by free electrons cannot be responsible alone for the light emitted by the corona. Bound electrons seem to be present in the corona, and the corona itself seems to emit unpolarized light.

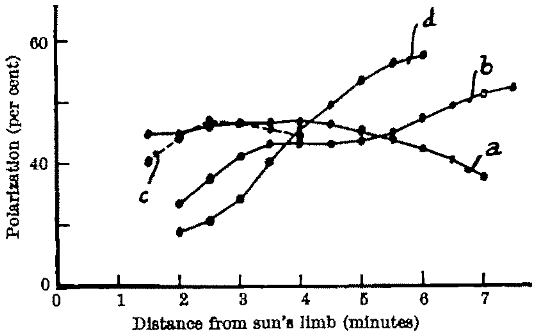

Fig. 1.

POLARIZATION OF THE EASTERN PART OF THE SOLAR CORONA, FEBRUARY 14, 1934.

Curve	Plates	Wratten Filters No.	Maximum transmission
a	Agfa Astro, backed	36	420 mμ
b	Agfa Astro, backed	47	447
c	Eastman I-H	75	482
d	Agfa Superpan, backed	29	668

Detailed results of the reduction will be published later.

Part of the work was supported by grants from the Rumford and Permanent Science Funds of the American Academy of Arts and Sciences. Many friends and institutes helped in carrying through this investigation; see the acknowledgment in the preliminary report[1]. The Imperial Japanese Government furnished the transportation to Laoi Island, and made the observations and work possible there.

WILLI M. COHN.

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Nov. 13.

[1] Cohn, W. M., *Pub. Ast. Soc. Pacific*, 46, 177-185 (1934).

Time Lag of the Vacuum Photo-Cell

IN a well-known experiment, Marx and Lichtenecker[1] swept the image of a narrow slit across the cathode of a photo-cell by means of a mirror that could be rotated at speeds up to 170 revolutions per second, and found that the photo-electric current was constant, no matter at what speed the mirror was rotated. The shortest duration of illumination at any point on the cathode was $1{\cdot}46 \times 10^{-7}$ sec. The experiment was taken to mean that the cell had no time lag or period of induction comparable with this interval.

I have recently repeated the experiment with two G.E.C. cells, a *KMV* 6 and a *KV* 6, using a faster mirror and a sharper image, and find that, while the law of proportionality between quantity of light and photo-electric current still holds for the *KMV* 6 cell, there is an appreciable breakdown in the case of the *KV* 6. If the periods of illumination are decreased from $1{\cdot}59 \times 10^{-6}$ sec. to $7{\cdot}4 \times 10^{-8}$ sec., the time required to charge the electrometer to a given potential is increased. My last three determinations give an increase of 0·30 ± 0·50 per cent, 0·70 ± 0·31 per cent, and 0·85 ± 0·59 per cent, the mean of which is 0·62 per cent. If we make the assumption that this increase is due to there being a period of induction before the electrons start to come off, its duration works out at 5×10^{-10} second.

At the highest speed of rotation there is a slight vertical oscillation of the image which puts a limit to the accuracy of the determination, owing to its shifting the light on to a different part of the cathode.

Details of the experiment will be published later.

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Nov. 27.

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[1] *Ann. Phys*, **41**, 124 (1913).

Primary Oxide Film on Iron

DURING the course of an electron diffraction study of oxide films formed on iron, I have found it rather difficult to obtain surfaces the initial diffraction pattern of which can be attributed to iron alone. In particular, if the surface of a piece of clean Armco or electrolytic iron is abraided by rubbing it lightly over dry 0000 emery paper, the resulting pattern consists of the usual rings of α-iron plus two diffuse rings or bands the mean radii of which correspond to spacings of 2·6 A. and 1·5 A.

The belief that these rings might be due to a thin film of oxide (Fe_3O_4) has been confirmed by a series of experiments with films of electrolytic iron evaporated and condensed *in vacuo* on glass, iron, platinum and quartz surfaces. The evaporation was carried out in the diffraction camera with the receiving surface mounted in the sample holder. Reflection pictures taken immediately after evaporation yielded only iron rings. If, however, the sample is exposed to dry air at room temperature and atmospheric pressure for a brief interval, the resulting diffraction pattern is markedly different. The iron rings are considerably fainter, while two diffuse bands appear in the same positions as found on the abraided iron. In some of the pictures other fainter rings appear which, together with the bands, are in good agreement with the pattern to be expected from a thin film of Fe_3O_4 overlying the iron.

Traces of oxide on evaporated films have been found on pictures taken after brief exposure to air pressures not exceeding 10^{-3} mm. of mercury. Exposures to atmospheric air longer than four minutes produce very little change in the pattern. Heating the specimens in air for 3–7 min. at temperatures of 150°–200° C. is sufficient to cause the disappearance of the iron rings and greatly to strengthen those due to the oxide.

The possibility that a definite orientation relationship exists between the iron and the oxide lattices has been tested by forming thick evaporated films on various surfaces under conditions which yield a high degree of preferred orientation of the individual iron crystals. Such a film all the iron crystals of which have their [111] directions mutually parallel (within 5°) exhibits an equally high degree of preferred orientation of the Fe_3O_4 film after brief exposure to air. The observed orientation relationship is one in which a $[01\sqrt{2}]$ direction of the cubic oxide crystals is parallel to the [111] direction of the iron. This parallelism does not, of course, determine the complete space orientation relationship between the two lattices. It must be pointed out, however, that the observed orientation is exactly satisfied if the Fe_3O_4 cube planes (100) lie parallel to iron cube planes, and the [110] directions in the (100) planes of the oxide are parallel to the [100] directions in the (100) planes of the iron.

Mehl, McCandless and Rhines[1] have found the same orientation relationship existing between "FeO" grown at high temperature on single iron crystals. More recently, Mehl and McCandless[2] have reported that "FeO" grown by reduction on a single magnetite crystal has the same orientation as the underlying Fe_3O_4. In the light of these results, the present experiments can be interpreted by saying that the primary oxide film on iron consists of Fe_3O_4 oriented *as if* "FeO" were formed first and then oxidized to Fe_3O_4. Such is probably not the actual process, because there is no evidence of "FeO" in the diffraction patterns and furthermore it is unstable below about 575° C. As has been pointed out by Mehl and McCandless, there is a striking similarity between the positions of the Fe atoms in the iron lattice and their positions in the "FeO" lattice, and this similarity can be traced through to the Fe_3O_4 lattice when it is oriented as described above.

Electron diffraction pictures of Fe_2O_3 films grown on highly oriented Fe_3O_4 films by heating at 200° C. in air show no trace of orientation. Continuous rings of the randomly orientated Fe_2O_3 crystals appear superimposed on a fading but still well-oriented Fe_3O_4 pattern. Long after the Fe_3O_4 pattern has disappeared, the Fe_2O_3 rings begin to show evidence of a preferred orientation which seems to be independent of the nature and degree of orientation in the underlying layers.

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Nov. 11.

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[1] NATURE, **134**, 1009 (Dec. 29, 1934).

[2] NATURE, **137**, 702 (April 25, 1936).

Distortion and Yield Point of Molybdenum

IN a recent communication[1], Dr. E. W. Fell refers to a letter from us[2] and comments on the yield point of molybdenum wires after a certain heat-treatment in hydrogen followed by nitrogen, as shown in Fig. 1 (No. 2) of our letter. He points out that in Fig. 1 (No. 1), which shows the load-extension curve for wires treated in hydrogen only, no such yield point is present, and attributes the difference in the shape of the two curves (that is, No. 1 and No. 2 in our letter) partly to the different heat-treatment affecting the crystal size of the two samples.

While admitting that, in general, the crystal size may have an influence on the yield of the wire, we must point out that, in the particular case dealt with, the crystal sizes of the two samples were exactly identical. Notably the sample No. 2 was pretreated in hydrogen at 1,400° C. for 2 min., and during the second treatment at 1,300° C., which was done for 20 sec. in nitrogen, no further change in the crystal structure occurred at all. Thus it is quite clear that the remarkable yield shown is entirely due to the presence of *nitrogen* sorbed during nitriding at the second treatment.

Incidentally, this can also be demonstrated very convincingly by the following two methods. If nitrided wires treated in the same way as those to which Curve No. 2 of our previous letter relates are reduced in hydrogen, say, at 1,000° C., they revert entirely to a stage which is identical with that represented in Curve No. 1. There is no yield. On the other hand, if wires are heated in the same manner as in that of Curve No. 2, the only difference being that the second treatment at 1,300° C., continued for 20 sec., is carried out in *hydrogen* instead of nitrogen, the resulting wire is exactly like that of Curve No. 1. Again there is no yield.

If, during nitriding, changes in the crystal structure are also taking place, the conditions are somewhat more complicated, and the behaviour of the wire is then dependent on the resulting crystal size as well as on the *quantity* and *distribution* of nitrogen sorbed.

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Nov. 16.

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[1] NATURE, 138, 760 (Oct. 31, 1936).

[2] Túry, P., and Krausz, S., NATURE, 138, 331 (Aug. 22, 1936).

Water and Fat Contents of Tsetse Flies

A CONSIDERABLE amount of work has recently been carried out or is in progress concerning the physiological responses of tsetse flies to environmental conditions. These studies have been largely concerned with the effect on the water and fat content of the flies.

There is a point to which attention may be directed as it has not been taken into consideration in any paper of the above nature which has as yet come to my hand. In estimating the water content, it seems to be the practice to utilize the gross wet and gross dry weights of the flies. It is to be pointed out, however, that the ether soluble 'fat' contains no water, and is very variable in quantity in different circumstances. It is obvious that, with the same quantity of water, the water content, expressed as percentage of the wet weight, will vary inversely with the fat content.

In the course of our work with *Glossina morsitans*, one hundred and fifty unfed flies, killed within two hours of emergence, have furnished a mean water content, based on gross weights, of 70·8 per cent. If the weight of the 'fat', the mean of which is near 1·70 mgm., is subtracted from both wet and dry weights, however, the mean water content is 76·4 per cent. There is practically no difference between the sexes in this connexion.

The distribution of the respective percentage water contents shows the following ranges in round figures:

(1) With 'fat' included: 66–74 per cent.
(2) With 'fat' excluded: 72–79 per cent.

Unfed flies which have been under starvation for any considerable period have naturally consumed a large portion of their fat reserve, and the loss of fat tends to raise the final percentage of water if the latter is reckoned on gross wet and dry weights. On this basis, in fact, it may appear that no significant disturbance of the water balance has taken place during an experiment, whereas if the 'fat' is excluded a significant difference may be revealed.

A single instance will illustrate this point. A group of unfed flies, which had been exposed to certain conditions, returned the following mean figures:

Wet weight	19·6 mgm.
Dry ,,	5·7 mgm.
'Fat' ,,	0·60 mgm.

Using gross weights, the proportion of water is 70·9 per cent, practically the mean of the control. Excluding the 'fat', the proportion of water is 73·2 per cent, which is definitely below the mean of the control calculated on the same basis. Tested by *t*, this result has been found to be statistically significant.

One further point is rather obvious, namely, that, in the case of an insect containing in the first place 70–76 per cent of its weight in water, a considerable loss of actual water is not very conspicuously reflected in the final ratio between wet and dry weights. As this is merely a matter of simple arithmetic, I will not enlarge upon the point beyond remarking that the fact adds importance to relatively small differences in the ratios recorded.

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Four Molluscs rarely recorded from the Red Sea

As an example of the way in which the distribution of marine animals is complicated by ecological factors, I quote four species of nudibranch mollusc, all of which are large and conspicuous, and which, though common in Zanzibar, have been rarely recorded from the Red Sea. I have myself only lately seen specimens, though twenty-three out of the last thirty-five years have been spent on this coast:

Asteronotus hemprichi Ehr. One specimen on Sudan coast, 1905; one specimen by Dolfuss, in Gulf of Suez, 1927–29; two here in 1934.

Chromodoris (*Glossodoris*) *annulata* Eliot, fairly large for its genus and so strikingly marked that if seen it could not be missed. Colour white with distinct yellow spots. Mantle border violet, with large rings of the same on the back, one enclosing the rhinophores, the other the gills. None seen until 1934, when two were collected (there is another species here of exactly the same colour except that the characteristic rings on the back are missing. This might be taken for a local variety, but in *C. annulata* the gills are laid horizontally, in the other they are vertical, and kept in motion).

Ceratosoma cornigerum Adams and Reeve. Two specimens by Dolfuss, two here in 1936.

Thordisa crosslandi Eliot, another large form not seen again anywhere until one specimen was taken here this year.

None of these species was found by the Cambridge Suez Canal Expedition.

C. CROSSLAND.
(Director.)

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Ghardaqa,
Red Sea District.
Nov. 30.

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Pruvot-Fol, *Mem. Inst. d'Egypte*, 89 (1933).
O'Donoghue, Camb. Exped. Suez Canal, *Trans. Zool Soc.*, 22 (1929).

Colloids and the Biological Effect of Radiation

SOME eight years ago there came to my notice a phenomenon which I now think must have been of the same type as that described in the letter from Dr. F. Ellinger, published in NATURE of December 12, p. 1014.

It was desired to demonstrate by means of a projection microscope the Brownian movement in certain colloidal solutions. Messrs. Zeiss kindly placed at our disposal a projection microscope in which the demonstration substance was subjected to very powerful illumination. It was found that when a colloidal calcium oleate protected by gelatine was placed in the cell, the particles, which showed very active Brownian movement, were rapidly brought to rest in the illuminated area. If the cell was moved slightly, the particles which had been unilluminated were seen to be in active movement, but within some forty seconds all had come to rest. The sol in question contained small quantities of sodium chloride and other electrolytes, and it is suggested that the illumination decreased the stability of the colloid sufficiently for these salts to bring about precipitation.

The phenomenon observed was not due to heating or drying up of the solution, since a water cell was interposed between the source of illumination and the slide, and also when a titan white suspension was substituted for the colloidal calcium oleate the particles remained in active movement during many hours of continuous illumination.

R. T. M. HAINES.

British Colloids, Ltd.
Dec. 16.

Points from Foregoing Letters

DR. W. B. LEWIS, W. E. Burcham and W. Y. Chang report that α-particles accompany the radioactive disintegration of lithium atoms (mass 8) into beryllium atoms of the same mass, with emission of an electron. These α-particles are attributed to the disintegration of excited ^{8}Be nuclei formed in the above reaction. It appears that the ^{8}Be is always formed in an excited state, and the lowest excess energy is not less than two million electron volts.

Attention is directed by Dr. M. S. Vallarta to a lack of agreement in the observed data concerning the intensity variation of cosmic rays with longitude. Some determinations show a maximum off the West African coast at long. 12° W., in agreement with the theory of Lemaître and Vallarta (assuming the position of the magnetic centre of the earth to be at about long. 160° E., as calculated by Schmidt). Hoerlin and Clay, on the other hand, find a maximum at long. 80° W., in the Pacific Ocean, which would place the magnetic centre at 100° E.

The changes brought about by the yellow oxidation ferment and Warburg's co-ferment consist, according to Prof. J. Kenner, in the removal of a proton and a hydrogen atom associated with an electron. He gives several examples of such reactions and suggests that they may likewise throw light on the function of methyl groups in the lactoflavin molecule in connexion with the activation of vitamin B_2.

The biological activity of corticosteron, a crystalline substance isolated by Reichstein from the cortex of the adrenal gland, is reported upon by a group of investigators from Amsterdam, Oss and Zurich. They find that its curative action upon dogs from which the adrenal glands have been removed, is about 2,000 times that of a standard 'cortin' solution, or 100,000 times that of fresh gland.

Benzoyl oxide and benzoyl peroxide have the property of stimulating growth in the same manner as the growth-hormone 'auxin'—according to experiments by R. Snow. The stimulation of growth was noted after applying the substances, mixed with lanoline, to one side of oat coleoptiles from which the tops had been removed.

Dr. E. L. Lederer compares his equation for the viscosity of binary mixture and that of Arrhenius with the equation recently suggested by A. J. A. van der Wyk, and states that the former two are to be preferred.

An equation for determining the molecular heat of a gas at a known pressure from the loss of energy of an electrically heated wire is given by Prof. H. S. Gregory and R. W. B. Stephens. Alternatively, taking as known the 'molecular' heat of a monatomic gas, it is possible to check the pressure readings of a McLeod gauge in the region of rarefied pressures.

A comparison is given by Dr. S. R. Khastgir of the observed values for the *volume* rectification ratio of carborundum with those calculated by means of a hypothesis which postulates that photo-electrons are set free when a voltage exceeding their binding force is applied. The values of the minimum potential differences needed are different for the two opposite directions of the current flow.

Curves showing the polarization of light of several wave-lengths in the solar corona, from photographs taken during the eclipse of 1934 by means of a specially equipped polarigraph, are given by Dr. W. M. Cohn. The author deduces that both 'bound' and free electrons are present in the solar corona.

The time lag of the vacuum photo-cell has hitherto not been measured, but it is usually assumed to be less than 3×10^{-9} sec. By a refinement of the rotating mirror method, Dr. R. A. Houstoun has managed to measure it for one cell, and finds it to be 5×10^{-10} sec.

Surfaces of pure metallic iron, if they have been at all exposed to air, show the presence of a film of oxide, Fe_3O_4, when analysed by means of the X-ray diffraction method. H. R. Nelson has investigated the orientation of the oxide lattice structure in relation to that of the underlying iron crystals and finds it similar to that which has been observed at higher temperatures in the case of 'FeO'.

While admitting that crystal size may have an influence on the yield point of heat-treated molybdenum wires, as suggested by Dr. E. W. Fell, it is stated by P. Túry and S. Krausz that in the particular case described by them the crystal size of the two samples was identical and the difference in the yield point must be attributed to the presence of nitrogen sorbed during nitriding.

R. W. Jack points out that changes in the fat content of tsetse flies should be allowed for when estimating variations in the 'water balance' of these insects, otherwise significant differences may be overlooked.

Research Items

Palæolithic Portraiture

DR. HERBERT KUHN has assembled all known reproductions of the human form in the Franco-Cantabrian school of palæolithic art with the view of studying how the artist of this school represented himself and his fellow men and women as a type (*Z. Rassenkunde*, 4, 3). These representations, more numerous than is appreciated, fall into three classes: (1) sculptures and reliefs; (2) engravings in which the figure is masked; and (3) engravings in which there is no mask. In (2) and (3) the masked figures predominate, owing to the preoccupation of the period with magic. In (1) statuettes of Aurignacian age in ivory, bone, or other material number fifty-nine from sixteen sites, distributed over an area extending from Italy-Spain-France to Siberia. All but two are female. Of reliefs there are five, all from Laussel, Dordogne. Two of the female figures hold horns in one hand. Of the statuettes of Magdalenian age there are four from four sites, all situated in France. They are of slender type, whereas the Aurignacian statuettes and reliefs are full-fleshed, with the sexual characters strongly marked, thus pointing to connexion with a fertility cult centring in the female. These statuettes, like the masked figures of (2), throw little light on physiognomy in the period. Of the masked figures of (2) there are seventy-one from twenty-four sites. With two exceptions (Klause bei Neuessing, Bavaria, and the Pin Hole Cave, Derbyshire), all the sites are in France. The masks include birds, lion, buck, goat, bison. A number show no features or are unrecognizable. They afford evidence of a cult of magic. The figures without masks (3), from this point of view the most interesting, number nineteen. Of these, eight, including hunting scenes, show no features; but the remaining eleven, with features either in full face or profile, show how palæolithic man saw himself, though at times in so grotesque a form as to suggest caricature. It is to be noted that the head is always short and round. The nose is prominent but broad. A beard is indicated, and the bodies of both sexes are hairy, even on the female breast.

Ætiology of Goitre

GOITRE is a disease, with enlargement, of the thyroid gland, which has a high content of iodine. The results of an investigation by the Committee on Iodine and Thyroid Disease, jointly appointed by the Medical Research Council and the Agricultural Research Council, are contained in a report issued by the Medical Research Council entitled "The Relationship of the Iodine Contents of Water, Milk, and Pasture to the Occurrence of Endemic Goitre in two Districts of England" (Special Rep. Series, No. 217. London: H.M. Stationery Office, 1936. 6*d*. net). Two former studies upon this subject have already been published (Nos. 123 and 154), but revealed discrepancies which made this further work desirable. The accurate determination of minute quantities of iodine met with in the materials examined was carried out by a method devised by Mr. C. O. Harvey, and contained in a report in this series (No. 201). The results embodied in the present report give general confirmation of previous work that environmental deficiency of iodine, as indicated by the iodine content of the local water, is once more shown to be associated with a high incidence of goitre. At the same time, the actual amount of the iodine in the environment is not simply and directly related to the intensity of the incidence of goitre. It is suggested that some factor other than the mere iodine content, such as variations in the availability of the iodine present, may be responsible for the discrepancies met with.

Caddis Flies of India

VERY few species of Trichoptera or caddis flies have been described or collected in India. A recent contribution to this subject is to be found in a paper by Prof. A. B. Martynov, the well-known authority in Leningrad (*Rec. Ind. Mus.*, 37, 93–209; 1935). The paper forms the first part dealing with the suborder Annulipalpia. The material studied by Prof. Martynov was from the Indian Museum, and numbered about 93 species. It is significant that 77 of these species constituted new records for continental India and that 61 of them were previously undescribed. This paper brings the number of Trichoptera-Annulipalpia known from continental India up to about 134 species. From the points of view of zoogeography and ecology, caddis flies are an interesting group. It is very desirable that further investigations should be undertaken, including the larvæ and the exact nature of their habitats. Prof. Martynov's paper, which is very fully illustrated, is one of special importance to students of this order of insects, who will doubtlessly welcome further contributions from the author dealing with the Indian forms.

Corpuscles in Cœlomic Fluids of Invertebrates

A SERIES of four communications by Toshio Ohuye (*Sci. Reports, Tôhoku Imper. Univ.*, Oct. 1936) continues the author's investigations on corpuscles in the cœlomic fluids of invertebrates. The previous papers dealt with a holothurian and an earthworm and the present papers include the examinations of four ascidians, another holothurian, an echinoid and a brachiopod. The papers are well illustrated, and the value of the survey is enhanced because a similar technique is employed throughout and the same person is responsible for the interpretation. In the ascidians and the holothurian, nine different types of corpuscles, and in the echinoid and the brachiopod, six different types are recognized. Some of these corpuscles exhibit considerable variation in the body of the animal and some undergo marked changes when they are removed from the body. Amœboid corpuscles are present in all species examined, and in the echinoid the hyaline amœbocytes may run together to form a plasmodium.

Crossing-over and Chiasmata

THE mechanism of crossing-over is still the subject of much investigation, based on both cytological and genetical data. Dr. K. Mather (*J. Genetics*, 33, No. 2) has applied the chiasmatype theory to the knowledge that crossing-over is not constant per cytological unit distance along the chromosomes, particularly in *Drosophila*, and is able to draw various conclusions from the mathematical discussion. If crossing-over is more frequent at certain points, there must evidently be some localized determining mechanism. The spindle fibre attachment appears to be the site of this mechanism, and in the *V*-shaped chromosomes of *Drosophila* the two arms are known to be independent in their crossing-over. This is less surprising as it is evident that these were originally separate chromosomes. The frequency of crossing-over and chiasma formation in any region is then a function of its distance from the spindle attachment. Owing also to interference, the frequency of crossing-over at any point depends on (1) its distance from the spindle attachment, (2) the length of the chromosome arm. It is concluded that, in *Drosophila*, crossing-over and chiasma formation begin at the spindle attachment and proceed regularly along the arm.

Internal Cork of Apples

'INTERNAL CORK' of apples, which has for some years been a prevalent source of loss in certain areas of New Zealand, has recently been effectively controlled by the injection of boron compounds. H. O. Askew and E. Chittenden (*J. Pom. and Hort. Sci.*, 14, 3, 227; 1936) have found that hydrated borax applied as a top dressing will rapidly increase the boron content of certain soils to a depth of eighteen inches, and is readily absorbed by Jonathan and Dougherty trees. The boron content of apples from a healthy area and free from internal cork was similar to that of fruits from unhealthy soil receiving 100 lb. borax per acre. The treatment was effective in reducing the incidence of internal cork on trees previously affected, and no definite effect on the size or dry weight of the fruits was observed. It was estimated from the boron content of healthy leaves and fruits that the annual boron requirement is approximately 44 gm. per acre, which is amply supplied by a top dressing of 50 lb. of hydrated borax per acre to the soil. Complete control of internal cork was obtained by injecting individual branches of Jonathan and Delicious trees with 0·25 per cent hydrated borax solution. A total quantity of 2·5 gm. was effective, though 15 gm. could be given without injury. Control was also achieved by spraying the trees with 0·1–1 per cent borax solution, and as the addition of lime did not diminish the control, it is suggested that borax may be applied along with routine lime-sulphur sprays.

Cereal Rusts on Incompatible Hosts

DR. THEODORA B. HANES has studied the important problem of what happens when a rust fungus attacks a host upon which it does not normally occur (*Trans. Brit. Mycol. Soc.*, 20, pts. 3 and 4, Nov. 1936). Uredospores of *Puccinia triticina*, *P. glumarum Tritici*, *P. anomala*, *P. coronata* and *P. graminis Secalis* were inoculated upon a wide variety of cereals, and many 'inappropriate hosts' were included. The fungus usually initiated invasion of these unsuitable host plants, but was soon checked by local death of the mesophyll, or even of the stomatal guard cells. Experimental results are set forth in great detail in the paper.

The Refractivity Intercept

THE value of investigations of refractivity in the examination of hydrocarbons and mixtures of hydrocarbons is emphasized in a paper by S. S. Kurtz, jun., and A. L. Ward (*J. Franklin Inst.*, 222, 563; 1936). The authors have used the accurate data available for the isomeric heptanes to examine the additivity of the molecular refractivity, and come to the conclusion that too much is demanded of the classical refractivity equations of Lorenz-Lorentz, Gladstone and Dale, and Eykman. Such equations cannot be expected to give the effect of both variation of temperature and constitution on refractive index and density. A graph of refractive index (n) against density (d) for the homologous series of paraffins confirms the fact that a linear equation expresses the relationship between these two quantities. It is therefore proposed to use the equation $b = n - d/2$ where b is a constant, and is referred to as the refractivity intercept. The latter is characteristic of each homologous series. The refractivity intercept is of greater use in the study of hydrocarbons and hydrocarbon mixtures than the classical refractivity equations, since it is practically independent of boiling point and molecular weight. It is of value in the selection of reliable data concerning the properties of hydrocarbons, and for confirming the structure of new hydrocarbons and establishing their purity. It is of use also in the qualitative analysis of organic liquids. The refractivity intercepts of organic compounds other than hydrocarbons are usually less than unity, whereas hydrocarbons themselves (except in a very few cases) give a value greater than 1·01. In the case of mixtures of hydrocarbons, the intercept may be used to distinguish between saturated cyclic and aromatic hydrocarbons. It is possible, by a graphical method, to analyse quantitatively mixtures containing two or three different types of hydrocarbons. The authors discuss briefly the electronic interpretation of the refractivity intercept.

Development of Radio Receiving Valves

AT a meeting of the Wireless Section of the Institution of Electrical Engineers held on December 2, a paper entitled "Modern Receiving Valves: Design and Manufacture" was presented by Messrs M. Benjamin, C. W. Cosgrove and G. W. Warren of the M.O. Valve Co., Ltd., and the G. E. C. Research Laboratories. This paper discusses the main features in the geometrical design of the types of valve in common use to-day and the various factors, mechanical and chemical, which impose limitations in manufacture. Attention was directed to the fact that the minimum tolerances of the dimensions of the electrode systems must be of the order of one per cent if reasonable similarity of characteristics is to be obtained in the mass production of valves of the same type. The paper includes a brief historical survey of the recent improvements in thermionic emitters and gives details of the precautions necessary in the production of modern highly efficient oxide-coated cathodes and insulated heaters. A brief description of the pumping and activation processes employed in modern manufacture is given, and the main factors affecting the life of a valve are discussed. The authors conclude with some observations on possible future developments of the receiving valve. The reading of the paper was accompanied by demonstrations, illustrating, first the improvement attained in the past five years in making the receiving valve free from microphone noises, and secondly the use of the very small 'acorn' valve for the transmission and reception of telephony on a wave-length of about one metre.

Lobster Research in Norway

DR. ALF DANNEVIG in a recent paper* gives a general review of the lobster industry and lobster culture in Norway. For about twenty years lobsters have been investigated at Flødevigen. Yearly grants have been made for this purpose, and much has been done in studying the lobster in all aspects, especially by fishery statistics, marking experiments and rearing the young to the bottom stage after which they are freed into the sea. The results of these researches have been published in various reports and journals, and here a collected view of the whole problem is given and discussed.

Beginning with the history of the fishery from early times to the present day, the author passes on to details of legislation and shows that there has been a big improvement in the fishery since a size limit and a close season were enforced.

Early researches on lobsters were made by Rathke, G. O. Sars, G. M. Dannevig, Appeløf and Sünd leading to the present author's work, which is chiefly concerned with the rearing of the young. The foundation of our knowledge of the life-history and development was laid down by G. O. Sars, who in 1875 described the post-embryonic development for the first time. The newly hatched larvæ he found in the well of a fishing boat and later collected them in the surface waters of the sea by means of a fine net. In this way he distinguished three larval stages and prophesied that the fourth would probably be on the bottom, which was later found to be true. Even in these early years, Sars advocated summer protection and inspection, both of which have now been in force for some time.

Lobsters were first artificially reared from the egg to the bottom stage by G. M. Dannevig, who showed that the young were very sensitive to salinity and, more especially, to temperature, and also found out the proper way to feed these young. Appelløf did much in the way of biology and studied specially the growth of the lobster and instituted marking experiments. It was on the basis of his work that special rearing experiments were begun in 1912 by O. Sünd, who carried out systematic measurements of lobsters on various parts of the coast. Later the rearing experiments were continued by Alf Dannevig, and are still going on at Flødevigen.

It is shown that males are mature at a length of about 16 cm. at Flødevigen and females at between about 21–23 cm. The eggs are extruded in the summer and development takes about a year, during which time the female keeps the eggs under its abdomen attached to the pleopods. Hatching usually takes place in June or July according to the temperature of the water. A spawning lobster of 23 cm. may have about five thousand eggs. The larval development through three free-swimming stages to the bottom stage takes about fourteen days with favourable conditions and normal summer temperature—about 16–18° C. in the Skagerak.

The natural food of the youngest stages consists of small planktonic animals, but in captivity they thrive on crab meat and ox liver. They seize almost anything but throw it away if not liked. In the rearing experiments in the Isle of Man which have been going on for some years, the larvæ are fed with fresh plankton in which copepods predominate, and they thrive on this. Adult lobsters are not naturally carrion eaters, although they will eat dead fish and crabs. Dannevig has observed that in Nature, sea-urchins, chætopods and thin-shelled mussels take a prominent place as food and he has also found remains of fish. Little is eaten in cold weather, the appetite rising with temperature. No food is taken just before and during the period of shell casting, which takes place usually in late summer and autumn when the reserve food is consumed. During the first few days after casting, the lobster does not eat, but as the new shell hardens the appetite grows and soon is normal again. The best quality lobsters are those with a thick shell which has not been cast for some time; thus the best lobsters are usually those caught in the late winter and spring. In captivity, it is essential to feed the lobsters if they are to be in good condition for eating, otherwise they are watery. Temperature and food are of great importance with regard to shell casting, and lobster growth depends on the casting of the shell.

Growth measurements in captivity compare favourably with those in Nature obtained from marking experiments, and the reared lobster young at Flødevigen grow in much the same way as those reared at Port Erin, Isle of Man. The young at Flødevigen reach a length of about 30 mm. in the first growth period and about 60 mm. in a year, the shell casting, practically speaking, being limited to the time when the temperature is above 10° C.

Marking experiments have shown that there is little sign of wandering far, although the lobsters come into shallow water when the water is warm and go down into the deeper water when it becomes cold, or in stormy weather. On most of the Norwegian coast the wandering is probably limited to about a hundred metres in a horizontal plane. There may then be said to be a stationary stock and, usually, about 44 per cent of the marked lobsters are caught again the year after marking. For example, a hundred lobsters, 19–20 cm., were released in the autumn and 44 were taken again the next autumn, the average size being 22 cm.

The present minimum size is 21 cm., and since it is known that hens are normally not ripe until 22–24 cm., it is clear that raising the minimum size to 22 cm. would save many which will breed the next year, especially as the greater part of the fishermen's present catches consists of those of less than 22 cm. This would also be of advantage eventually to the fishermen, for the catches though smaller would be more valuable. It is calculated that, if the minimum size is raised a centimetre, after two years there will be an increased lobster stock, and this with no lasting expense to the fishery.

Since 1879 there has been a protection period to prevent fishing of lobsters which have just cast their shell. This is from July 15 until the first weekday after September 15, varying slightly in different districts. An earlier protection time in spring would save many breeding lobsters, and extension to later in autumn would bring with it a better quality of fish.

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*Hummer og Hummerkultur. By Alf Dannevig. (Fiskeridirektoratets Skrifter. Serie Havundersøkelser. Report on Norwegian Fishery and Marine Investigations, 4, No. 12. (Copenhagen: Director of Fisheries, 1936.)

The breeding experiments at Flødevigen are carried on in view of the fact that by increasing the number of young by enclosing a mother lobster, hatching the eggs in captivity and rearing the young to the bottom stage, an increase of lobster stock will be effected, for in this way the larval stages which are the most exposed to dangers are protected for the most susceptible time of their life. The lobsterlings when they have attained the bottom stage are set free into the sea. A technique has now been evolved which is very sure, and one can reckon on an output of 20–40 per cent. It is now possible to bring lobster young from the egg to the bottom stage in so great numbers that it is undoubtedly valuable in increasing the stock. This technique has been described in Dannevig's former paper "The Rearing of Lobster Larvæ at Flødevigen" (1928). The technique being established, it is now only a question of how cheaply the whole of the rearing and transport can be effected. There is every ground for believing that it is possible to bring working expenses of production down to a fractional part of the present amount. The plans for the immediate future include still further research in those areas where the young are released. So far, the rearing experiments have prospered. Important results should follow these successes.

Petroleum and Petroleum Products

THE group of papers on conservation of petroleum and natural gas given at the third World Power Conference forms the subject of a report by H. C. Fowler (Section IV, Paper No. 12). Mr. Fowler stressed the principle enunciated by Sir John Cadman that petroleum should not be produced without adequate need, having regard to the vital part played by crude petroleum in the life of civilized communities to-day, and the view held by technicians that resources of crude petroleum are not unlimited. The problem of conservation presents a different aspect in each oil-producing country, and it is difficult to assess it from the point of view of world resources. In the case of the United States of America, the problem is unique and the ultimate policy adopted there will probably have a greater influence on the world petroleum industry as a whole than that of all other oil-producing countries combined.

Before effective measures for world conservation can be adopted, however, there are certain preliminary investigations to be made. The extent and character of waste production in countries having relatively large portions of known oil resources should be determined and note taken of methods employed to conserve resources under specific conditions. In those countries which depend chiefly on imported supplies of oil, the problem should be regarded from the point of view of conservation of utilization. Further, organization of the industry in different countries should be surveyed from the point of view of the effect of property laws, State regulations, etc. Finally, the uses of petroleum should in every case be justified or otherwise, and decisions on this point taken only with full cognisance of all possible substitutes for petroleum and a knowledge of their specific uses. These and other economic factors which are bound to affect utilization and conservation of petroleum should be carefully weighed before judgment is passed on the whole problem of how best to use or conserve this commodity, which now seems indispensable to modern industrial life, but is at the same time believed to be capable of exhaustion.

In his general report (Section II, Paper No. 6) on papers submitted at the Conference on the organization of the production, transportation and distribution of natural and manufactured gas, E. R. Weaver directed attention to the marked contrast between European and American practices within the gas industry. The contrast is chiefly attributable to the greater abundance and variety of fuels obtainable in America, and to different legal and financial factors within the industry. Moreover, in practically every European country, distribution of adequate gas supplies is undertaken by public bodies, whereas in the United States of America public interest is for the most part not represented on the boards and councils of gas concerns. Large holding companies, therefore, compete with each other for areas of supply and are not responsible for their policies to any higher authority. This fact cannot be said to further ultimate national conservation of this commodity in America.

In the case of European countries, a strikingly similar development of the gas industry appears to have taken place in each of them, and such differences as exist are rather differences in stages of development than fundamental dissimilarities. Germany is at present pursuing an advanced policy of consolidation, the professed ideal being delivery of gas to every station at every moment as economically as possible, and also at the same time withdrawal from each producing unit of an allotted quota. To achieve this, not only daily but also hourly load of every pipe has to be calculated and attention given to weather reports and other factors likely to influence gas sales. The question now being debated by technicians is whether fundamental conditions exist in other European countries which will prohibit a similar national programme of gas economy to that aimed at by Germany.

E. B. Swanson gave a general report (Section II, Paper No. 5) on papers in connexion with present-day organization of the petroleum industry. The industry may be said to comprise five structural components: exploration, production, transportation, manufacturing and distribution. The degree of economic stability attainable by an individual country or company is dependent largely upon the extent to which it is possible for it to enter into all five branches of the industry's activities. Papers descriptive of the organization of the petroleum industry in the Argentine, Austria, Canada, China, France, Germany, Great Britain, Hungary, Poland and the United States, substantiate this fact, and at the same time facilitate classification of these countries into four categories: producer; producer-refiner-marketer; purchaser-refiner-marketer; and purchaser-marketer.

The ultimate aim of each country is to engage in all branches of the industry and to attain a balanced degree of activity in each branch.

Several factors, however, determine the status of individual countries and/or units within the industry. The most important of these are the extent to which the indigenous supply of crude petroleum is capable of fulfilling the demand for petroleum products within a country; problems of general industrial organization and the extent and influence of governmental control or assistance. In turn, the degree to which governmental influence is exerted or withheld is based on the particular growth of the industry within each country. Far-reaching governmental control and stringent legislation will be found to operate in those countries where there has arisen progressive lack of balance between indigenous supply and home demand, lack of stabilization of markets through non-participation of lesser units, or other economic maladjustments.

The Bushman Skull

IN the course of a discussion of the significance of the Bushman skull (*Soölogiese Navorsing v. die Nas. Mus., Bloemfontein*, 1, 3–4), Dr. T. F. Dreyer contends that the genus *Homo* at a very early date evolved along three independent lines—Neanderthal, the Eurasian and the Bushman. The Bushman, in the smallness and orthognathism of the face, the steepness of the forehead, and the flatness of the dorsal profile, shows features, in which it resembles the juvenile skull. It is here suggested that this fœtalization' (Bolk) is not due to an adult retention of juvenile features, but is a precocious assumption of the adult. This explains the fact that a Bushman baby of about twelve months is already a Bushman, and differs distinctly from the babies of other races, as does the adult Bushman from other adults. This difference is thus due to the projection of adult features into the earlier ontogenetic stages.

The typical orthognathism of the Bushman skull, after a period of prognathism which lasts for some months after birth, is extreme up to six years and then is less pronounced in maturity. This is a result of two growth processes, the peak of jaw formation falling within the fœtal period, while the upper face, correlated with the growth of the base of the brain, grows more rapidly during the first six years after birth. The cranial form, with characteristic bulging of the forehead and flatness of the dorsal profile, is due to the differential growth of the roof and floor of the brain; there being a lack of growth of the anterior end of the base, while the roof grows very slowly during fœtal life, very rapidly during the first two years after birth, and then keeps pace with the floor of the brain until maturity is reached.

Modern miscegenation with Bantu produces a small brain and a long face (Baralong), but early crosses of Bushman with a Hottentot-like race (Matjes River) produced a large brain with a small face. In both cases the proximate cause appears to be a disturbance in the functioning of the pituitary gland. The sella turcica in the Bush-Bantu is abnormally large—the first case recorded of hypertrophy of the pituitary in an African—while in Bush skulls the sella turcica is abnormally small.

Hybridization with the Bushman would thus seem to set up a disturbance of hormonic control, with the result that one or other set of racial characters becomes exaggerated. It remains to be determined whether the differences between the Bushman and other groups of *Homo sapiens* are of such a degree of importance that most important physiological disturbances result from hybridization, and are of sufficient weight to demand the separation of the race from *H. sapiens* as a distinct species.

Work of the Rothamsted Experimental Station

IN studying the annual report for 1935 of the Rothamsted Experimental Station*, it is impossible not to be impressed by the number and value of the experiments carried out at this institution in co-operation with various bodies and individuals. If the British farmer and his trading associates are averse to co-operation in commerce, they have not proved to be so in the field of research directed from Rothamsted. One of the fruits of bringing together producer and expert buyer has been progress in the direction of understanding 'quality', as applied to some agricultural products.

A series of fertilizer experiments, carried out with the help of the sugar-beet factories, and planned at the Statistical Department at Rothamsted, has the object of putting the manuring of this crop on a sound and more accurate basis. Trials carried out in Great Britain indicate that this crop does not give the response to various manures that might be expected from Continental experience. In the trials directed from Rothamsted, not only is the effect of fertilizers carefully assessed, but also an elaborate examination of the soil is in progress, in order to correlate soil properties and fertilizer responses. This crop is also the subject of trials at Rothamsted and Woburn, arranged under the ægis of the Ministry of Agriculture and of the sugar-beet factories. These trials are designed to measure the effects of spacing, and of sulphate of ammonia applied at different spacings; the results at both centres indicate that nitrogen produces a greater effect in the narrower rows.

Useful information was gathered from conferences of growers of malting barley; these took the form of exhibitions of samples sent from various parts of the country, and valued by the Barley Valuation Committee of the Institute of Brewing. One of the most interesting facts gleaned is that the results of the experiments made by Rothamsted in the last ten years on the manuring of barley have passed into practice; these results indicated that barley is not a starvation crop, and that, provided the danger of lodging is kept in mind, the crop repays manuring.

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* Rothamsted Experimental Station: Lawes Agricultural Trust. Report for 1935. Pp. 279. (Harpenden: Rothamsted Experimental Station, 1936) 2*s*. 6*d*.

The expanding acreage of vegetable crops grown in Great Britain is reflected in the increasing attention given them in the Rothamsted scheme of experiments. The expansion in this branch of work was made possible by the investigation into the value of dried poultry manure, put in hand by the Ministry of Agriculture and controlled from Rothamsted. Although the standard errors proved to be rather higher than the average of large-scale root-crop trials, a number of statistically significant fertilizer effects were found for some crops. More work was done on Brussels sprouts than on other crops. Comparing poultry manure with sulphate of ammonia providing the same amounts of nitrogen, the results indicate that, in the more favourable growing season of 1935, as compared with 1934, sulphate of ammonia proved more effective. Another interesting feature is that the manurial responses showed up more in the first pickings—an important consideration in the marketing of this crop.

The report has also something of interest for hill farmers. In the Bacteriological Department, the work on clover organisms continues, and it appears that the soils of certain hill districts contain harmful strains that do not themselves benefit the clover plant, and also prevent most beneficial strains from forming nodules. Some beneficial strains, however, can overcome the harmful effects of the bad strains, and enable the plant to make normal growth. Promising results have been obtained from experiments on the inoculation of these beneficial strains into soils containing the harmful ones.

The Report includes a review by Dr. W. Brenchley of thirty years' work of the Botanical Department (1906–36). The problems tackled by this Department have been many and varied. The work on boron in relation to plant growth is one of many interesting landmarks in this survey. A chance observation directed attention to the possibility that this element might be essential for plant growth, and it was established conclusively by later work that boron is essential for the growth of many plants, the meristematic tissues being affected in its absence. Dr. Brenchley is perhaps best known in the agricultural world for her researches on weed eradication, work that demanded a number of surveys to ascertain how far weed species, or groups of these, are associated with particular soils or crops.

The survey concludes with an account of the work on the Park grass plots, in which various aspects of grassland management have been studied, such as the influence of season and manuring upon the botanical composition of the herbage from year to year.

Separation of Isotopes

AN interesting report by G. Champetier (*Bull. Soc. Chim.*, (5), 3, 1701; 1936) deals with the separation of the isotopic forms of elements.

The proportion of the isotopes in an isotopic mixture is very variable. In hydrogen, the atomic ratio is $^{3}H : {}^{2}H : {}^{1}H = 7 \times 10^{-10} : 1/5750 : 1$; bromine is a mixture of approximately equal parts of ^{79}Br and ^{81}Br. Apart from the well-known case of the isotopes of lead produced by the radioactive changes of uranium (^{206}Pb) and thorium (^{208}Pb), slight differences in the atomic weights of different specimens of natural elements have been found. A difference of 0·000108 in atomic weight between atmospheric oxygen and oxygen from the water of Lake Michigan has been reported. Small differences in density of water from the surface and from the depths of the sea in various localities are probably due to separation of light and heavy water by gravity. The first quantities of water collected in rain are heavier than the following, whilst snow and glacier water is lighter than ordinary water. These separations are due to differences in vapour pressure and melting point. Water from the wood or dry leaves of a tree is heavier than normal water. All these differences are very slight.

The artificial separation of isotopes has been achieved in various ways. Neon has been separated by fractional diffusion; mercury, zinc, potassium and chlorine (as hydrochloric acid) by distillation at very low pressure; minute quantities of the lithium isotopes, ^{6}Li and ^{7}Li, and more appreciable amounts of the potassium isotope, ^{39}K, by the mass-spectrograph; and neon, hydrogen, water, ammonia, carbon tetrachloride and oxygen by fractional distillation.

The diffusion method gives better results. If x_0 and y_0 are the volumes of the two constituents in the original mixture, and x and y the volumes remaining after diffusion, the enrichment coefficient $r = \frac{y}{y_0} \div \frac{x}{x_0}$ is related to the isotopic masses m_1 and m_2 by the equation

$$r = a\sqrt{V_0/V}$$

where $a = (m_1 + m_2)/(m_1 - m_2)$; $V_0 = x_0 + y_0$; $V = x + y$. The values of a for HD and H_2 is 5, for neon 21, and for $^{18}O^{16}O$ and $^{16}O^{16}O$, 33. The diffusion method has been particularly used by Hertz, who has used batteries of porous clay tubes in series, and also by diffusion into mercury vapour of the pumps circulating the gas. In the first method, pure ^{20}Ne has been obtained, and in 8 hours 1 c.c. of pure D_2 from a mixture containing only 1 in 1000 of D_2. Recently, a partial separation of the carbon isotopes ^{12}C and ^{13}C has been achieved by diffusion of methane. Diffusion of hydrogen and deuterium through heated palladium has also been used.

The electrolytic method is the one most successfully used in the separation of hydrogen and deuterium from water. A slight separation of the oxygen isotopes is also effected, but it has been calculated that, to obtain 1 c.c. of $H_2{}^{18}O$ by this process, it would be necessary to electrolyse more water than is found on the surface of the earth. In an attempt to separate the tritium isotope, ^{3}H, from water, 75 tons of water have been reduced to 0·5 c.c., when the ^3H content rose from 7×10^{-10} to 7×10^{-6}.

Separation of isotopes has also been achieved by chemical means. These generally make use of the so-called exchange reactions, of which the following are typical:

$$NH_3 + HOD \rightleftharpoons NH_2D + H_2O ;$$
$$2H_2{}^{18}O + C^{16}O_2 \rightleftharpoons 2H_2{}^{16}O + C^{18}O_2.$$

The photochemical method is probably capable of extension. Phosgene, $COCl_2$, containing the chlorine isotopes 35 and 37, is exposed to light, when the molecules containing only ^{35}Cl are preferentially decomposed (in presence of a trace of iodine). The free chlorine is absorbed by mercury and has an atomic weight lower than normal. Preferential photochemical oxidation of the mercury isotopes has also been achieved.

University Events

BIRMINGHAM.—The degree of D.Sc. has been conferred on the following: Donald Parkinson (geology) for papers on "The Faunal Succession in the Carboniferous Limestone and Bowland Shales at Clitheroe and Pendle Hill", "The Carboniferous Succession in the Slaidburn District of Yorkshire", and other papers published in the *Quarterly Journal of the Geological Society* and elsewhere; Robert Anthony Robinson (chemistry) for "Investigations on the Thermodynamic Properties of Aqueous Solutions of Electrolytes" published in the *Transactions of the Faraday Society* and for other papers; Horace Augustus Thomas (electrical engineering) for papers on the "Frequency Stabilisation of Valve Oscillators" and "Developments in Rotating Radio Beacon Transmitters and Receivers", published in the *Journal of the Institution of Electrical Engineers*.

CAMBRIDGE.—The Clerk Maxwell scholarship has been awarded to E. Bretscher of Fitzwilliam House.

DR. SIMON FLEXNER, emeritus director of the Rockefeller Institute of Medical Research, has been appointed Eastman visiting professor in the University of Oxford for the academic year 1937–38. The professorship was founded by the late George Eastman of Rochester, U.S.A., to provide for scholars in American universities to go to Oxford as visiting professors for terms of one to five years.

THE Rhodes Trust has issued a statement for 1935–36 showing the distribution of the Rhodes scholars (95 from the British Empire, 90 from the United States and 5 from Germany) among the various subjects (either in the final honour schools or for research degrees) chosen by them. It shows a large majority under the headings natural science and medicine (62), philosophy, politics and economics (41), and jurisprudence and B.C.L. (32). Next come modern history (14), English (13), mathematics (8), Litt. Hum. (7), economics (6), geography (3), modern languages (2), theology (1) and education (1). Of the 16 who obtained honours in philosophy, politics, and economics, 12 were from the United States, 2 from Canada and 2 from Africa.

Science News a Century Ago

J. D. Forbes's Work on Terrestrial Magnetism

ON January 3, 1837, in a letter to Arago, J. D. Forbes said: "I write to mention some results respecting terrestrial magnetism at which I have lately arrived. In 1832 I made an extensive series of experiments with Hansteen's Intensity Apparatus in the Alps, and in 1835 in the Pyrenees. One principal object was to ascertain the influence of heights. I doubt extremely whether any decided result can be drawn from preceding observations. . . . Those of M. Kuppfer seem to be of little value. They were not made at the summit of the Caucasus. . . . I have referred the positions of my stations in the Alps and Pyrenees to the three co-ordinates of latitude, longitude, and height, and deduced the influence of each. . . . I have in the first instance confined my calculation to horizontal intensities. From three different series of observations, made with two needles, I find always a negative co-efficient of the height, indicating, at a mean, a diminution of ·001 of horizontal intensity for 3,000 feet of vertical ascent. If, as Humboldt states, the dip diminishes in ascending, the diminution of total intensity will be somewhat greater. You will judge of the extent of the inductions upon which this is founded when I mention that the sum of the heights to which I have carried Hansteen's apparatus exceeds 160,000 feet, or thirty vertical miles, twelve *lieues*".

Airy at Greenwich Observatory

IN his review of the events of 1837, Airy in his autobiography said: "My connection with Cambridge Observatory was not yet finished. I had determined that I would not leave a figure to be computed by my successor. In October [1836] I had (at my private expense) set Mr. Glaisher to work on reducing the observations of Sun, Moon, and Planets made in 1833, 1834 and 1835; and subsequently had the calculations examined by M. Hartnup. This employed me at times through 1837. I state here, once for all, that every calculation or other work in reference to the Cambridge Observatory, in this and subsequent years, was done at my private expense".

"On Jan. 3rd," Airy wrote, "I gave notice to the Admiralty that I had finished the computations of Groombridge's Catalogue, and was ready to print. The printing was authorized and proceeded (the introduction was finished on Nov. 22nd) but the book was not quite ready till the beginning of 1838". For furthering the magnetical work at Greenwich more ground was necessary. When the Visitors met in 1836, a suitable site was chosen and in 1837 "on Jan. 3 I was informed unofficially by Mr. Wood (Admiralty Secretary) that the addition of the Magnetic Ground was sanctioned".

Among other entries relating to 1837 is that in which Airy says "In the month of July the Admiralty wished for my political assistance in a Greenwich election, but I refused to give any".

Botany of Battersea Fields

AT a meeting of the Botanical Society held on January 5, 1837, a communication was read by the curator, Mr. Daniel Cooper, author of "Botanical Rambles within Thirty Miles of London", on the distribution of the localities of wild plants in Battersea Fields. It was accompanied by a map of the district to a scale of 2 feet to the mile, with the locality of the plants shown. Mr. Cooper said that the Battersea Fields had been for years past famous for the profuse supply of specimens of interest to the naturalist, particularly to the botanist. Of the 104 natural orders of British flowering plants mentioned in Dr. Lindley's first edition of his synopsis of the "British Flora", "61 are found in this locality; of the 503 genera, 214 are here distributed; lastly, out of the 1500 estimated species of British flowering plants 406 are here dispersed".

Cooper, who was trained in medicine and became an assistant in the zoological department of the British Museum, died at Leeds on November 24, 1842, at the early age of twenty-five years.

A Stephenson Locomotive in Russia

QUOTING from a letter from St. Petersburg dated December 14, 1836, *The Times* of January 6, 1837, said: "The locomotive engine made by Mr. Stephenson of Newcastle-upon-Tyne was tried on the 11th on the iron railroad from Paulowsk to Kouzmino. Notwithstanding the extreme severity of the weather a crowd assembled to witness the experiment, the interest of which was increased by the fact that an apparatus of four brushes had been affixed to the engine, for the purpose of clearing the snow from the rails; the apparatus succeeded completely. The engine drew eight waggons or carriages, containing 256 persons, from Paulowsk to Kouzmino, a distance of 7 wersts, or a full German league in 17 minutes, and returned in the same time. . . . On this occasion birchwood was used as fuel, in order to prove that coal is not indispensable, although there is no doubt that with coal the velocity would be considerably increased".

Societies and Academies

Edinburgh

Royal Society, December 7.

A. M. Hain: Microphthalmia and other eye-defects throughout fourteen generations of albino rats. The affected rats were healthy, vigorous animals, but the female parent of such rats rarely littered again after giving birth to young with defective eyes. Analyses of selected matings showed that, out of a total of 154 defectives, only 8 were born to defective parents, whereas 132 were born to normal parents with defective antecedents. The mode of inheritance was not straightforward; the data are consistent with the existence of a dominant factor with a poor expression which is conditioned by genetic and physiological modifiers.

H. P. Donald and Miss Rowena Lamy: Ovarian rhythm in *Drosophila*. In *Drosophila pseudo-obscura* an ovarian rhythm is present which is characterized by the ripening and laying of eggs in batches with long periods of rest between bursts of oviposition. The form of the rhythm varies according to age and to absolute fecundity as measured over a period of days. In *D. funebris* and *D. melanogaster* no rhythm has been observed, but in the former there is a distinct tendency to lay during the daytime. Examination of the ovaries provided consistent results.

R. A. Sampson: Studies in clocks and timekeeping. (6) The arc equation. In 1930, the clock "Shortt No. 4" showed evidence of the mutual effect of variations of pressure, arc and rate. Observation revealed that the effect of pressure upon arc increased as pressure diminished; ultimately a balance obtained, and further reduction of pressure made the clock go slower in place of faster. The experimental question of the effect of arc upon rate is indeterminate at any one mean pressure. At full exhaustion, the whole circular error should presumably appear. Investigation is made whether it appears full at other pressures, with comparison with the experiments of other authorities.

J. Small and I. K. Johnston: Quantitative evolution in Compositæ. The frequency distribution of generic sizes in Compositæ agrees reasonably well with the calculated frequency distribution, using Yule's formulæ. The ages in doubling-periods for the subtribes within tribes show a clear seriation with previously suggested order of origin. The *Dp*-ages of both tribes and subtribes show a complete seriation with suggested times of origin when averages are taken for each of the geological periods concerned, and this seriation extends to the subdivisions of both Pliocene and Miocene.

Moscow

Academy of Sciences (*C.R.*, 3, No. 7; 1936).

S. Sobolev: Limited fundamental problem for polyharmonic equations in a domain of indefinite contour.

M. Poljakov and K. Grjanenko: Role of the solid phase in the ignition of combustible mixtures.

A. Polesickij and P. Tolmačev: Solubility and activity of the halogenates of some bivalent metals. (3) The solubility and activity of $Ra(IO_3)_2$ in water and in solutions of electrolytes.

M. T. Lindtrop and J. M. Tolmačev: Spectral analysis of mineral waters.

M. F. Neiburg: Stratigraphy of the Trias in the Kuznetsk basin.

V. A. Zilberminz and E. M. Bonstedt: The diamond from the new deposit in the Syuren River basin (Bashkiria).

G. M. Pohakadze: New data on chromosome number in domestic sheep.

R. L. Dozorceva: (1) Sex-linked heredity in *Pteromalus puparum*. (2) The morphology of chromosomes in the ichneumon, *Pteromalus puparum*.

V. M. Katunskij: (1) The causes of pre-floral and post-floral movements of peduncles and scapes (in the genera *Papaver*, *Crepis* and *Tussilago*). The movements are due to a growth-promoting hormone developed in the growing ovules of flower buds. (2) The development of the female gametophyte and the production of the growth-promoting hormone by flower buds.

G. G. Kolumycev: Winter hardiness and earliness of wheats.

(*C.R.*, 3, No. 8; 1936).

W. K. Turkin: Quasi-normalizers of the elements in finite groups.

D. Iwanenko and A. Sokolov: The law of force between heavy particles.

G. S. Landsberg and V. J. Malyšev: The rays of second order in the Raman spectra.

V. Veksler and B. Isayev: Measurements of intensity of X-ray radiation with a proportional amplifier.

F. M. Šemiakin and A. I. Lazareva: Undulating cracks and periodic crystallization in gelatine gel in the formation of mercury carbonate.

I. A. Smorodincev and N. V. Nicolaeva: Modification of cathepsine in the case of autolysis of muscular tissue.

I. A. Ledikas: The *Oncophora* strata in the Dnieper region.

N. Vedenejeva and S. Grum-Gržimajlo: The spectropleochroimeter and investigation of dichroism in minerals.

A. A. Meniajlov and S. I. Naboko: The question of the occurrence of platinum in the Far East.

N. G. Cholodnyj: The theory of vernalization.

V. E. Šestakov: Frost resistance of winter crops during the light stage.

V. E. Šestakov and A. D. Smirnova: Temperature hardening and the differentiation of the embryonic spike in winter wheats during the light stage of development.

Rome

Royal National Academy of the Lincei
(*Atti*, 23, 543–641; 1936).

A. Russo: Chemical nature, increment and reversibility of chondriome.

W. Blaschke: Integral kinematics.

L. Campedelli: An observation on the plurigenera of the elliptic surfaces of genus $P_g = 0$.

G. Palamà: Generalization of the formulæ of Newton and of Waring.

G. Scorza Dragoni: Regarding a theorem of Caccioppoli on the conformal representation of surfaces.

G. Andreoli: 'Flutter' in wings.

A. Galli: Vibrations of an elastic system with inert and elastic links.

M. Manarini: Vectorial homographies with kinematic applications in S_n spaces (2). Homographies which are the product of two axials.

E. Pistolesi: Problem of the rotating wing.

E. Volterra: Plane elastic arches (2).

L. Gialanella: Moment of the quantities of motion of the planetary system, and the cosmogonic hypothesis of Laplace.

P. Guareschi: Viscosity of gases.

G. Bergami, E. Bobbi and P. Baer: Colorimetry during the period of development of colour.

G. Centola: Hydration and structure of starch.

A. Galamini: Alcoholæmic curve and experimental beriberi (1). Course of cardiac activity during asphyxia (2).

V. Zagami: Behaviour of creatin bodies and of urinary sulphur and chlorine during fasting and subsequent feeding (1).

V. Zagami and V. Capraro: Behaviour of creatin bodies and of urinary sulphur, phosphorus and chlorine during fasting and subsequent feeding.

Vienna

Academy of Sciences, October 15.

Leo Pollak and Gabriele Fehér: Influence of insulin on the distribution of injected galactose among the organs of the body.

Alfred Ebel and Hans Mautner: Action of glycocol on normal guinea pigs and those poisoned with diphtheria toxin.

Oskar Peczenik and Ludwig Popper: The posterior lobe of the pituitary and the thyroid gland.

Julius Pia: Survey of the chalk Algæ of the carboniferous limestone.

Hermann Tertsch: Abrasive hardness of barytes.

Franz Kahler: The peri-Adriatic region east of Villach.

Karl Rinner: Wiener's imaginary projection.

W. J. Müller and E. Löw: Theory of corrosion phenomena (5). Application of the pore theory of corrosion to the phenomenon of Thiel and Eckell's difference effect.

W. J. Müller: (1) The local current theory of metal potentials and its application to the behaviour of metals in oxygen-free solutions. (2) Theory of corrosion phenomena (6). Experimental determination of the potential of a working anode and the potentials and resistances responsible for the 'local elements.

E. Abel, H. Schmid and F. Pollak: Kinetics of the oxidation of ferrous ions by nitric acid.

Otto Redlich and Josefa Zentner: Latent heat of fusion of mixtures of heavy and ordinary water.

Robert Sandri: Measurement of the heat of reaction of slow reactions.

A. and R. Skrabal: Dynamics of the formaldehyde-bisulphite reaction.

A. Rollett, R. Birkner and K. R. Posselt: Azo-colours.

A. Franke and A. Kroupa: Cyclic ethers from glycols.

K. Freudenberg: Determination of the constitution of natural substances of high molecular weight.

W. N. Haworth: Size of polysaccharide molecules.

H. Holter and K. Linderström-Lang: Distribution of enzymes in protoplasm.

E. Philippi, F. Hendgen and F. Hernler: Synthesis of doubly substituted 6,6-dihydrouracil.

St. J. v. Przylecki: The properties of proteins as a function of their fine structure.

R. Seka and G. Prosche: A new synthesis of chrysin and other oxyflavones.

E. Späth: Natural cumarin and its action on fish.

G. F. Hüttig: Reactions involving solid substances.

G. Jantsch and K. Klein: Halides of the rare earths (10). Melting points, with particular reference to the bromides.

G. Jantsch and E. Wiesenberger: Compounds of the rare earths involving high valencies (2). Dysprosium oxide.

R. Kremann and O. Fruhwirth: Ultra-violet absorption and orientation polarization of binary mixtures. Allyl mustard oil and piperidine.

W. Lotmar and H. H. Meyer: Fine structure of crystallized caoutchouc.

W. J. Müller and E. Nachtigall: Passivity (30). Anodic passivity of magnesium in acid solutions.

W. Pauli and A. Baczewski: Preparation of a platinum sol (2). Platinum hydrosol.

I. N. Stranski: Calculation of the specific surface, edge and corner energy of small crystals.

Karl Schwarz and Rudiger Stockert: Diffusion constant and valency of silver in liquid silver amalgams.

G. Breuer and J. Schnitzer: Cyclohexylamine and N-dimethylcyclohexylamine.

F. Lindmair: Accuracy of trichromatic colour measurements.

F. Seidl: Electrical conductivity of solidified melts of Rochelle salt crystals.

Ph. Furtwängler and O. Taussky: Skew circles.

Ph. Furtwängler: A theorem on determinants.

Forthcoming Events

Wednesday, January 6

INSTITUTE OF WIRELESS TECHNOLOGY (LONDON AND HOME COUNTIES SECTION).—H. J. Barton Chapple: "High Definition Television".

Thursday, January 7

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—B. L. Goodlet: "Lightning".

Friday, January 8

ROYAL SOCIETY OF ARTS, at 3.—Prof. G T. R. Hill: "How We Fly" (Dr Mann Juvenile Lectures. Succeeding lecture on January 13).

Saturday, January 9

BRITISH ECOLOGICAL SOCIETY, at 10.30.—Annual General Meeting to be held at University College, Gower Street, London, W.C.1.

Dr. W. H. Pearsall · "The Soil Complex in Relation to Plant Communities" (Presidential Address).

CONFERENCE OF EDUCATIONAL ASSOCIATIONS, January 4–11.—Twenty-fifth Annual Conference to be held in University College, Gower Street, London, W.C.1.

January 5, at 5 p.m.—The Right Hon. W. Ormsby-Gore: "Some Educational Problems of our Colonial Empire" (Presidential Address).

MATHEMATICAL ASSOCIATION, January 4–5.—Annual meeting to be held in the Institute of Education, Southampton Row, London, W.C.1.

January 4, at 3.15.—Prof. A. R. Forsyth, F.R.S. · "Applied Mathematics in School Training. Some General Considerations" (Presidential Address).

PHYSICAL SOCIETY, January 5–7.—Annual Exhibition to be held at the Imperial College of Science, South Kensington, S.W.7.

January 5.—Sir James Swinburne: "Electrical Measurements in the 'Eighties, particularly those associated with Ayrton and Perry".

January 6.—Dr. Harry Moore · "The Influence of Industrial Research on the Development of Scientific Instruments".

SCIENCE MASTERS' ASSOCIATION, January 5–8.—Annual Meeting to be held at the University of Manchester.

Dr. J. S. B. Stopford, F.R.S.: "Aims of Biology in Education" (Presidential Address).

CONFERENCE ON MECHANIZED FARMING, January 5–8.—To be held at Rhodes House, Oxford.

GEOGRAPHICAL ASSOCIATION, January 5–7.—Annual Conference to be held at the London School of Economics, Houghton Street, Aldwych, London, W.C 2.

January 7, at 10.—Sir Josiah Stamp. "Geography and Economic Theory" (Presidential Address).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

PROFESSOR OF PHYSICAL CHEMISTRY in the University of Cambridge —The Vice-Chancellor (January 30).

UNIVERSITY DEMONSTRATOR IN PATHOLOGY in the University of Cambridge—Dr F. J. W. Roughton, Physiological Laboratory (March 1).

Official Publications Received

Great Britain and Ireland

Sale of Food and Drugs: Extracts from the Annual Report of the Ministry of Health for 1935–36 and Abstract of Reports of Public Analysts for the Year 1935. Pp. 16. (London H.M. Stationery Office.) 3*d*. net [1412

ULAWS (The University of London Animal Welfare Society) Tenth Annual Report, 1st October 1935 to 31st July 1936 Pp 48 (London · The University Union) [1412

An Experiment in Co-operative Research in the Cotton and other Textile Industries. By Dr Robert H. Pickard. (Eighth Gluckstein Memorial Lecture, 1936.) Pp 19 A Chapter in the Chemistry of Essential Oils. By Prof. John Read (Nineteenth Streatfeild Memorial Lecture, 1936.) Pp. 34 (London Institute of Chemistry) [1412

University College of Wales, Aberystwyth Survey of the Work of the Agricultural Departments, submitted to the Court of Governors of the College on 21st October 1936 Pp 185. (Aberystwyth University College of Wales) [1512

Other Countries

Svenska Hydrografisk-Biologiska Kommissionens Skrifter Ny Serie, Hydrografi 12 Interne Wellen im Kattegatt. Von Borje Kullenberg Pp 17. Ny Serie, Hydrografi 13 · Untersuchungen von Tragheitsstromungen in der Ostsee. Von T Gustafson und B Kullenberg. Pp. 28 Svenska Hydrografisk-Biologiska Kommissionens Fyrskeppsundersokning År 1933. Pp. 45. (Gåseberg. Svenska Hydrografisk-Biologiska Kommissionen.) [1412

Bulletin of the Central Meteorological Observatory of Japan. Vol. 5, No 2 · The Second Polar Year Report, No. 2. Magnetic Observations at Toyohara. Pp. iii+170+28 plates. (Tokyo: Central Meteorological Observatory.) [1412

Journal of the Faculty of Agriculture, Hokkaido Imperial University Vol. 39, Part 3: Studies on the Young Fruit-Rot of Apple-Tree. By Yoshichika Shima. Pp. 143–270+plates 3–9. (Tokyo. Maruzen Co, Ltd) [1412

Report of the Institute of Scientific Research, Manchoukuo Vol. 1, No. 1 *Ostericum* and *Angelica* from Manchuria and Korea By Masao Kitagawa. Pp. 28+10+3 plates. Vol 1, No. 2 · Studies on Mongolian Sheep Wool, I. By Dr. Michio Saito. Pp 29–62+11–17. (Hsinking · Institute of Scientific Research.) [1412

Publikace Pražské Státní Hvězdárny No 9 · Observations photographiques de la planete Eros en 1931. Par V Nechvíle, en collaboration avec V. Guth, J Štěpánek et feu J Kaván. Pp. 10. No. 10. Sur les methodes de reduction des observations astrographiques et le calcul des positions d'Eros en 1931. Par V. Nechvíle Pp 34 (Prague Pražské Státní Hvězdárny.) [1512

U S. Department of Agriculture. Circular No. 409. The Effect of Thallium on Plant Growth. By E E. Horn, Justus E. Ward, James C. Munch and F E. Garlough. Pp 8 (Washington, D.C Government Printing Office.) 5 cents. [1612

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association Agricultural and Chemical Series, Bulletin No 50 Soil and Plant Material Analyses by Rapid Chemical Methods By Francis E Hance. Pp. 187–300. (Honolulu: Hawaiian Sugar Planters' Association) [1612

Cornell University. Agricultural Experiment Station. Bulletin 652 Storage and Germination of Seeds of Aquatic Plants. By W C Muenscher Pp 17. Bulletin 653: Soils in relation to Fruit Growing in New York Part 9. Tree Behavior on Important Soil Profiles in the Newfane–Olcott Area, Niagara County. By Joseph Oskamp. Pp. 20 Bulletin 656 Use and Value of Highways in Rural New York. By W. M. Curtiss. Pp. 30. Bulletin 657. Local Government in Tompkins County, New York By T. N. Hurd. Pp. 44. Bulletin 658. Variations in Town Taxes in New York By M. P. Catherwood Pp 44. Bulletin 659. Receipts and Expenditures of 876 New York Towns in 1934. By M. P. Catherwood. Pp 50. Bulletin 660 · The Vitamin-G Requirement of Poultry By L C Norris, H S Wilgus, Jr., A. T. Ringrose, Victor Heiman and G. F. Heuser. Memoir 190: Some Factors influencing Growth and Fruit-Setting in the Pepper (*Capsicum frutescens* L) By H. L Cochran Pp. 39. Memoir 191 · Effect of Relative Humidity on the Growth of Mold on Eggs in Storage By Paul F. Sharp and George F. Stewart. Pp. 12. (Ithaca, N Y Cornell University.) [1612

Zoologica Vol. 20, No. 3 · Deep-Sea Fishes of the Bermuda Oceanographic Expeditions. No 3. Family Serrivomeridæ. By William Beebe and Jocelyn Crane Pp. 53–102. (New York: New York Zoological Society.) [1612

Catalogues, etc.

Neue Bucher fur naturwissenschaftlich Gebildete. Pp. 16. (Jena: Gustav Fischer.)

Calendar for 1937. (London: British Museum (Natural History))

Modern Gas Equipment for Laboratories. (GT 1167.) Pp. 12. Toxic Gases Detection Apparatus. (GT 1165.) Pp. 2. (London. Griffin and Tatlock, Ltd)

A Catalogue of Rare and Valuable Works. (No. 528.) Pp. 160 (London · Bernard Quaritch, Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 2, No. 11, December. Pp. 31–44+iv. (London: Wild-Barfield Electric Furnaces, Ltd)

Caxton Head Bulletin No. 20. Pp. 30 (London: James Tregaskis and Son.)

Catalogue of Watson Microscopes. Parts 1 and 2. Microscopes and Accessories for all the Biological Sciences. Thirty-sixth edition. Pp. 260. (London W Watson and Sons, Ltd.)

Calendar for 1937. (London. The *Chemical Trade Journal*.

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National Museums of Natural History

AT the present day most States possess their national museums, in which are exhibited long ranges of animals, plants, fossils and rocks. Many of their larger cities support their own local museums, regarding them as centres of culture and of education. Such smaller museums cater for a local population, and for the most part their exhibits centre round their own localities. They are generally connected with the local education authority and with a local university if such exists. The interests of national museums, on the other hand, extend farther afield. They usually attempt to show a world range in their exhibits, while displaying with especial care the organisms of their country. They thus are associated with the higher education of their nation, specialists in the biological sciences usually passing some part of their student days in study within their walls.

This association of natural history museums and teaching is well seen in the study of their foundation and history. Sir Richard Owen, in a Royal Institution lecture in 1862 "On the Extent and Aims of a National Museum of Natural History", after discussing the foundation by Prof. Louis Agassiz of the Museum of Comparative Zoology at Cambridge, Massachusetts, went on to remark (p. 110) that "the instances of the most rapid advance and perfection of Natural History Museums have all been associated with the fact of their curatorships by professors notable for their successful public teachings of the science; as, for example, the Botanical Museum at Upsal, under Linnæus; the Anatomical and Palæontological Collections at Paris, under Cuvier; the Zoological Collections at Paris, under Geoffroy St. Hilaire, Lamarck and Latreille". Sir Richard Owen, whose advocacy extending over twenty years induced the Government in 1877 to vote £70,000 for the erection of the Natural History Museum, South Kensington, himself lectured for a long period at the Royal College of Surgeons, where the professor is by the statutes required to give annually not less than twenty-four lectures, a combination of the functions of professor and curator which he urged "on every suitable opportunity".

Owen made the Natural History Museum a national institution, and he was succeeded by Sir W. H. Flower, who had been Hunterian professor at the Royal College of Surgeons, while two of the subsequent four directors had previously been teachers in universities. The reason is obvious; such teaching officers have necessarily to keep themselves abreast of the most recent developments of their science—and such developments constitute the section in any museum most interesting to the public. An art museum may leave very many exhibits on display permanently; indeed, only altering them when a better piece by the same artist is obtained. In contrast a science museum, except in historical exhibits, must be for ever changing as its science evolves. It may be in advance of its public where the perspicacity of its director makes this possible, but it must never lag far behind or it will be deemed to be a collection of 'dry bones', worthy of a visit perchance but useless for study.

In national museums there is, however, a secondary function to which we more particularly wish to refer. Advances in biological science are often founded on definite specimens of animals and plants, living or fossil. Those specimens are the authority upon which the advance is based, and, as at once acquiring historical importance, should be preserved. Universities and teaching institutions may attend to this, but their changing personnel with new interests too frequently neglect or disperse the material on which their predecessors' work was founded. Clearly the only place for a permanent historical record, representing the advances of the nation, is in the national museum, the bias of which is preservative.

Often such research material consists of long series of animals or plants, systematic or taxonomic collections, as they are termed. The species is the unit in biology, because it is something definite in structure, to which a name can be given with a full meaning thereby implied. Besides its exhibition series, a great museum collects and preserves examples of as many species of animals and plants as it can obtain, so that the inquirer has the inestimable advantage of seeing the concrete form rather than being dependent on written description. There are millions of species, and a museum sets out to contain as many type specimens, both male and female, as there are species, or as many as it can secure.

The museum is thus a 'library' of species brought together so that the basal accuracy of science can be maintained. But single specimens of species are not sufficient. There must be added a series of specimens illustrative of such variations as are induced by climate, nutrition and other external factors. These for the same species fluctuate in different countries, and the species from each may have to be preserved. The museum curator is a cataloguer and, so great are the number of species and the diversity of phyla of animals and plants, that he may spend all his life in becoming a specialist in one narrow groove. He may be extraordinarily capable in his own line, but he is in danger of thinking of his organisms as dead material, which is to be merely catalogued on its anatomies. This may be corrected by sending him into the field to collect and study, as is done by most museums, greatly to their and his advantage. Yet withal, he gets little opportunity of thinking of his creatures as essential entities in that single realm of Nature, for which the museum, both in its exhibitions and in research, must stand.

Ideally there should be one great clearing house of species for all countries, but this, with the rivalries of nations and the delays involved by distance, is impossible to attain. Museums try to preserve as many of the specimens used for the original descriptions of species as may be obtained —'types' as they are termed. In practice, museum specialists compare specimens with these original types, and these, if proved by a competent specialist to be the same species, become almost as useful as 'types', the possession of which is only of importance should doubts arise. Each continent has its own museums, many specializing in its fauna and flora, but it is only in Europe and the United States where there are museums—and they are few in number—which try to embrace all species of all countries and which alone can act as efficient clearing houses. Such necessarily great collections can only be developed on national lines, being quite beyond the means of private institutions. This is well illustrated in the British Museum (Natural History) at South Kensington, which employs more than fifty scientific officers mainly in conserving and cataloguing its immense cosmopolitan collections.

Of course naturalists can do without museums in countries where their more happily situated neighbours can give them hospitality in such. Thus difficulties and dangers to science need scarcely be felt in Europe or North America In South America the accurate determination of the flora and fauna is generally impossible since there are not the necessary central collections. South Africa depends partially on Cape Town, while collections from the tropical and northern parts must mostly be referred to London, Berlin or Paris. At present, London has larger collections from their localities than either the Indian or Australian museums, the sole institutions representative of the life of their continents. Here are four museums founded on British culture, of which those of London and Calcutta are in heavy centres of population, while those of Sydney and Cape Town may well one day represent nations in importance akin to the United States.

What relationship, beyond the ordinary courtesies of friendship, exists between these institutions ? We know of no such ties, and we wonder whether the interests of science in our Commonwealth of Nations would not be best served by attempting to develop such links. A free interchange of co-types could do much. The same specialist could determine the species of his group from all the four regions with a distribution of the named specimens to all. But more is wanted, for the taxonomists in all must have the same methods and ideas as to species in their work, and this can be secured by the periodical interchange of members of their staffs. Most are in the employment of their States and would welcome such an interchange. Is it not worth while for their Governments to regularize and encourage such visits, the effects of which may well extend far beyond the limits of pure science ?

The Theory of Dimensions

The Theory of Dimensions and its Application for Engineers
By Dr. F. W. Lanchester. Pp. xxiv+314. (London: Crosby Lockwood and Son, Ltd., 1936.) 12*s.* 6*d.* net.

"THE first business of an author," says Dr. Lanchester in the preface, "is to state clearly the object of his work. . . . This book is written with the primary object of helping the young engineer to acquire a sound knowledge of dimensional theory, a subject which he can no longer afford to ignore." Although the subject forms a part of the curriculum of the engineering courses in all universities, the author maintains that subversive doctrines are being taught, and one of the avowed objects of the book is "to extirpate heresy of this kind", a job which he sets about with evident zest.

Of the 314 pages, about a hundred are devoted to tables of physical constants of the atmosphere, water, steel, fuels, etc., weights and measures, and although they contain much useful information, many of these chapters make little or no mention of dimensions. The rest of the book may be divided into two parts, mechanical and electrical. In the former, the author is evidently on his native heath; he hits out with no uncertain aim and speaks with an authoritative air. In the latter he is admittedly an explorer, feeling his way, asking directions from others, and quoting their opinions. As he says, "No attempt is made in the present work to decide between one system and another; the author has endeavoured to keep an open mind—only he declines to subscribe to any system that does not conform to his axiom," the axiom being that any one physical entity cannot have assigned to it more than one dimensional expression. In the preface he makes the somewhat enigmatic statement that "the fundamental dimensions recognised by physicists are (1) length, (2) mass, (3) time. There are really no others." It is not quite clear whether this is intended to mean that if physicists did recognize any other they would be sinning against a Lanchester axiom, but this doubt is dispelled when, with reference to Everett's statement that the choice of fundamentals is a matter of convenience, he says that it may be so, but, if true, is of little more than academic interest.

After showing that the entity and its dimensions are not one and the same, and that even the concept of velocity is not necessarily associated with length and time, but only becomes so by our definitions and methods of measurement, the author launches into an attack on the 'slug', a unit of mass introduced about fifty years ago by Prof. Perry and apparently still used by some misguided folk. A five-page appendix on the same subject is a sermon on the text, "the evil that men do lives after them".

The chapters dealing with the application of dimensional theory to a large variety of mechanical problems are excellent. In discussing thermal entities, the author regards entropy as a dimensionless numeric, whereas Kaye and Laby give it dimensions; temperature is regarded as having dimensions L^2/T^2, and the heat imparted to a mass to raise its temperature becomes ML^2/T^2, the dimensions of energy. This matter is also discussed in an appendix.

Only forty pages of the book, excluding appendixes, are devoted to electric and magnetic dimensions, but the whole of Rücker's paper on "The Suppressed Dimensions of Physical Quantities" is reprinted as an appendix, as is also FitzGerald's paper on "The Dimensions of Electromagnetic Units", and a paper by Sir J. B. Henderson on "Fundamental Units in Electrical Science".

It is on p. 104 that the author leaves his native element and enters the electromagnetic world. In his opening sentence he says, "Electrical entities depend upon the three fundamentals *L*, *M*, and *T*, as do other derived physical entities discussed in the preceding chapters". It would have been more explanatory of the history of the subject if he had said that they may be made to appear to depend upon *L*, *M*, and *T*, by making certain arbitrary assumptions about which scientific workers have been squabbling for the last fifty years. The same is true of the subsequent statement that "it is agreed by all authorities that electrostatic units and electromagnetic units have different dimensional values although the entities represented may be the same". Is it not that they are made to appear to have different dimensional values by the adoption of different arbitrary assumptions? The electrostatic units of inductance or capacitance may differ largely in magnitude from the corresponding electromagnetic units, but they cannot really have different dimensional values.

Although the author expresses strong disapproval of the unit pole, he has not been bold enough to free himself entirely from it. Much of the confusion and uncertainty which pervade the electric and magnetic units is due to the fact that the classical system is based in part upon an ill-defined unreality, namely, the pole strength of a permanent magnet. If we assume that ferro-, para-, and dia-magnetism are all due to the orbital movements of electrons superposing their effects upon the externally applied magnetomotive force, we are justified in regarding all magnetic phenomena as electromagnetic, and as being manifested in 'non-magnetic' space. In iron, the value of H is enormously increased by the molecular currents, but the relation between B and H is really the same as in air. It is usual, however, among engineers to retain the symbol H for that small component of the magnetizing force which can be ascribed to the externally applied ampere-turns, and to ask no question about the molecular mechanism whereby it produces in iron a magnetic induction B so much greater than in air. In discussing the fundamental relations between electric and magnetic concepts it is very desirable to exclude such complex phenomena as the magnetization of iron and steel and, above all, such a fictitious complexity as a permanent magnetic point-pole of unit strength.

If one must have a magnet of unit pole strength, let it at least be an electromagnet—a coreless solenoid, the current in which can be adjusted to the correct value: a much more convenient procedure than stroking a knitting needle the requisite amount with a bar magnet, even in imagination. Moreover, one is not then likely to pretend that, having measured the force on the unit pole when placed at a given point in the magnetic field, one has determined something called H, whereas, if one had measured the force on a length of wire carrying a current one would have determined something called B. With a solenoid the assumption that the 'polarity' is concentrated at a point is the end of the make-believe, but with a permanent magnet it is but the beginning, for it is assumed that, if immersed in another medium of different permeability, the pole strength is unchanged; but seeing that 'pole strength' is a fiction which has only been defined in air, it is meaningless to say that it remains unchanged in another medium. When driven to be precise, most physicists would probably admit that they assume the total flux to remain constant, but such an admission undermines the basic nature of the unit pole.

In my opinion, we are concerned in reality with only two forces, namely, that between charges at rest and that between charges in motion, that is, between currents. Just as we write the gravitational formula

$$f = G\frac{M.M'}{L^2}$$

with a dimensional constant, so for the same reason we write (omitting trigonometrical coefficients and signs of integration)

$$f = \frac{1}{K}\cdot\frac{q}{r^2}\cdot q \quad \text{and} \quad f = \mu\,.\,\frac{ids}{r^2}\,.\,ids.$$

The classical formula $f = mm'/\mu r^2$ is merely the latter formula wrapped in mystery.

These two fundamental formulæ may be written

$$f = \frac{1}{K}\,.\,4\pi D\,.\,q = \mathcal{E}\,.\,q,\ \text{where}\ \frac{q}{r^2} = 4\pi D \quad \text{and}$$

$$\mathcal{E} = \frac{1}{K}\ 4\pi D,$$

and

$$f = \mu\,.\,H\,.\,ids = B\,.\,ids,$$

$$\text{where}\ \frac{ids}{r^2} = H\ \text{and}\ B = \mu H.$$

We are here confining our attention to space and not considering the numerical effects of a change of medium on K and μ. It is quite a mistake to imagine that the distinction between H and B is necessarily associated with ferromagnetism or with any assumptions as to its nature. The same applies to the distinction between D and $\mathcal{E}$, which is not necessarily associated with phenomena in material dielectrics.

The above formulæ are, of course, linked by the relation $i = dq/dt$, from which it follows that both $\mathcal{E}/B$ and H/D have the dimensions of velocity.

It will be seen from the above formulæ that $\mathcal{E}$ and B are measurable characteristics of the electric and magnetic fields, the former by the force on a stationary charge and the latter by the force on a current or moving charge, irrespective of the medium. D and H, however, are not directly measurable concepts. The displacement D is calculable at any point by dividing a charge by the square of a distance, that is, by an area; and similarly the magnetizing force H is calculable by dividing a current by a length. The latter is often expressed in ampere-turns per centimetre and is regarded as a localized cause producing at every point a magnetic induction B depending on the medium. *Similarly D appears as a calculated localized cause producing at every point a condition of space designated by $\mathcal{E}$ depending on the medium*; this is a reversal of the usual conception.

Some readers may object to the time-honoured magnetizing force H being relegated to the realms of unmeasurable concepts, and may quote from Prof. F. A. Lindemann's recent Guthrie Lecture (*Proc. Phys. Soc.*, 823; Nov. 1, 1936) that "a concept is meaningless unless it is in principle possible to observe the quantity which it typifies", but since both current and length will presumably be conceded as observable, their quotient can scarcely be dismissed as meaningless.

The procedure is analogous to that followed in the theory of elasticity and indeed throughout the whole of mechanical engineering. A load, that is, a force, is applied to a member, say, a tensile test specimen, and produces a strain or displacement at every point. One conceives this strain to be due to the stress at the point, this stress being an unmeasurable concept having the dimensions of a force divided by an area. Just as the mechanical engineer pictures the strain at a point as being due to a localized cause which he calls stress, so the electrical engineer pictures the magnetic condition at a point which he calls the magnetic induction B as being due to a localized cause which he calls the magnetizing force H. As the area integral of the stress is equal to the total applied force, so the line integral of the magnetizing force is equal to the total applied magneto-motive force or ampere-turns (neglecting numerical constants). If any reader feels disinclined to agree that mechanical stress is an unmeasurable concept I would refer him to p. 114 of Prof. R. V. Southwell's recently published "Theory of Elasticity", where he says:

> "External loads can be measured, and the displacements of points on the surface of a body (in the case of transparent materials we can make some attempt to measure the displacements of internal points); but *stress* (or internal action) has never been measured directly, and we can assert with some confidence that it never will. In these circumstances all that we can do is to construct a theory on assumptions which are consistent with experimental observations, and to look for confirmation of that theory to tests of particular conclusions—namely, predictions regarding displacements which can be measured."

It is to be noted that the one circuital equation

$$\frac{d\Phi}{dt} = A\,\frac{dB}{dt} = E = \mathcal{E}\,.\,l$$

involves only the directly measurable concepts, whilst the other

$$4\pi A\,\frac{dD}{dt} = m.m.f = H\,.\,l$$

involves only the non-measurable concepts.

On p. 299 of his book, Dr. Lanchester says, "In the opinion of the author it [μ_0 the permeability of space] is a mere number, a numeric". We can only say that we have failed to find anywhere in the book any valid reason, other than convenience, for this assumption, and that we have set out the above formulæ with the intention of showing clearly that there is no more reason for regarding μ_0 as a numeric than there is for making this assumption with regard to K_0. If, however, one assumes either explicitly or implicitly that a permanent magnet pole measures H, whilst a current-carrying conductor measures B, and then assumes that a permanent magnet is a conglomeration of molecular currents, it is little wonder that when one puts $B = \mu H$, one is able to prove that μ is merely a numeric.

In Appendix V, Sir James Henderson quotes Maxwell in support of the view that μ_0 is a dimensionless numeric, but the support is very unconvincing and one sentence is definitely against this view. The author attempts to brush this aside with the suggestion that Maxwell was nodding when he wrote the sentence, and he even goes so far as to rewrite it for him—to "re-mould it nearer to the Heart's Desire". We prefer to adopt a humbler role and to suggest that the quotation is by no means convincing that by "identical" Maxwell meant dimensionally and not merely numerically identical in the electromagnetic system of units, as the sentence which he dislikes certainly suggests. When Maxwell appears to support his view his "vision was wonderful"; when the support appears doubtful Maxwell's "clear view was obscured".

In Appendix VII Dr. Lanchester disagrees with Giorgi and the S.U N. Commission of the International Union of Pure and Applied Physics and concludes that "the M.K.S. or Giorgi system requires that the new unit of μ_0 shall be 10^7 c.g.s. units and not 10^{-7} as given in the various reports and memoranda". μ_0 is not a symbol for permeability but for one special permeability, namely, that of space, and we do not know what the author means by "the new unit of μ_0". He seems to have been confused by the unfortunate wording of the Report of the S.U.N. Commission, which stated that "the 'fourth unit' of the M.K.S. system is 10^{-7} henry per metre, the value assigned on that system to the permeability of space" This is very misleading. In the M.K.S. Giorgi system in which the absolute units of current, resistance, etc., are the ampere, ohm, etc., a medium to have unit permeability must be 10^7 times as permeable as space, and therefore the permeability of space, μ_0, is 10^{-7}, if expressed in M.K.S. Giorgi units. A further source of confusion is probably the introduction of the unit of inductance, the henry, into the definition, for although the dimensions of inductance are those of permeability multiplied by a length, its numerical value involves such things as the number of turns, and we have always regarded its inclusion in the Report as meaningless. It is not surprising that Dr. Lanchester has found it very confusing.

How much trouble has been caused by the persistent attempts to force by hook or by crook the electromagnetic concepts into the framework of L, M and T? Nothing in this book is more reasonable than the concluding paragraph of Rücker's paper, namely, that by not suppressing the secondary fundamental units such as μ and K,

> "I think that the symbols are thus made to express the limits of our knowledge and ignorance on the subject more exactly than if we arbitrarily assume that some one of the quantities involved is an abstract number."

The Giorgi suggestion to regard one of the electromagnetic concepts as fundamental is in keeping with this. If permeability be thus adopted as fundamental, there can be no question of its dimensions. The dimensions of length, mass, time and permeability are then L, M, T and 'μ', and just as certain values of the first three (C.G.S. or M.K.S.) are taken as units, so in the Giorgi system, unit permeability is 10^7 times that of space. All the electromagnetic concepts can be expressed dimensionally in terms of L, M, T and 'μ' without ambiguity and without making arbitrary and unjustifiable assumptions. If, in the future, Nature divulges some secret whereby the limits of our knowledge are extended so that we are able to express 'μ' in terms of L, M and T, the dimensional expressions can then be readily reduced to these three fundamentals; but in the meantime let us be honest with ourselves and not pretend to knowledge that we do not possess.

In Appendix VI Dr. Lanchester attempts to obtain light on the subject by calling in relativity, but seeing that it leads him to the conclusion that "a wave generated by a static charge undergoing acceleration will, in free space, be a wave having only magnetic characteristics, but which when arrested will revert to the static form", whereas "radiation from a magnetic pole or doublet would be wholly static in its manifestations until received and brought to rest", I am forced to conclude that in his search for light Dr. Lanchester has wandered into the outer darkness. In my opinion the author was unwise to include this section in a book the avowed object of which is to help the young engineer. G. W. O. HOWE.

Gmelin's Inorganic Chemistry

Gmelins Handbuch der anorganischen Chemie Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft.

(1) System-Nummer 4: Stickstoff. Lief. 2. Pp. 283–506. 35 gold marks.

(2) System-Nummer 4: Stickstoff. Lief. 3. Pp. 507–854. 55 gold marks.

(3) System-Nummer 4: Stickstoff. Lief. 4. Pp. 855–1038. 25.15 gold marks. System-Nummer 23: Ammonium. Lief. 1. Pp. 242. 28.10 gold marks.

(4) System-Nummer 35: Aluminium. Teil A, Lief. 3. Pp. 451–534. 14 gold marks.

(5) System-Nummer 35: Aluminium. Teil A, Lief. 4. Pp. 535–682. 24 gold marks (Ausland preis, 18 gold marks).

(6) System-Nummer 55: Uran und Isotope, mit einem Anhang über Transurane. Pp. xviii+x+279. 46 gold marks. (Ausland preis, 34.50 gold marks.)

(Berlin: Verlag Chemie, G.m.b.H., 1935–36.)

(1, 2 and 3) THE various hydrides and oxides of nitrogen comprise the subject matter of parts 2 and 3 of the volume on nitrogen, but aqueous solutions of ammonia and the oxyacids are not included. Prominence is given to the preparation of the raw materials used in the industrial synthesis of ammonia. It is pointed out that nitrogen extracted from air is very much cheaper than hydrogen, which comes chiefly from water-gas (51·8 per cent), coke-oven gas (30 per cent) and electrolytic plants (16·67 per cent). The Linde, Claude and Messer processes for extracting hydrogen from coke-oven gas are given very fully, as well as the synthesis of ammonia by the Haber-Bosch, Claude, Fauser and Mont Cenis methods. There is also an account of heavy ammonia, ND_3, which has been obtained pure by the action of deuterium oxide on magnesium nitride.

The action of different types of electric discharge upon air and other mixtures of oxygen and nitrogen is fully discussed, but the well-known processes of Birkeland-Eyde and Pauling are not described, since it is reported that they have been largely superseded and indeed contribute at present less than one half per cent of the world's production of synthetic fixed nitrogen. There is, however, a long list of publications upon the processes.

The fourth section of the volume on nitrogen contains an account of the oxyacids and their derivatives. It is stated that nitrous acid is still unknown in the free state, but its importance has attracted the attention of many investigators. Of the three possible structural formulæ, that one which has a semi-polar double bond is supported by evidence derived from the parachor. Among less familiar substances described are the somewhat evanescent compound nitroxyl, NOH, which polymerizes to hyponitrous acid, and pernitrous acid, O : N.O.OH, an isomer of nitric acid, arising from the interaction of hydrogen peroxide and sodium nitrite.

Compounds of the radical ammonium are so numerous and important that a whole volume has been devoted to its consideration. Sir Humphry Davy was the first to use the term ammonium and to point out its metallic properties, in particular its power of forming an amalgam, although the free radical is not yet known. That the ion has a tetrahedral structure was deduced by W. H. Mills from the optical activity of its quaternary salts. The present issue (Lief. 1) contains a full account of investigations of the system $NH_3 : H_2O$ and of the difficult problems connected with the basicity of ammonia. The extensive use of ammonium nitrate as an important constituent of high explosives was responsible for much work upon the properties of this polymorphic salt, a useful summary of which has been included.

(4 and 5). The production of special surface coatings to aluminium has become so important industrially that a whole part (*A* 3) is devoted to it, while numerous alloys of aluminium are described in another part (*A* 4). Both metals and non-metals are used for surfacing the metal, but whereas the former are chiefly used for decorative effects, the latter are mainly protective and greatly increase the usefulness of aluminium. Of particular interest is the electrochemical oxidation of the surface, the chief electrolytes used being chromic acid (in England), oxalic acid (in Germany and Japan) and sulphuric acid (in America). The last-named process is particularly adapted to the application of organic dyes to the oxide layer.

Alloys of aluminium have also attracted the attention of research workers in recent years to such an extent that some deviation from the general plan of the handbook has been adopted in order to collect together all those alloys which contain more than 50 per cent of aluminium. Special attention is given to alloys with silicon, which mixes with aluminium in all proportions in the liquid state, a simple eutectic system resulting on solidifying. The texture of the valuable eutectic alloy can be greatly improved by the addition of sodium or sodium fluoride.

(6) The technical uses of uranium are still very small in comparison with the amount of material rendered available as by-products in the extraction of radium. Uranium is used as a catalyst in the synthesis of ammonia, in the manufacture of steel, glass and ceramics and in dyeing and photography. A summary is given of the investigation of its isotopes, particularly of actino-uranium, with a probable atomic mass of 235, and of the synthetic radio elements beyond uranium.

Mohammedan Marriage Customs

Marriage Conditions in a Palestinian Village
By Dr. Hilma Granqvist. Vol. 1. Pp. vi +200. 75 Fmk. Vol. 2. (Societas Scientiarum Fennica : Commentationes Humanarum Litterarum, III, 8 and VI, 8.) Pp. 366. 160 Fmk. (Helsingfors : Akademische Buchhandlung ; Leipzig : Otto Harrassowitz, 1931, 1936.)

DR. HILMA GRANQVIST'S book is important both from a methodical point of view and on account of facts recorded in it. Her field studies were restricted to the village of Arṭās, situated south of Bethlehem at the edge of the Judaean desert and inhabited by Mohammedan Arabs. She examined all the information she was able to obtain regarding the marriages that had been contracted in the village during a period of a hundred years—in all, 264 marriages entered into by 199 men—and also procured information concerning a smaller number of marriages contracted by Arṭās women with men in other places. On the basis of her family lists she worked out statistics and compiled tables which formed a complement to the genealogical trees, and round this foundation the rest of her material was grouped.

This method has no doubt obvious advantages. The author writes: "In registering and discussing all the people in the village during four to five generations, we came upon a great many facts which would probably not otherwise have come to light, and the material appeared quite naturally, without having to be suggested in any way." On the other hand, it is a drawback that the genealogical method can be applied only to very limited areas, and it must also be admitted that it has not proved to be a key to so many doors as it has sometimes been supposed to unlock. Dr. Granqvist has widened the outlook by quoting numerous parallels or contrasts, remarks and references, found in printed sources relating both to Palestine and to other Mohammedan countries; but she has wisely relegated them to footnotes in order not to blur the picture given in the text.

Most of Dr. Granqvist's information was obtained from two native women recommended to her by Miss Louise Baldensperger, whose knowledge of Arṭās, where she had lived more than thirty years, was "of inestimable help and value" to the author. Those two informants learned to relate so slowly that their statements could be taken down word for word. The material is thus to a large extent a direct translation of the literal reports given by the women, but very frequently the translation is followed by the Arabic original. This is particularly the case with the copious songs, proverbs and formulæ found in the text, which, consequently, also should make the book a valuable contribution to Arabic dialectology.

The importance of Dr. Granqvist's investigations is enhanced by the fact that they have been made by a woman among women. In a society where the sexes are so secluded from each other as they are in the Mohammedan world, I think that the women can be properly studied only by members of their own sex; but in most cases the writers on Mohammedan marriage customs have been men. The author writes that those who have women as informants are in a specially favoured position, because "the women are very much interested in their conditions and linger with pleasure over things which the men glide over lightly". But as marriage is an institution in which both sexes are concerned, I also think that there are aspects of it which can be properly studied only by men.

A Mohammedan marriage is a complicated procedure, and Dr. Granqvist gives a graphic description of its successive stages. She has chapters on the age of marriage and child betrothal; the choice of a bride; the exchange of bride for bride and the bride price; the betrothal ceremonies and the making of the marriage contract; preparations for the wedding; the fetching of the bride; her arrival in the bridegroom's house; and the wedding week. There are chapters on the married woman in her husband's house and on her relation to her father's house, which are the more interesting since they deal with subjects that have not generally been sufficiently noticed in the literature on Mohammedan marriages. A woman is even after her marriage closely bound to her father's house, and her position in her husband's house is dependent on the esteem she enjoys and the support she can count upon in her old home. In critical situations she takes refuge there; when she is dissatisfied with the manner in which her husband treats her or when she is divorced by him. So also she is protected by her brother: "a man is even more responsible for his sister than for his wife and children".

The people themselves are said to find with surprise how well marriage generally turns out. Polygyny is certainly a disturbing factor; there is a saying that "the co-wife is bitter even if she were honey in a jar". But polygyny is not frequent in Arṭās, and in one great clan altogether lacking. A reason for this is the deficiency of women, which has compelled many men to take wives from other places. The author raises the question whether this deficiency may be due to the high percentage of cousin marriages, in accordance with my finding that in various cases inbreeding is combined with an excess of males. Thus, according to statistics of 1901, the small community of Samaritans at Nablus, who never marry outside of their own body, consists of 97 males and 55 females. Divorce is even less frequent in Arṭās than polygyny, which is contrary to the opinions generally held about Mohammedan peoples. While of the 199 married men 26 are or have been polygynous, only 10 have divorced their wives. The author admits that the infrequency of divorce is probably connected with the poverty of the village and the small number of women, but thinks available statistics would prove that the prevalence of divorce in the Mohammedan world has been greatly exaggerated. This is an altogether exceptional case in which Dr. Granqvist's study of the little Palestinian village has led her to such far-reaching speculations. A chapter on widower and widow concludes her remarkable book, which also contains excellent illustrations from photographs taken by the author.

EDWARD WESTERMARCK.

Die Fermente und ihre Wirkungen

Von Prof. Carl Oppenheimer. Supplement. Lief. 5. (Band 1: Specieller Teil: Haupt-Teil 12.) Pp. xii+641–781. (Den Haag: Dr. W. Junk, 1936.) 10 fl.

THE fifth delivery of this supplement continues the description of those enzymes which attack proteins, namely, the proteases and peptidases. It commences with two chapters of particular and general interest, one containing a discussion of some special questions relating to protein structure and the other being devoted to the question of the simplification of the true proteins by these enzymes. Both are of considerable value at the present time, when so much is uncertain in this intricate field of knowledge, and their study, though far from easy, will be helpful for those workers who are trying to bring some clarity into the subject.

The proteases are described in some detail under the headings of their qualitative and quantitative detection and their separation. About half the volume is devoted to the properties of the peptidases from a number of different aspects.

Magneto-optik (ohne Zeeman-Effekt)

(Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Band 16, Teil 1.) Von Prof. Wilhelm Schütz. Pp. x+378. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936.) 32 gold marks.

PROF. SCHÜTZ has ably carried out the task of co-ordinating and discussing the numerous experimental and theoretical researches on magneto-optics published up to the early part of the year 1936. More than half the book is naturally concerned with the Faraday effect. Since the appearance of Voigt's account of magneto-optics in 1916, much experimental and theoretical work has been done, not only on the normal diamagnetic rotation but also on the selective diamagnetic, the paramagnetic and the ferromagnetic rotations, and a convincing account of these topics is given. An interesting summary of various theories of the Faraday effect begins with the classical electron theory and goes up to the quantum-mechanical theories of Rosenfeld for atoms, and of Serber for molecules. The section under the heading of the transverse magnetic double refraction of light directs attention to the Voigt effect, but is particularly devoted to the Cotton-Mouton effect, for Prof. Cotton's powerful electromagnet has enabled him and his collaborators to obtain and measure effects beyond the ken of other observers. It is interesting to note (p. 218) how the measurement of the transverse magnetic double refraction in nitro-benzol can serve as a measure of the efficiency of an electromagnet.

A third section deals with the magnetic double refraction and dichroism of colloidal suspensions (Majorana effect), and of coarse suspensions of powdered crystals in liquids. In addition to Cotton's work, that of Procopiu at Jassy, Rumania, is prominent here. Experimental work on the magneto-optic Kerr effect is considered under the headings of polar, meridional and equatorial Kerr effects. The Voigt and Snow theories linking up the Kerr and Faraday effects to various optical constants of metals are amply discussed. Adequate mention is made throughout of the researches carried out in various countries, and Prof. Schütz's own important work is modestly treated.

The term 'gauss' is still preferred to 'oersted' as the name of the unit of magnetic intensity, and the plane of the electric vector is called the plane of polarization. Apart from a few trifling mis-spellings of proper names, the book appears remarkably free from defects. N. D.

Keris and other Malay Weapons

By G. B. Gardner. Second edition. Pp. 138. (Singapore: Progressive Publishing Co.; London: Bernard Quaritch, Ltd., 1936.) 6*s*. 6*d*.

THE author provides a complete survey of the *Keris*, enumerating its parts, main types and processes of manufacture. His general classification is clear and convincing, and marks a distinct advance in the study of oriental arms; it will be of special use to museum curators. It is noteworthy that his definitions are given in detail and used consistently. It is now, therefore, possible to classify this interesting local weapon and to discuss its typology with an agreed terminology.

As to its origins, Mr. Gardner quotes the use of the ray sting [*Ikan Pari*] as a *keris*, and directs attention to the thumb and finger grip it demands. He, also, follows Dr. van Stein Callenfels in his early dating (seventh century A.D.) for the all-metal, anthropomorphic *keris* Majapahit. Apart from this strange little weapon, the hilts of *keris* seem to fall into two main groups, based on a bird type and a demon type, both of which are found on the mainland, extending to the Shan area. Both these basic types, when over-foliated, would seem to merge in the well-known Madura 'flower'-hilt, which would, therefore, appear to be secondary. In any event, the *keris* Majapahit remains a little anomalous.

Mr. Gardner's notes upon *keris* magic are of special interest; sword magic has been somewhat neglected in the Orient, and is commoner than extant publications would suggest. K. de B. C.

The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland;

with a Record of Publications issued during the Session 1935–1936. Compiled from Official Sources. Fifty-third Annual Issue. Pp. vii+170. (London: Charles Griffin and Co., Ltd., 1936.) 10*s*. net.

THE fifty-third annual issue of this year-book maintains the high standing that its predecessors have achieved, thus making it an indispensable guide in scientific, technical and other libraries, laboratories, universities, research institutions, etc. The learned societies are classified under fifteen headings, and this, together with a very full index, makes reference a very easy task. Under each society, association, etc., are given the list of officers, details of membership, arrangements for meetings, titles of publications, etc. The fact that all this information is gleaned from official sources makes the volume authoritative and one which is almost unique among the annual publications of reference literature.

Reactions of the Human Machine

By John Yerbury Dent. Pp. 288. (London: Victor Gollancz, Ltd., 1936.) 8*s*. 6*d*. net.

THE author of this lively and well-written book, besides being a medical practitioner, is quite clear that a doctor should also be something of a psychologist. The type of psychology which appeals to him is sufficiently indicated by the title. He has no use for "the older subjective language" which includes words like sensation, consciousness and will. Equally little use has he for the psycho-analytic libido and censor. He sees nothing in the "human machine" except the structure of the organism and its responses to environment. Few psychologists will agree with him; but his method of psychological approach has not prevented him from writing an extremely good book on its own lines, quite intelligible to the layman, and useful also to medical men.

Radium Beam Therapy and High-Voltage X-Rays*

By Prof. A. S. Eve, C.B.E., F.R.S., and L. G. Grimmett,
Radium Beam Therapy Research, London

THE quantity of radium now employed in the treatment of cancer, by the 'beam' method alone, exceeds 120 gm., with a value in excess of £800,000. The Continental names for this method are *telecurietherapie* and *Radiumfernbestrahlung*, while 'radium beam therapy' is the term commonly used in Great Britain. In this method of treatment a considerable quantity of radium (2–10 gm.) is surrounded by a large mass of lead or of tungsten alloy, and a beam of gamma-rays passes from the radium through a hole or window in the lead and is directed at the tumour or glands as may be desirable. A typical modern apparatus is shown in the photograph (Fig. 1).

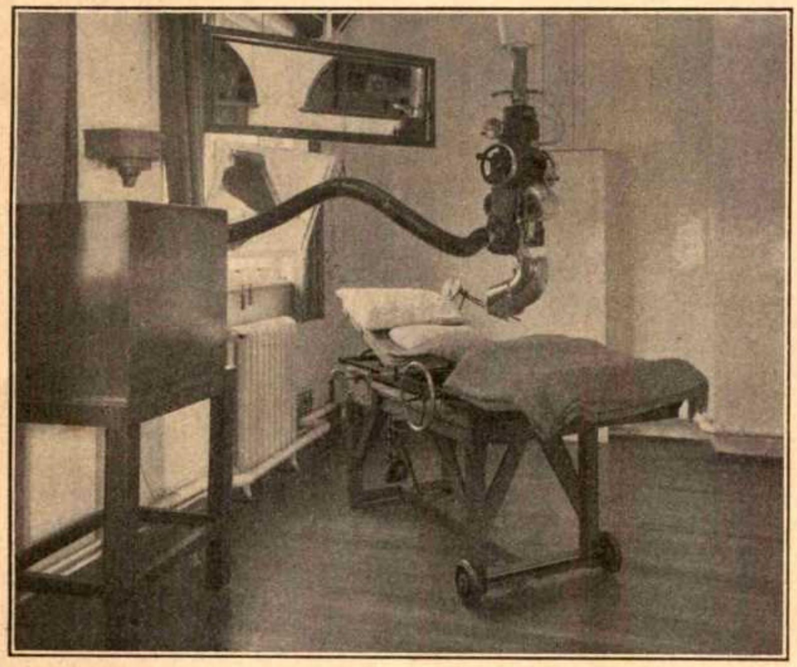

Fig. 1.
THE LATEST 5 GM. RADIUM UNIT OF THE RADIUM BEAM THERAPY RESEARCH, LONDON. THE RADIUM CAPSULE IS TRANSFERRED PNEUMATICALLY TO AND FROM THE LEAD STORAGE-SAFE TO THE UNIT, WHERE THE GAMMA RADIATION IS CANALIZED BY A MASS OF DENSE TUNGSTEN ALLOY. THE BEAM CAN BE ORIENTATED IN ANY DESIRED DIRECTION BY SCREW ADJUSTMENTS, AND THE DOSAGE CAN BE MEASURED AT ANY POINT.

In Table 1 is a list of institutions which are equipped for radium beam treatment.

One of the most complete radiation institutes is that recently built at Stockholm with funds collected to celebrate the jubilee of King Gustav V. It is a building of five stories, measuring about 170 ft. × 190 ft., well provided with radium and X-ray apparatus, together with all modern conveniences for examining, treating and nursing patients. There are arrangements for keeping records of all cancer cases in Sweden. The institute has an able staff of therapists, pathologists and physicists, and the whole organization is part of the new University Hospital at Stockholm. Any country desirous of establishing an efficient radiological institute would do well to study the Swedish scheme. A full description of the building is given in a booklet published by Norstedt and Söner, Stockholm.

A great weakness of radium beam therapy in the past has been the lack of a good system of dosage units. Now, however, thanks to the physical research of the last few years, it has become possible to express gamma-radiation in the international 'röntgen' or *r* unit, already so well established in X-ray therapy. The röntgen (*r*) is that quantity of radiation which, when secondary electrons are fully utilized, and wall effects avoided, produces ionization in air at 0° C. and 760 mm. mercury pressure, such that one electrostatic unit of charge per cubic centimetre is liberated at saturation current. The unification of X- and gamma-ray dosage units is a great step forward, and will hasten the solution of many of the controversial problems of radiology.

It is of the utmost importance that the beam of rays shall be suitably directed, that the dosage-rate at any particular part of the tumour or glands shall be known, and that the dosage shall be repeatable, or modified at will to any desired degree that experience may dictate. These purely physical problems have now been solved, and there is no longer any excuse for slipshod or haphazard treatment.

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* This article has been published with the approval of the Executive Committee of the Radium Beam Therapy Research, on behalf of which we are glad to acknowledge the generous loan of 10 gm. of radium by the Union Minière du Haut Katanga.

In planning for the future, it is impossible to ignore the rival claims of radium and X-rays. Many radiologists believe that gamma-ray therapy is superior to X-ray therapy in its biological effects, and they attribute this superiority to the shorter wave-length of the gamma-rays; encouraged by this belief, they are striving after X-rays generated at higher and higher voltages, which approach the gamma-rays of radium in their nature. While there are many who would contest this point of view vigorously, yet since it is the motive which prompts the building of high-voltage X-ray plants, we may be permitted, without entering into a discussion of such controversial points, to inquire how far an X-ray tube working at, let us say, 1 million volts is capable of imitating the radiation emitted by radium.

TABLE 1.

Country	Institution	Quantity of radium	Number of units
		gm.	
Austria	Municipality of Vienna	3	1
Colombo	Institut Radium, Bogota	4	1
Canada	Toronto Hospital	4	1
	British Columbia Cancer Foundation, Vancouver	3·5	1
France	Institut de Radium, Paris	11	2
	Centre de Strasbourg	8	2
	Centre de Lille	6	2
	Institut de Radium, Villejuif	5	1
	Centre de Bordeaux	4	1
	Centre de Lyon	3	1
Great Britain	Radium Beam Therapy Research, London	10	2
	Cancer Hospital, London	5	1
	Westminster Hospital, London	4	1
Hungary	Municipalité de Budapest	3	1
Norway	Norske Radiumfond	3	2
Sweden	Radiumhemmet	8	2
U.S.A.	Michael Reese Hospital, Chicago	6	2
	Belle-Vue Hospital, New York	5	1
	Memorial Hospital, New York	4	1
	American Oncological Hospital, Philadelphia	4	1
	New York Institute for the Study of Malignant Disease, Buffalo	4	1
	Veterans Bureau	2	1
	Dr. Williams Cameron, New York	2	1

The nature of the radium spectrum has been known for a long time. It consists of a small number of sharp monochromatic 'lines' with energies ranging from a few kilovolts up to 2·2 million volts. They are represented in Fig. 2 by a number of vertical lines the heights of which are proportional to the intensity of the radiations. These data have been taken from "Radiations from Radioactive Substances" by Rutherford, Chadwick and Ellis, in conjunction with the latest values of the photoelectric coefficients.

An X-ray tube working at 1 million volts yields a continuous spectrum with a sharply defined short-wave limit at 1 million volts. The bulk of the radiation output corresponds to a voltage considerably less than 1 million volts. No data have as yet been published on the spectral distribution obtained with high-voltage X-ray tubes, but we can obtain some idea of its nature by extrapolating Kramer's law, which holds very well for lower voltages of the order 100 kv. According to Kramer's law, the energy in the continuous spectrum which is included between the frequencies ν and $(\nu + d\nu)$ is given by:

$$I\,d\nu = \frac{8\pi}{3\sqrt{3}l} \times \frac{e^2h}{mc^3} \times Z\,(\nu_0 - \nu)\,d\nu\,;$$

where ν_0 is the frequency of the short-wave limit, l is a numerical factor of order 6, Z the atomic number of the target, and the remaining symbols have the usual significance. If we fix the material of the target, and change the variable from the frequency ν to the wave-length λ, we may write:

$$I_\lambda = \text{const.}\ V^2\,(V_0 - V)\,;$$

where V_0 is the maximum voltage applied, and V is the voltage corresponding to the wave-length λ. The relative values of I_λ calculated in this way for the unfiltered radiations are given in Table 2, together with the relative values of I_λ after filtration with 1 mm. and 2 mm. lead. The latest available absorption data of Read and of Jones have been used in calculating the transmission through the filters.

TABLE 2.

Probable Energy Distribution in Continuous Spectrum of a Million-volt X-ray Tube, based on Kramer's Law.

Wave-length	Equivalent Voltage	Relative Intensities I_λ		
		Unfiltered	1 mm. Pb	2 mm. Pb
	kilovolts			
12·35 X.U.	1000	0	0	0
13·0	950	452	407	387
13·8	900	810	725	645
14·5	850	1080	961	855
15·4	800	1280	1140	1000
16·5	750	1410	1240	1100
17·6	700	1470	1290	1120
19·0	650	1480	1280	1120
20·7	600	1440	1240	1060
22·5	550	1370	1160	990
24·6	500	1250	1040	870
30·8	400	960	745	580
41·1	300	630	405	260
49·3	250	470	243	128
61·5	200	320	111	29
82·2	150	19·1	2·1	2·3
123·5	100	9	0·2	—

The three curves corresponding to no filter, and filters of 1 mm. and 2 mm. lead respectively, are drawn, together with the radium spectrum, in Fig. 2. The great disparity between the radium spectrum and that of the million-volt X-ray tube is evident. The peak of the X-radiation output occurs at a value between 600 and 700 kilovolts. There is very little radiation at 1 million volts and nothing at all beyond this value. On the other hand, a considerable portion of the radium spectrum is located above 1 million volts, with a particularly intense line at 1·8 million volts. To generate radiation comparable in quality with the gamma-rays of radium a voltage approaching 3 million would be required! Assuming that the engineering difficulties were overcome, it is not certain that electrons driven by 3 million volts on to a target would expend all their energy in the production of röntgen rays, as other transmutations might take place.

The greater energy emitted by an X-ray tube is of some advantage. It is not difficult to make an X-ray tube the output in ergs of which is equivalent to that from some hundreds of grams of radium. This allows the tube to be used at a distance of 1–2 metres from the patient's skin, giving a practically parallel beam resulting in a high 'depth dose', that is, a high ratio between the tumour-dose at a depth, and the surface-dose on the skin. For it must be remembered that the skin reaction is the limiting factor in treatment. With the relatively small quantities of radium which are available for beam treatment, it is necessary to work with the radium sources so close to the skin as 5–10 cm. in order to obtain intensities capable of producing biological effects. This results in a strongly divergent beam, and a poor depth-dose. This point is well illustrated in Table 3, which gives the percentage depth-dose, as measured in water, at a distance of 10 cm. below the surface for various kinds of radiation at different distances from the surface.

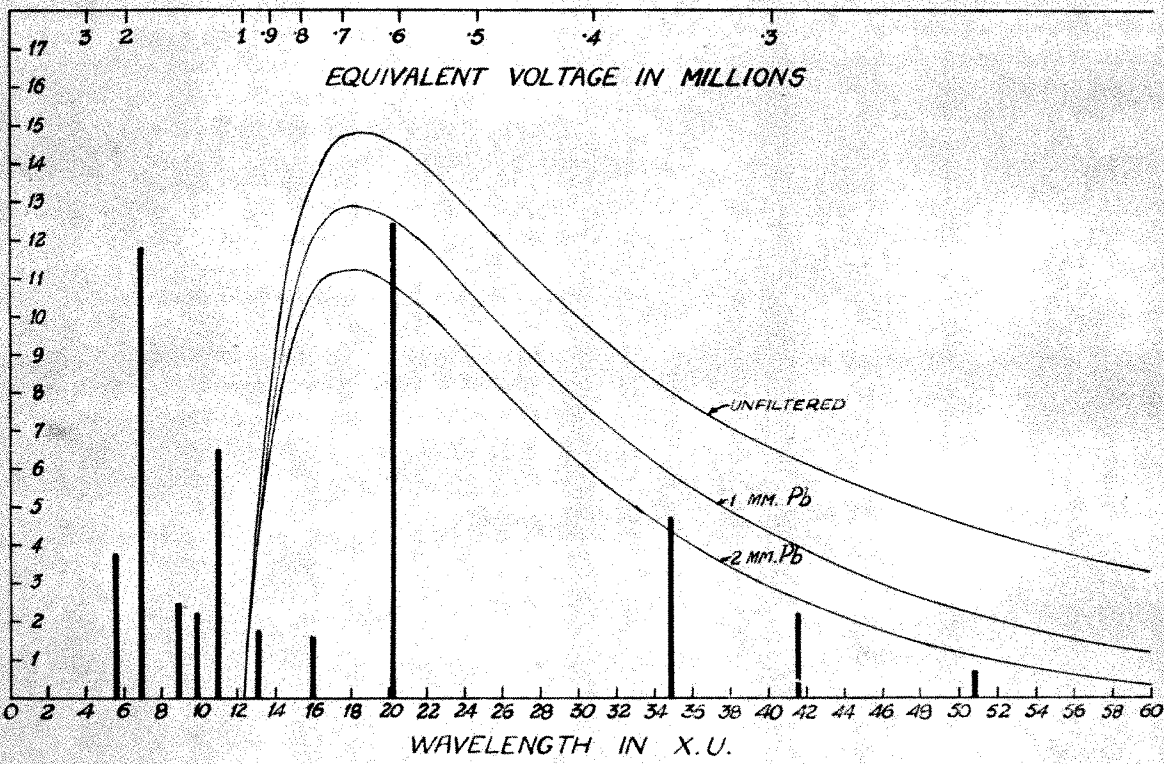

Fig. 2.

COMPARISON OF THE GAMMA-RAY LINE SPECTRUM OF RADIUM WITH THE CONTINUOUS SPECTRUM FROM A MILLION VOLT X-RAY TUBE, CALCULATED ACCORDING TO KRAMER'S LAW, FOR DIFFERENT FILTRATIONS.

TABLE 3.

Depth Doses Measured in Water.

Radiation source	Filter	Distance from surface	Percentage depth dose 10 cm. below surface
X-rays, 370 k.v.	5 mm. Cu.	75 cm.	43 per cent
X-rays, 200 k.v.	0·5 mm Cu.	75 cm.	36
Radium point source	0·5 mm. Pt.	5 cm.	11
[Radium point source	0·5 mm. Pt.	75 cm.	58]

We thus have the paradoxical situation that the more penetrating radiation appears to penetrate less. The fact is that both radium and X-ray treatments are governed by the inverse square law, and that the superior penetrating power of gamma-rays cannot be exploited unless prohibitive quantities of radium are available to make it possible to work with large radium-skin distances (cf. last line of Table 3). Even radiologists themselves are apt to lose sight of this important point and often stress, unduly and erroneously, the high penetration of gamma-rays.

The true advantage of radium treatment would therefore seem to depend on the property that *a great part of the electromagnetic waves proceeding* *from radium are shorter in wave-length than those that emerge from any X-ray tube at present in use.*

It is possible that in a few years time the new discoveries of physics, the neutron and artificial radioactivity, will find a place in radiation therapy. Already, in the United States, neutron beams are available of sufficiently high intensity to produce strong biological effects; their mode of action must differ in many respects from the radiations with which radiologists are familiar. Also it is now possible to obtain gamma-rays from artificial radioactive substances with energies far in excess of anything which radium emits. Radio-sodium, for example, disintegrates with emission of gamma-rays having energies in excess of 3 million volts. This substance has already been produced in weighable quantities; if it should prove possible to make it cheaply in bulk, it could be inserted daily into a radium unit of conventional design, and used for treatment in place of radium. All the knowledge which has been accumulated for radium beam therapy in the past could be brought to bear on the powerful new radiation.

In the meantime, it is of the greatest importance that there should be competent comparisons of the effects of radium and X-ray treatment, in which therapists, pathologists, biologists and physicists may make a thorough study of the results produced in living tissue, whether healthy or diseased, and explore to the full the new methods which the advance of physics is making available.

Biological Work of the Oxford University Expedition to North-East Land, 1935-36

By D. B. Keith

NORTH-EAST LAND is the second largest island of the Spitsbergen archipelago and lies astride the parallel of 80° N. Until a few years ago, it remained virtually an unknown land of evil repute. It was thought to lie outside the influence of the Gulf Stream and therefore to suffer from a far severer climate than the rest of Spitsbergen. The Oxford University Expedition, under the leadership of A. R. Glen, was the first expedition to winter in the country, and besides the radio research work, glaciology, survey and other activities of the expedition (see NATURE, Jan. 2, p. 10), biological work was carried out through the year.

It may be said at the start that the animal life of North-East Land is incredibly meagre, and the reason for the great difference between there and the rest of Spitsbergen is the very much colder summer conditions prevailing on the island. The winter, too, is severer, but this has not the same effect on the animal life; but when it is realized that the temperature in the summer months very rarely rises above 40° F., that snow storms are liable to occur at any time and that strong winds are almost continuous, it is not hard to see the reason for the paucity of animal life. It is probably not quite true to say that the Gulf Stream has no effect on North-East Land, for it now seems almost certain that the north-western coast does come under its influence, but its effect here is so small that the air temperature is invariably low and the weather usually windy and misty.

The difference between North-East Land and even the nearest areas of New Friesland is at once apparent in the vegetation. In North-East Land, the vegetation type most common is so open that it seems impossible to believe that biotic factors have played any part in its formation, whilst even in such areas as Treurenberg Bay and Lomme Bay, close plant communities are fairly extensive. In fact, the only areas in North-East Land where anything approaching close formations are to be found are in such places as the scree slopes below bird cliffs, areas (usually small islands) where colonies of eiders or terns are nesting, or, in a smaller way, round old nests of eiders, brent geese or glaucous gulls. Much of my biological work this summer was carried out in Murchison Bay, a large bay on the western coast, thickly dotted with islands, but one of which almost all the surrounding country is composed of dolomite. The sterility of the vegetation in such an area defies description. The rock weathers into fragments which are found covering great areas and lying loosely over the surface, entirely prohibiting any plant growth. Here and there a few specimens of *Saxifraga oppositifolia* or *Papaver radicatum* may have been able to take root; but it is almost true to say that the only places where plants are found are those where there has been manuring in some form or another.

My main work was a study of the birds, and here again the same may be said with regard to the paucity both of species and individuals. So far, only twenty-seven species of birds have been recorded from North-East Land, and of these only some sixteen breed regularly. As the base hut was built on a small area of level ground at the foot of a wall of towering basaltic cliffs, which in the summer were tenanted by nesting fulmars and Mandt's guillemots, I had a good opportunity for watching the arrival of these birds in the spring, which was of particular interest for the fact that the guillemots used at first to spend only certain hours each day at the cliffs.

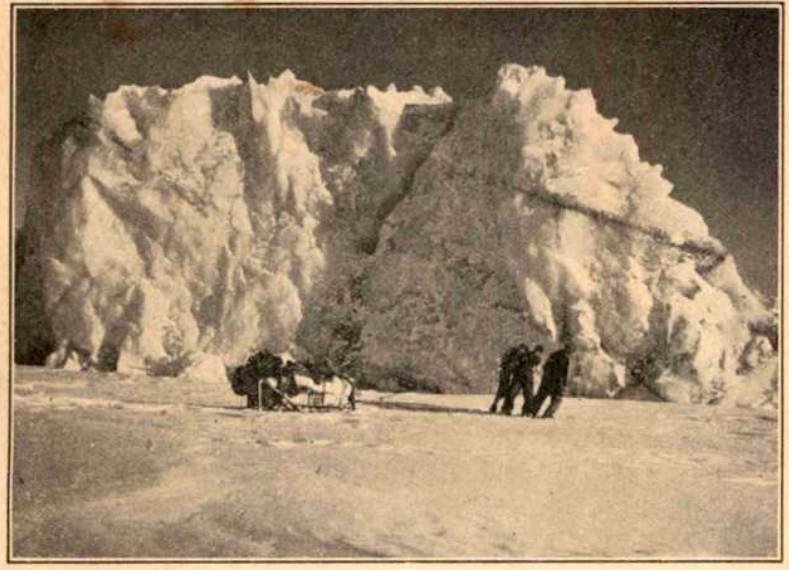

Fig. 1.
SLEDGING DOWN EQUIPMENT FOR THE BIOLOGICAL STATION IN MURCHISON BAY. PASSING AN ICEBERG WHILE TRAVELLING OVER THE FROZEN LADY FRANKLIN BAY.

The first sign of life in 1936, apart from a few solitary bears and one or two reindeer, was when a fulmar was seen flying silently along the face of the cliff in the half light of February 15, more than a week before the sun rose. Nothing else was seen until March 10, when four Mandt's guillemots visited the cliffs. This was the beginning of a long series of visits, for the guillemots arrived every night and left again early in the morning. As the month progressed they spent longer times at the cliffs, but these were always deserted in the afternoons. By March 19 the numbers had increased and the birds were staying until about 11 a.m. By March 31 they were arriving at 1 or 2 a.m., but leaving again at about 7 a.m. Gradually they began to arrive earlier and stay later. This curious habit of deserting the cliffs in the afternoon was not followed by the fulmars, which began to arrive after April 7. In the night and morning the cliffs were shared by guillemots and fulmars, but in the afternoons the latter were in solitary possession; and this continued until the end of April, when guillemots began to stay at the cliffs throughout the day.

The first nest I found was one of a red-throated diver, which on June 21 contained one egg (Fig. 3). From that date the divers and eiders began to nest, but it at once became evident that though the former were nesting in normal numbers, that is, there was a breeding pair on almost every freshwater tarn of suitable size, only a very small percentage of the ducks were breeding at all. This non-breeding, which this year was found in the case of the eider and brent geese, is a regular feature of arctic bird life and one of great interest. From work done all over the Arctic, notably in Greenland and Spitsbergen, it seems fairly certain that every fourth year or so certain species of birds are affected, and of these

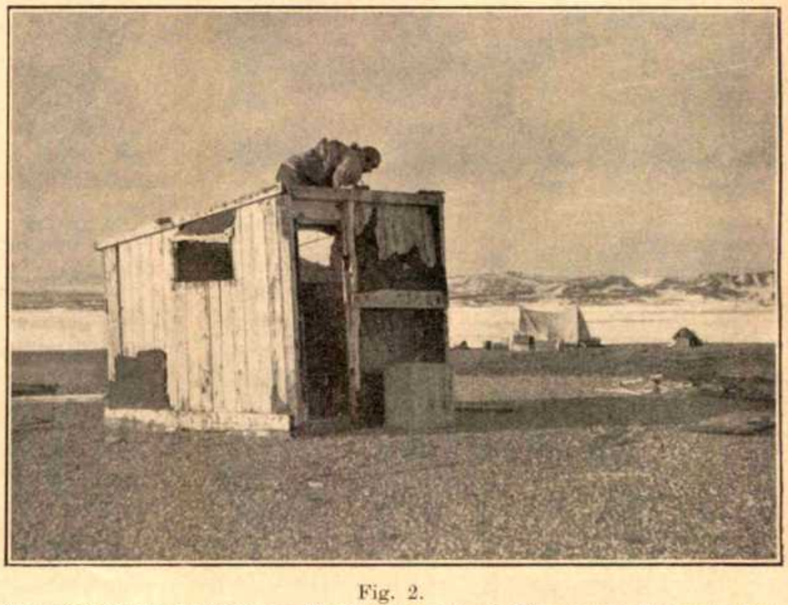

Fig. 2.
THE BIOLOGICAL STATION ON RUSSIAN ISLAND IN MURCHISON BAY OCCUPIED BY KEITH AND GODFREY FROM APRIL UNTIL JULY, 1936.

species many less than the normal percentages are found breeding. The birds most commonly found to be affected are the ducks, geese and divers, but in North-East Land the divers were breeding in normal numbers.

It is as yet difficult to account for this phenomenon. Many and varied suggestions have from time to time been put forward. It would appear that it must bear some relation to changing climatic conditions, as these must be assumed to be the only variable factor in the environment of the birds until some variation at present unknown is shown to take place in their marine food supply. But this leaves us with the difficulty of explaining the regularity of the occurrence of the non-breeding years by climatic changes which have not yet been shown to follow the necessary cycle of 3–4 years. The late melting of the sea-ice and disappearance of the snow from the land might in some cases give an explanation, but this cannot find universal acceptance because in a non-breeding year the birds that do breed do not usually begin to nest any later than usual. Again, such a condition could scarcely affect the ducks without to some extent also affecting the red-throated divers. It is also impossible to suppose some general factor which affects reproduction throughout the Arctic, because species such as the waders and passerines have never yet been shown to be affected in this way. During the earlier part of the summer, I examined the gonads of many eiders, and the general result was that the ovaries were scarcely enlarged at all, but that the testes of the drakes were developed to the normal size of a breeding bird. It would be unwise as yet to argue from this one case, but if similar observations are carried out elsewhere and the same result found, the reason for the non-breeding will have to be found in some factor which affects the sexual development of the female and not of the male. It was noticeable throughout the first part of the summer how much more sexually excited the drakes were than the ducks.

Even in normal years North-East Land has a large non-breeding population, but this is entirely different from that which I have been describing above. The island lies at the extremity of the breeding area of most birds visiting it, and it seems to a large extent to be populated by birds which were bred elsewhere and have had to move out from the more favoured areas of their range to this uninviting marginal territory. Only by this supposition can I account for the large non-breeding population which seems to be a normal feature in every species. It is difficult to estimate non-breeding percentages among cliff nesting species, but it was abundantly clear that large numbers of non-breeding Arctic skuas, terns, grey phalarope, purple sandpipers and snow buntings were a normal feature of the ornithology of North-East Land. It was also clear that the numbers of each species which were breeding were quite inadequate to maintain the status of that species with anything like a normal rate of mortality.

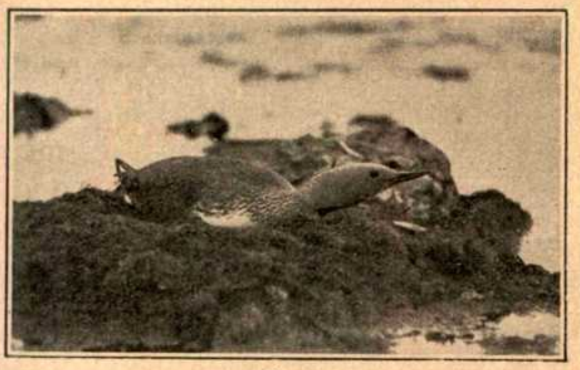

Fig. 3.
RED-THROATED DIVER ON NEST.

This question of non-breeding both in normal and abnormal years is one of the most interesting confronting the ornithologist visiting North-East Land, and I have but touched on it here. Another problem is that of distribution. North-East Land is an excellent field for this and other inquiries, as the factors which have to be considered can be so much more easily seen there than in more temperate regions with their more complex bird communities.

Obituary Notices

Sir Grafton Elliot Smith, F.R.S.

WITH deep regret we record the death of Sir Grafton Elliot Smith, the famous anthropologist and former professor of anatomy in the University of London (University College), which took place at Broadstairs on January 1 after a prolonged period of ill-health, at the age of sixty-five years.

Grafton Elliot Smith was born on August 15, 1871, at Grafton, New South Wales, and was educated at the Universities of Sydney, where he obtained the degree of doctor of medicine in 1895, and Cambridge, where he was a fellow of St. John's College, on which foundation he afterwards became an honorary fellow. On obtaining his degree in medicine, he devoted himself especially to the study of the comparative anatomy of the brain. Not only did this orientation of his studies largely determine his future achievement by directing his attention to human palæontology and the problems of the evolution of man, but also the publication of the results of his early researches in the *Journal of Anatomy* and other professional periodicals speedily won him wide recognition as one of the foremost authorities on the anatomy of the brain.

Of little less importance, however, in influencing the development of Elliot Smith's thought and the direction of his studies was his appointment to the chair of anatomy in the Egyptian Royal School of Medicine, Cairo. Here he was brought into contact with a number of problems arising out of investigation of the history and culture of the ancient Egyptians, which were germane to his own studies. Skeletal remains from predynastic and dynastic burials in almost countless numbers, and mummies from the various periods of Egyptian history, were studied on his own initiative or were brought to him for examination and report. In particular, he was deeply impressed by the character of the skeletal remains obtained by G. A. Reisner from his Nubian excavations. With this material under his hand, Elliot Smith was attracted inevitably to the consideration of such questions as the racial origins and composition of the ancient Egyptian population, their pathology and the incidence of diseases among them, as well as the history and development of the practice and technique of mummification as manifested in the anatomical evidence. Nor did his active mind rest there; he was drawn on to examine the cultural and religious ideas with their modifications in course of time, which were implicated in all this material. In communications, for example, submitted to Section H (Anthropology) of the British Association so long ago as the Dublin meeting of 1908 may be discerned the germ of ideas and concepts which were to play a very important part in the work of his later years.

In 1907 Elliot Smith was admitted a fellow of the Royal Society. His services to scientific studies in Egypt were recognized by the award of the Order of the Mejidie. In 1909 he left Egypt to occupy the chair of anatomy in the University of Manchester. Apart from a number of papers contributed to scientific journals, the most important of his publications arising directly out of his work in Egypt was "The Royal Mummies", which as a result of the anatomical examination of well-known examples from the Royal burials, threw a new light on certain dynastic problems of Egyptian history. It was published in 1912.

Of more immediate consequence in Elliot Smith's career was the publication in 1911 of his "Ancient Egyptians", which was received with enthusiasm by many anthropologists, notably the late W. H. R. Rivers. Here, working largely on evidence afforded by the skeletal material obtained by Reisner, to which he had had access though it long remained unpublished, as well as on material from burials at Gizeh, he deduced the intrusion of a new racial element of Asiatic (Armenoid) origin into the population of early dynastic Egypt. To these people he attributed the introduction of metal tools, facilitating the working of stone, and consequently, as he had been led to believe by his study of the *mastaba* and other forms of Egyptian burial practice, leading up to the erection in stone as a sepulchral monument, of which the idea had been carried far and wide in the early world to give rise to the widely distributed megalithic monument. The publication of this book is a landmark in Elliot Smith's development as an anthropologist.

In the following year (1912) Elliot Smith presided over Section H (Anthropology) of the British Association at the Dundee meeting. Through his personal influence with former pupils and friends, as well as by his own contributions, the proceedings of the Section on this occasion gave the members of the Association a remarkable review of certain aspects of Egyptological studies at the time.

Elliot Smith's most noteworthy part in the proceedings at Dundee, however, and at the same time his most considerable contribution to anthropological science on this occasion, as perhaps might be expected, lay in his presidential address. In this he dealt with the identification of the neopallium, the associational area in the frontal region of the brain, and demonstrated its bearing upon the evolutionary problem in man, views then made known to a wider public for the first time. Notwithstanding the fact that subsequent neurological research has led to the very considerable modification of Elliot Smith's views on this localization of function, the conclusions which were there put forward on the development of man's faculties in the evolution from lower forms of life afforded a great stimulus to further research on such questions as the development of stereoscopic vision, of speech and generally on the evolution of form and function. This address, in fact, marks a stage in the study of the brain of early man, of which the development, more especially by the use of the endocranial cast, was probably Elliot Smith's greatest and most lasting contribution to the study of human palæontology.

The announcement, which followed shortly after, of the discovery of the Piltdown skull, brought Elliot Smith into the discussions which followed on the reconstruction of that early relic of man, and it was under his supervision and with his collaboration that the late Dr. J. Hunter, after the Great War, effected a reconstruction of the cranium, which once and for all brought the chimpanzoid jaw into sufficiently harmonious relation with the rest of the skull to place the individual and human character of both elements, which had been questioned, beyond doubt.

Elliot Smith by now was recognized as one of the foremost authorities on early man, and with Sir Arthur Keith divided the honours of arbiter in pronouncing upon the character and importance of any new discovery. He was the first to demonstrate the Rhodesian skull before the Zoological Society and the Royal Anthropological Institute in 1921, and he described the "Lady of Lloyds'", the primitive skull found in the City of London in 1925, which, as he showed at the International Congress of Prehistoric and Protohistoric Sciences in London in 1932, may possibly be the earliest known example of the 'modern' type of man. An account of this skull appears in the second edition of his "Evolution of Man", first published in 1924. It is perhaps worth while to recall that Prof. Raymond Dart, whose sensational discovery of *Australopithecus* in South Africa in 1925 caused no little controversy, was one of the many pupils whom Elliot Smith inspired with his own enthusiasms.

It was, however, in connexion with the discovery of Peking man that Elliot Smith was perhaps most active. He spared himself no pains to become fully acquainted with this early type of man in all its bearings, and to make it known to his colleagues and a wider public. He was able to speak with especial authority, as not only was he kept fully informed of the progress of investigation through his friendship with the late Davidson Black, but in his visits to the Far East he personally examined the relics of Peking man and informed himself on the geological and topographical conditions of discovery. Only a few weeks ago, in December last, a letter to *The Times* confirmed the importance of the latest discoveries and gave full credit to the work of Prof. Franz Weidenreich, the new director of the Cænozoic Laboratory, an appointment which Elliot Smith himself had recommended to the Rockefeller Trustees, although the nominee had been an acute critic of his own work.

In the meantime, while Elliot Smith had attained a commanding position as an authority on the evolution of early man, his activities in other directions had involved him in violent and sometimes embittered controversy. The ideas which were adumbrated in his view of the spread of the megalith put forward in his "Ancient Egyptians" in 1911 had undergone a wide development. In his study of mummification he had been much impressed by the similarities, or identities as he saw them, in the technical methods employed by the ancient Egyptians and in those which had been practised on the mummies brought back by the Cambridge Expedition to the Torres Straits in 1900. Further study of the ethnographical record of primitive peoples and of the peoples of antiquity convinced him that similarities in the cultures of the world at large were to be explained as the result of a wide diffusion of culture which had Egypt as its starting point. The earliest full statement of this theory, from which sprang the 'Historical School', appeared in a paper in the proceedings of the Manchester Literary and Philosophical Society, afterwards published (1915) as "The Migrations of Early Culture". It was developed further in "The Evolution of the Dragon" (1919), "Elephants and Ethnologists" (1924) and other works; it finds its best and most philosophical expression perhaps in "Human History" (1930). The development of this school of thought, which was opposed by its originator to the Tylorian system, or 'Evolutionary School', as Elliot Smith termed it, owed much to the work of W. J. Perry, an assistance of which Elliot Smith was ever generous in acknowledgement.

This is neither the occasion nor the place to enter into any critical examination of Elliot Smith's views on the subject, nor to dwell upon the opposition which they aroused. In fairness to him, two things must be said, one personal and one in relation to the development of his work at University College, where he succeeded the late G. D. Thane as professor of anatomy in the University of London in 1919. Elliot Smith was a man capable of inspiring in those who were well acquainted with him an admiration and affection which never faltered; but he had a nature which was extremely sensitive and reacted to criticism in the release of a pen which knew no mercy. Hence he frequently involved himself in unnecessary and acrimonious debate which might and should have been avoided with better understanding.

On the broader issue, it has perhaps too seldom been noted to how great an extent Elliot Smith's theories on the diffusion of culture were a counterpart of, and were influenced by, his views on the origin and distribution of races. Not indeed that he would have pressed too hard his conception of racial filiation and affinities. No one who heard his impressive denunciation of the misuse and misinterpretation of racial theory in the interests of political prejudice, when he presided over the Section of Physical Anthropology at the International Congress of Ethnological Sciences in London in 1934, could have remained under any misapprehension on this point. But there can be no doubt that he looked upon culture very much as an original stock spreading over the world from one centre of origin, which he found in Egypt, as a concomitant and an analogue of the spread of the stock of *Homo sapiens* to develop into the variety of the races of man in a diversity of local conditions. Such a filiation of racial characters, for example, was his hypothetical "Brown Race" extending from the Mediterranean to India and beyond, which has afforded physical anthropologist and archæologist alike a valuable theoretical basis for racial argument, in unravelling the ethnic and cultural history of the Mediterranean and Near and Middle East.

It was this concept of the fundamental unity and parallelism in the study of man, which was clearly before Elliot Smith's mind when he proceeded to remodel his Department at University College with the assistance of the grants which had been received from the Rockefeller Trustees. There he planned that the study of man's evolution and physical structure in the Department of Anatomy should proceed side by side with the study of the development of culture on the lines which he had worked out. This scheme he was able to bring to fruition with the appointment of Dr. W. J. Perry as reader in cultural anthropology in 1927.

When Elliot Smith retired owing to failing health at the close of the academic year 1935–36, he had been the recipient of many honours in recognition of his services to science. In 1934 he was knighted. He had been a member of the General Medical Council, and was formerly a vice-president of the Royal Society, from which he received a Royal Medal;

he received the Hon. Gold Medal of the Royal College of Surgeons of England, and the Prix Fauvelle of the Anthropological Society of Paris. He had delivered the Croonian Lecture, the Arris and Gale Lecture, the Huxley Lecture of Birmingham, the Imperial College and the Royal Anthropological Institute, as well as lectures of like standing in the medical colleges of Edinburgh, Dublin and the University of New York. He had been president of the Anatomical Society and the Manchester Literary and Philosophical Society among other societies concerned with his special studies, and his work had been recognized on the Continent by honorary fellowship or corresponding membership of the academies and more important anthropological societies of France, Holland, Belgium, Germany and Italy.

Dr. C. V. Jackson

Dr. C. V. Jackson, who at the early age of thirty years lost his life in a sleigh accident at St. Moritz on December 30, was a spectroscopist of considerable ability who had made valuable contributions to the establishment of accurate standards of wave-length. A graduate of the University of Oxford, he joined the Imperial College of Science and Technology about six years ago for the purpose of carrying on research in this subject under the direction of Prof. A. Fowler. On Prof. Fowler's retirement in 1934, he remained at the Imperial College as an honorary lecturer. His work included very precise interferometric measurements of iron, silicon, krypton and other spectrum lines, which were published in the *Proceedings of the Royal Society*, and he gave a considerable amount of attention also to the investigation of possible sources of light for the production of more satisfactory primary and secondary standards than those now accepted.

Dr. Jackson was a man of considerable financial resources, which he expended freely in the purchase of apparatus of the highest quality. His scientific work was characterized by quickness of mental apprehension and by an extreme fastidiousness in measurement which was in surprising contrast to the somewhat bewildering vagaries of his general temperament. He would alternate periods of intensive physical research with horse-racing and other social activities which are not usually found in such close association therewith. He was a member of the Commission on Wave-Length Standards of the International Astronomical Union, and attended the meetings of that body in Paris in 1935.

Dr. J. M. H. Munro

Before 1884, basic slag was a 'waste product', of which extensive spoil heaps had accumulated. It was the refuse of Bessemer steel converters which had been lined with basic mineral matter to abstract phosphates from the molten iron, and it contained about twenty per cent of phosphorus pentoxide (P_2O_5) combined mainly with lime. About forty years before that time, Lawes and Gilbert had demonstrated that the value of 'rock phosphate' as a fertilizer was greatly increased by treatment with sulphuric acid. The discovery by Wrightson and Munro of the fertilizing value of ground basic slag was of almost equal value to agriculture, and added vastly to the productivity of large areas of what were previously very poor pastures.

John May Herbert Munro, who died at Bath on November 6, at eighty-one years of age, matriculated at the age of seventeen and was one of the youngest men, if not the youngest, to graduate D.Sc. London five years later in 1877. His record included distinction in logic, botany and chemistry. In the early 'eighties, after having for a few years held an appointment in the Patent Office, he joined John Wrightson and William Fream in founding what was then the second of the English agricultural colleges, at Downton in Wiltshire. John Wrightson was a brother of Thomas Wrightson, whose firm of steel manufacturers was one of those which had used the basic process and accumulated spoil heaps of slag. The high phosphate content of the slag was, of course, known, but it did not occur to anyone that it could be used as a fertilizer until Wrightson and Munro demonstrated the fact by a series of agricultural and laboratory experiments at Downton in 1883 and 1884.

I came to know Munro and to visit him at Downton about that time when he was working out methods of determining the solubility of the P_2O_5 of the slag, its availability as a plant nutrient and the degree of 'fineness of grind', on which both depended. His extreme modesty prevented him, so far as I know, from ever claiming credit for this demonstration of the value of finely ground basic slag, which later became well known from experiments by Gilchrist and Somerville at Cockle Park, in Northumberland. At the same time, Munro was working in collaboration with Warington on problems connected with nitrogen fixation by the nodules of leguminous plants, a subject then in its infancy, and on which he published papers in the *Journal of the Chemical Society*. In 1892, I was fortunate in obtaining his collaboration in a long series of experiments at Warminster on the factors of productivity and of malting quality in barley, and in the forty years following, during which they have been in progress, I have had the inestimable benefit of his advice on the chemical problems involved. Later on, he deserted professional agriculture (except as an analyst) for medicine and bacteriology, and did valuable work on the composition and therapeutics of Bath mineral water.

E. S. Beaven.

We regret to announce the following deaths:

Prof. Louis M. Dennis, emeritus professor of chemistry in Cornell University, an authority on gas analysis, on December 9, aged seventy-three years.

Prof. D. F. Fraser-Harris, formerly professor of physiology in Dalhousie University, Nova Scotia, on January 3, aged sixty-nine years.

Geneviève Lady Watson, local secretary in Palestine to the Palestine Exploration Fund, on December 31, aged eighty-two years.

News and Views

Prof. V. L. Komarov

THE presidential chair in the U.S.S.R. Academy of Sciences, which became vacant last year owing to the death of Prof. A. P. Karpinsky, is now filled by the election of Prof. V. L. Komarov. The new president is an eminent botanist, particularly well known for his exhaustive studies in the flora and vegetation of Kamtchatka, Manchuria and the Far East generally. During the last few years, Prof. V. L. Komarov occupied the post of vice-president of the Academy and took an active part in various aspects of its work. It may be hoped that his election to the presidency will mean substantial developments in the natural history researches, which lately has remained somewhat in the background, since the main attention of the Academy, as a whole, has been directed to technical and engineering problems, which have to be studied in connexion with the 'socialistic reconstruction' of the country.

Alfred Willett (1837-1913)

THIS eminent London surgeon was born on January 3, 1837, the second son of William Catt of Brighton, who afterwards took the name of Willett. His medical education was carried out at the Sussex County Hospital, where he was a pupil for three years, and at St. Bartholomew's Hospital, London. After qualifying in 1859 he held a number of junior appointments at St. Bartholomew's Hospital, where he was successively elected assistant surgeon, surgeon in charge of the orthopædic department, full surgeon and lecturer in surgery. In 1897 he delivered the Bradshaw Lecture on "The Correction of Certain Deformities by Operative Measures upon Bones" at the Royal College of Surgeons, where he served on the Council from 1887 until 1903 and as vice-president in 1894 and 1897, but declined nomination for the presidency. Among the other appointments of distinction which he held were those of president to the Royal Medico-Chirurgical Society and of surgeon to Queen Charlotte's Lying-In Hospital and the Evelina Hospital for Children. Willett was an excellent example of the transitional period between the pre-Listerian era and that of antiseptic surgery. Undeterred by the unsympathetic attitude of his colleagues, he studied Lister's methods, and in the early eighties was the only surgeon in the hospital to perform systematic abdominal operations in conjunction with the celebrated gynæcologist, Dr. Matthews Duncan. The interest which he took in orthopædic surgery was rewarded by his successful treatment of deformities. His death took place twelve years after his retirement from St. Bartholomew's Hospital, on June 20, 1913. A silver medal named after him is awarded annually to the winner of the highest marks in operative surgery at the Brackenbury Surgical Examination at St. Bartholomew's Hospital.

Solar Eruptions and Radio Fade-outs

THE associated phenomena of a bright hydrogen eruption on the sun on December 3 and a radio fade-out, described in NATURE of December 12, p. 1017, had an interesting sequel 27 days later. On December 30, the sun was under continuous observation with the spectrohelioscope at the Royal Observatory, Greenwich, from $9^h\ 45^m$ to $12^h\ 55^m$ U.T., and at first attention was concentrated on a region near the central meridian which showed signs at $9^h\ 45^m$ of having been recently active. At $10^h\ 30^m$, a bright eruption began rapidly to develop there and lasted until about 11^h. At $10^h\ 57^m$, on turning to another part of the disk, a very bright and extensive hydrogen eruption was seen to have begun at a position about 55° west of the central meridian in latitude 22° north; in about 20 minutes this bright eruption had spread southwards to about latitude 14° north, so that the eruption when fully developed was spread over a distance of about 60,000 miles in latitude. (This active region was nearly identical in position with the region that was active on December 3.) It is shown by a whole disk spectroheliogram, taken in hydrogen light ($H\alpha$) by Mr. Evershed at his observatory at Ewhurst, that at $10^h\ 34^m$ this second and larger eruption on December 30 had not begun, though another spectroheliogram taken at $11^h\ 20^m$ (after information had been received from Greenwich) shows the eruption near its full development. The most probable time of the beginning of the eruption, derived by extrapolating an intensity curve given by photometric measures made at Greenwich after $10^h\ 57^m$, is about $10^h\ 50^m$. The declining stages of the eruption were relatively slow, and by $12^h\ 50^m$ the streaks of emission were of the normal brightness of ordinary flocculi.

IT is of considerable interest that three radio fade-outs were reported later as having occurred during the morning of December 30 on short-wave (of the order of 20 metres) wireless transmission between certain stations in the earth's sunlit hemisphere. The first of these occurred about an hour before the sun could be observed at Greenwich with the spectrohelioscope, but the disturbed appearance at $9^h\ 45^m$ of an area near the sun's central meridian may be significant; further solar data from observatories east of Greenwich may possibly be forthcoming. The second radio fade-out occurred from $10^h\ 31^m$ to $10^h\ 45^m$, and the third from $11^h\ 0^m$ to $11^h\ 20^m$. The agreement in time between the last two radio-fadings and the two bright hydrogen eruptions on the sun appears to be highly significant in view of the other occurrences to which attention has already been directed in NATURE. It must be mentioned, however, that radio experiments conducted in England on December 30, while the solar eruptions were in progress, indicate that the disturbed conditions of the ionospheric layers evident on December 3 were not reproduced on December 30.

"The Kiss Precise"

IN NATURE of June 20 last, we published some verses by Prof. F. Soddy under this title. Shortly afterwards, Mr. E. B. Wedmore sent two verses generalizing Prof. Soddy's equations for the circle and the sphere to space of n-dimensions, and more recently Mr. C. C. Mason has submitted a verse on similar lines. Prof. Soddy informs us that he received a verse (dated July 17, 1936) from Mr. Thorold Gosset, of 136 Chesterton Road, Cambridge, generalizing his equations, and, in response to his request, Mr. Gosset furnished a formal proof of the proposition later in the same month. Mr. Gosset seems to have extended the geometry of all the semi-regular figures to n-dimensions in a lengthy paper some forty years ago, but it remained unpublished, except for a few results which appeared without proofs in the *Messenger of Mathematics*. The existence of these figures has recently been rediscovered, some in Holland, some in England, and a paper by Dr. Coxeter on the subject has been published by the Royal Society, so that all are now known. Prof. Soddy's development of "The Kiss Precise" and "The Hexlet" appears elsewhere in this issue (p. 77). Dr. F. Morley has also recently furnished a formal proof of the hexlet, which is printed on p. 72. Mr. Gosset's fourth verse to the "Kiss Precise" is appended:

And let us not confine our cares
To simple circles, planes and spheres,
But rise to hyper flats and bends
Where kissing multiple appears.
In n-ic space the kissing pairs
Are hyperspheres, and Truth declares—
As $n + 2$ such osculate
Each with an $n + 1$ fold mate
The square of the sum of all the bends
Is n *times the sum of their squares.*

Museums and their Type Specimens

THE *Annals of the Transvaal Museum* (**18, 349–413**; **1936**) contain four papers by Dr. R. Broom. The list of the Karroo reptiles is increased by 15 new genera and 23 new species. Many of these are to be described in further detail elsewhere, and this information leads us to wonder with what object Dr. Broom now publishes abbreviated descriptions, the day for seeking priority in the accounts of new species being assuredly passed. The species are described almost exclusively on their skulls, and most of these, to judge by the figures, were capable of restoration. This process is obviously a fine art as seen in the occiput of *Notœlurops*, pictured as preserved and as restored. Clearly, in dealing with such a large and widely distributed fauna as that of the Karroo, it is best for the collector to reserve his more imperfect specimens rather than to describe such as "types". In this matter of "types" Broom has much to say in his "Review of some Recent Work on South African Fossil Reptiles" where he considers the publications of ten workers. The most prolific of these was Boonstra, who has contributed no less than twenty-four papers in the last six years.

OBVIOUSLY this output can only have been possible on a very different technique from the laborious chipping away of the matrix in which the skull is embedded, this being usually regarded as the safest method in developing a skull. Boonstra worked in the British Museum, and we learn how he dealt with a type specimen of *Theriognathus* Owen (1876), fracturing it in several places with a hammer and chisel. "The specimen now is of more value to the morphologist", but surely such an operation should only have been performed by the skilled preparators of the Museum. In another specimen Boonstra failed to find two small canines which had been figured and so ground down the type to see their roots. Broom regards these operations on type specimens carried out by a visitor as "a gross breach of trust" on the part of a Museum to which "types" are supposed to be sacrosanct. This is a serious statement, damaging in that it is likely to deflect the flow of material to the Museum. Obviously it calls for a statement on behalf of the Museum as to whether the operations are correctly described and were specifically authorized by its responsible officers.

Radio Research in India

MANY readers of NATURE will recall that, during his recent visit to Great Britain, Prof. S. K. Mitra expressed a desire to see a Radio Research Board established in India to carry out research of a fundamental nature on radio communication in a manner analogous to the working of the corresponding British Board. While this scheme had the enthusiastic support of eminent British authorities, there appears to be some difficulty in getting the Government of India to take a favourable view of the project. An article in the *Amrita Bazar Patrika* refers to a speech made recently on this subject in the Physics Department of the University of Allahabad. It is reported that in the opinion of the Government, the research station attached to the All-India Radio Organization will be able to conduct all the research work required for the time being. As Prof. Mitra points out, however, there is a great need for the setting up of a fully equipped Radio Research Board laboratory where more fundamental work can be conducted by experienced workers from the universities without in any way overlapping or interfering with the more applied work of the broadcasting organization. In England, the British Broadcasting Corporation conducts research on its own particular problems independently of the wider and more fundamental work of the Radio Research Board. Arrangements are in force whereby close liaison is maintained between the two organizations as necessary, and this is found to be of mutual advantage.

THE article referred to above also records a speech by Prof. M. Saha of the University of Allahabad, who is closely associated with Prof. Mitra in his efforts to obtain more support for research on radio problems. Prof. Saha complains, however, that the apathetic attitude of the authorities towards scientific research is not confined to radio matters. Many research chemists and physicists in India have to carry out their research while working in ill-equipped laboratories under various difficulties arising from insufficient financial provision. In these circumstances, it is certainly very creditable that some of these workers have been able to achieve international renown, but it is highly probable that a little more encouragement on the financial side would be amply repaid in the increase in knowledge and its resulting benefits both to India and the world at large.

Problems of Industrial Recruitment

SOME account of discussions between the Minister of Labour and his predecessor in office and representatives of employers' organizations and the Trades Union Congress General Council on conditions of employment and hours of work in particular industries with reference to unemployment from January 1935 onwards is given in a paper presented to Parliament (Cmd. 5317. London: H.M. Stationery Office. 2*d*.). In the earlier discussions, the Minister directed special attention to the possibility of increasing the number employed by reducing the hours of work, limitation of overtime, rotation of shifts, regular holidays and the effects of such measures on wages and costs. Difficulties in filling vacancies, the actual or potential shortage of trained work-people and the determination of the effective labour supply among the unemployed nominally attached to various industries were also suggested for investigation, and in later discussions the Minister directed special attention to the need for ascertaining accurately the size and nature of labour supply and unemployment in particular industries, as well as in regard to recruitment, training and hours of work.

REPRESENTATIVES of several industries undertook to supplement the available information in such matters, but the Minister directed attention to the lack of balance in the age distribution or in the labour supply or rate of recruitment which exists between different branches of industry. Evidence of present or prospective shortage of skilled labour in some industries was also discussed, including its bearing on the absorption of other workers in the same or in ancillary industries, and the attention of industries was directed to the necessity of considering the new circumstances which would result from the raising of the school-leaving age and the reduction in the number of juveniles who would be available for employment. The discussions have made available a valuable amount of industrial information which should afford a basis for Government or other action if the industries concerned prove unmindful of the responsibilities in regard to the absorption of the unemployed which have thus been brought into prominence, and they illustrate in a striking manner the need for some attempt to handle industrial recruitment on quantitative lines.

The International Commission of Snow

A NEW section of the Association of Scientific Hydrology to deal with the varied problems of snow and ice was organized in time to hold its first meeting in Edinburgh last September a few days before the official opening of the International Congress of Geodesy and Geophysics. A very large number of papers from all over the world were on the programme, and it was felt that the manifold activities of this new Commission will go far to remove the reproach that the study of snowfall, unlike that of glaciation, has been neglected in most countries, even in those which have much snow. The president, Prof. J. E. Church (U.S.A.), who was unfortunately not able to reach Edinburgh in time for the Conference, being detained in Moscow by illness, presented a valuable address on "Snow Surveying: its Methods and Principles", in which he showed the economic importance of the snowfall in the high mountain ranges of the western United States to the semi-arid plains below. The papers will all eventually appear in the *Proceedings of the Association of Scientific Hydrology*. The next meeting of the International Snow Commission will be in Washington, D.C., in 1939. Meanwhile, the various national sections will carry out group work in the problems of snow. In view of the first meeting of the International Snow Commission being held in the Scottish capital, the question of British co-operation in the work naturally came into prominence. A British group of members under the chairmanship of Mr. G. Seligman was formed during the early part of 1936, and by the time of the Edinburgh Conference totalled sixteen, of whom ten attended the Conference. Four papers were presented by the British group, two of which, appropriately to the occasion, dealt with snowfall in the British Isles, one by Captain W. N. McClean on the influence of snow and ice on river discharge in the Scottish Highlands, and the other by Mr. L. C. W. Bonacina on problems of drifting snow in mountainous districts with special reference to the Scottish Highlands.

Index of Geographical Literature

IN 1918, the Royal Geographical Society found it necessary on the grounds of economy to abandon the practice hitherto followed of including in each issue of the *Geographical Journal* a list of additions to the library. These lists from then onwards have been published as separate pamphlets from time to time and distributed to such fellows as expressed a desire to receive them. Up to December 1932, forty-one of these supplements had been published. The entries in these supplements, especially as regards books, atlases and papers, though nominally additions to the catalogues of the Society, in effect comprise a fairly exhaustive list of all geographical literature outside the pages of the *Geographical Journal*. The Society has now published an "Index to Supplements to the Geographical Journal, Vols. 1–5, Numbers 1–41: 1918–1932" (London: Royal Geographical Society. 16*s.*: to fellows, 12*s.* 6*d.*). The terminal date is chosen as coinciding with the termination of the "Fourth General Index" to the *Geographical Journal*. The volume also serves as an index to much of the contents of the annual volumes of the *Bibliographie Géographique Internationale*, for which decennial tables have not recently been issued, the volume numbers in the Index giving the date of publication to within five years.

THE Index which is thus made available is under one alphabet, giving authors and regional names in heavy type. Comprehensive headings are subdivided by italic headings, thus greatly facilitating reference. Thus under British Empire the subdivisions are agriculture and forestry, communications, defence, economics, education, history, mineral resources, politics, population, power, survey, text-books and travel. The lack of a rigid plan of subdivision and the adoption in each large grouping of one suitable for the character of the entries, are useful features. Considerations of space have limited each item to one subject entry. Titles in the less familiar languages are given in the language used in the summaries appended to the articles. Maps and photographs in the Society's collection are omitted, but all atlases are included.

Composition of Scientific Papers

EACH of our two leading medical contemporaries—the *British Medical Journal* and the *Lancet*—includes in the issues of January 2 some helpful suggestions to writers of scientific papers upon styles of composition and typographical conventions. The *British Medical Journal* is given a much more attractive appearance than it has had hitherto by the use of a cover of grey paper with a scarlet design upon it, and the type of the journal has been entirely changed, being now that created a few years ago for the printing of *The Times*. This type is more legible than that formerly used and is particularly suitable for comfortable reading. The *British Medical Journal* announces in the same issue that, in future, the Harvard system of references to scientific literature will be used, instead of numbered references, such as are used in NATURE. Examples are given of these two systems of references to papers. The *Lancet* publishes a special supplement containing advice to authors on the preparation of scientific papers, words and phrases to avoid, summaries, abbreviations, references, and related matters. If these instructions were followed generally, the work of editors would be greatly relieved.

Air Raid Precautions

AIR RAID PRECAUTIONS HANDBOOK No. 4 is entitled "Decontamination of Materials" (London: H.M. Stationery Office, 1936. 6*d.*), and deals with contamination caused by chemical substances capable of giving off poisonous gases. These gases are classified as non-persistent and persistent, the book dealing chiefly with the latter, which include the tear gases (ethyl iodoacetate or *K.S.K.*, and bromobenzyl cyanide or *B.B.C.*) and the blister gases (mustard gas and lewisite). Decontamination of tear gases can be effected by using water, earth or a mixture of glycerin and caustic soda according to circumstances. Decontamination due to blister gases includes ventilation, hosing with water, removal by solvents, several methods of applying bleaching powder, immersion in boiling water, covering with earth, and destruction of the contaminated article by burning. In all cases, identification of the poison gas should precede attempts towards decontamination, and the latter should therefore be carried out only by persons specially trained and thoroughly protected. Appendixes in the manual deal with the equipment of a decontamination squad and methods of dealing with road surfaces, the structures of buildings, household articles and vehicles.

Colorado Potato Beetle

IN consequence of the spread of the Colorado potato beetle from France and Belgium into Germany and Luxemburg, the Ministry of Agriculture and Fisheries has made an order "The Importation of Plants (Amendment No. 2) Order of 1936" regarding plant imports into Great Britain. The Order imposes restrictions on the importation from Germany and Luxemburg of certain kinds of horticultural produce as from January 11. The restrictions are similar to those already in force with respect to like produce from France and Belgium. The provisions of the order require a certificate in one of two forms to accompany living plants, potatoes, raw vegetables and cider apples imported from the countries mentioned. Copies of the Order (S. R. and O. 1936, No. 1288), price 1*d.* each net, may be obtained from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2.

Campaign against Noise

THE Leningrad Institute for the Protection of Labour is doing much useful work in combating the noise of machinery in Soviet factories. Some two hundred silencers of special design have been fitted to the automatically driven lathes of Leningrad factories manufacturing electrical apparatus. It is claimed that these silencers reduce the noise of the machines to the loudness of the normal human voice. The Institute is also carrying out experiments to reduce the noise of machinery at other types of works and factories and on the motor-ships of the Black Sea. During the past year the Institute has received more than twenty different designs for silencers from Soviet engineers and factory workers.

Earthquake in Kent on December 29

AT about 1.30 p.m. on December 29, a very slight earthquake, accompanied by a rumbling sound, was felt in the east of Kent. The villages in which it was observed (Adisham, Nonington, Snowdown, etc.) are close to the centre of the area disturbed by the much stronger Canterbury earthquake of November 27, 1776, that was felt with some intensity (about 6, Rossi-Forel scale) at Canterbury, Sandwich, Deal, Dover, Folkestone and Ashford, and, though very slightly, at Calais, thirty-four miles from the centre.

Sands, Clays and Minerals

The most recent issue of this journal (**3**, No. 1, November 1936. A. L. Curtis, Westmoor Laboratory, P.O. Box 61, Chatteris, Cambridgeshire, price 3*s*. 6*d*.) has been considerably enlarged and contains articles covering a wide range of subjects. Topics of economic importance dealt with in this number include nickel, silica sand as a basis for phosphate deficiency tests on lettuce, minerals of Brazil, titanium oxide in industry, boron, soils, industrial water supply, barytes in Greece, mining resources in Tanganyika, etc. The articles are written by authors actually engaged in research on the subject, thus making them authoritative. A contribution by A. L. Curtis on the history and activities of the Fuel Research Station at Greenwich makes interesting reading. The journal is attractively produced, and is an excellent source of information, especially for mineralogists, chemical engineers and other men of science and technology concerned particularly with the mineral resources of the British Empire.

Physical Society's Exhibition Catalogue

The Catalogue of this Exhibition, which was open on January 5–7, now covers nearly 200 pages and is well provided with indexes of exhibitors and of apparatus, plans, stall numbers on the outer top corner of each page, marks for new apparatus and for demonstrations, all of which help a visitor to find readily what he wants particularly to see. Illustrations are plentiful, but many are limited to views of the outsides of the boxes containing the instruments, while the interest of the visitor is more often centred in the principle of the instrument itself. The division of the catalogue into two sections devoted respectively to trade exhibits and research and educational exhibits is maintained, and the award of prizes to apprentices for exhibits of work done is continued. A new announcement is made of the intention of the Council to apply part of the legacy bequeathed to the Society by the late Herbert Spencer, for grants to fellows for the purchase of special research apparatus. The order of the stands in the catalogue and their stand numbers are arranged geographically to facilitate reference, and the asterisk which now marks a new exhibit in the body of the catalogue might with advantage in future years appear also in the apparatus index.

Announcements

Sir William Bragg will open the new extension to the Research Laboratories of the British Association of Research for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades and the British Food Manufacturers' Research Association at 2 and 4, Dalmeny Avenue, Holloway, London, N.7, on January 19. There will be a reception from 3 until 6 p.m.

The King has been pleased, on the recommendation of the Secretary of State for Scotland, to approve the appointment of Prof. Lancelot Hogben, professor of social biology in the University of London, to be regius professor of natural history in the University of Aberdeen, in succession to Prof. James Ritchie. Prof. Hogben was formerly assistant professor of zoology in McGill University, Montreal, and professor of zoology in the University of Cape Town.

Mr. N. B. Kinnear and Dr. H. A. Baylis have been appointed to deputy keeperships in the Department of Zoology of the British Museum (Natural History). Mr. Kinnear was born in 1882 and is a great-grandson of Sir William Jardine, the early nineteenth century naturalist. He is well known as an ornithologist, and prior to his appointment to the Museum sixteen years ago was in charge of the Bombay Natural History Society's Museum. He is the editor of the *Bulletin of the British Ornithologists' Club*. Dr. Baylis was born in 1889 and was educated at Epsom College and Jesus College, Oxford. He entered the Museum in 1912, and has specialized throughout his career in parasitic worms. He is the author of many scientific papers on this subject, and has built up a very large collection of these organisms, of which, before his time, the Museum possessed only a few specimens.

Prof. P. M. S. Blackett will deliver the Cantor Lectures before the Royal Society of Arts on January 18, 25 and February 1. The subject of the lectures will be "Cosmic Rays".

The Sir Halley Stewart Trust has placed at the disposal of the Medical Research Council a sum of £500 a year for three years for a senior fellowship tenable in the Neurological Research Unit at the National Hospital for Nervous Diseases, Queen Square, London. This arrangement has been gratefully accepted by the Council with the concurrence of the Medical Committee of the Hospital, and the position has been awarded to Dr. Joseph Doupe.

The seventy-first volume of the *Journal of Anatomy* is termed the "Elliot Smith Volume" and is dedicated to Sir Grafton Elliot Smith (see p. 57). Appropriately enough, Part 1, which was issued last October, contains his portrait as a frontispiece and commences with a biographical sketch of his early career by Prof. J. T. Wilson, who, in his early years in the Challis chair of anatomy in the University of Sydney, included Elliot Smith among his students.

Mr. B. D. W. Morley, of Holy Trinity Vicarage, Madeira Road, Bournemouth, Hants, asks anyone who has been studying, or has at any time studied, communication among ants, to get in touch with him.

Will Mr. Paul Molde, of Copenhagen, who sent a communication to the Editor entitled "On the Atomic Structure of Living Matter : A Biole Hypothesis", kindly communicate his address.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 73.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Ancestors of the Diptera

IN a previous communication to NATURE some years ago (May 18, 1929) I gave a short description of a remarkable genus *Permotipula*, represented by a complete forewing from Warner's Bay, N.S.W., and of Upper Permian Age. Although very primitive by comparison with existing types of Diptera, this wing was regarded by me as being definitely Tipuloid and lying well within the order. I added the following remarks: "The wing is of the greatest interest, because any student of venation would classify it as dipterous and nothing else, and yet *we do not know whether the insect to which it belonged had four wings or only two*! Also, it is the oldest known dipterous type of wing by many millions of years."

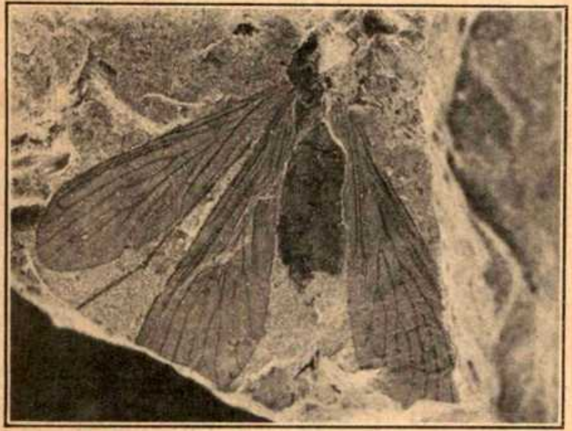

Fig. 1.

NEARLY COMPLETE SPECIMEN OF A PROTODIPTERON, ALLIED TO *Permotipula*, FROM THE UPPER PERMIAN OF WARNER'S BAY, N.S.W. LENGTH OF HINDWING ABOUT 5 MM.

It has always been my hope that, one day, a complete specimen of this insect, with its wings conveniently outspread, might be found at Warner's Bay by some lucky stroke of fortune. After many visits to that locality, and after the discovery of a fair number of dipterous wings, more or less allied to *Permotipula*, but, for the most part, too crumpled by the action of water to add much to our knowledge, I had almost begun to despair of ever finding a complete insect or of solving the problem of the nature of the hindwing in Permian times. But, on a recent visit, I had the good fortune to discover, right on the very edge of a large block of rock, an almost complete specimen of a genus extremely close to *Permotipula* (Fig. 1). This specimen had been preserved with the two wings on the right side superimposed in the normal way for a stegopterous insect, but, on the left side, the hindwing had slipped under and forward of the fore, so that the venations of both wings can be clearly made out, the only missing portion being the extreme apex of the forewing. We thus discover the remarkable fact that, apart from size, the forewings and hindwings are almost exactly alike; *if the hindwing had been found fossilized by itself, it would almost certainly have been considered to be the forewing of a primitive Tipuloid Dipteron.* In order to show this more clearly, a drawing of the separate hindwing is shown in Fig. 2, with the names of the veins marked on it.

It can be said at once that the venation is very close to that of the living family Tanyderidæ, though the fossil form is slightly in advance of the living types owing to the great reduction of the primitive fork of R_{2+3}. Further, we note the remarkable fact that the forewings and hindwings are attached to the thorax very close together, so that we are bound to conclude that the metathorax was already greatly reduced in the fossil form, in spite of the fact that the hindwing was large and fully functional. Finally, in view of the fact that a true Dipteron, closely allied to the Tanyderidæ, has now been discovered in the upper Triassic beds of Mount Crosby, Queensland, we are able to state definitely that the loss of the hindwing occurred during the period between the Upper Permian and the Upper Trias. But we are still as much in the dark as ever concerning the manner in which the reduction to a halter took place.

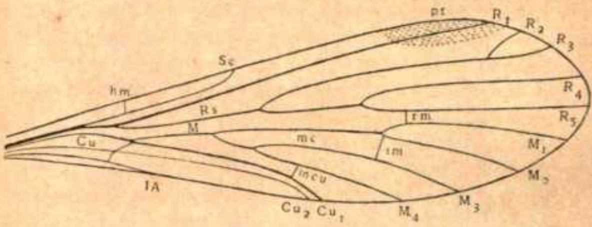

Fig. 2.

VENATIONAL SCHEME OF HINDWING OF THE SPECIMEN SHOWN IN FIG. 1. THE VENATION OF THE FOREWING IS SIMILAR, BUT *Sc* IS CONSIDERABLY LONGER.

As the new fossil cannot be placed in the order Diptera, and as it is clearly a specialized Paratrichopteron possessing a reduced anal area and only a single anal vein, I propose to term the group to which it belonged Protodiptera. The evolutionary series leading to the Diptera is now as follows:

(1) Order MECOPTERA (s.str.), family PERMOCHORISTIDÆ.

Rs with four or more branches, *M* with five or more branches, usually six; three anal veins present. All four wings present.

(Lower Permian to Upper Permian.)

(2) Order PARATRICHOPTERA.

Both *Rs* and *M* with four branches only, arranged dichotomically; three anal veins present. All four wings present.

(Upper Permian to Lias.)

(3) Order PROTODIPTERA.

Rs with four or three branches; *M* with four branches; anal veins reduced to two or one only. Cu_2 becoming obsolete and approaching Cu_1 closely. All four wings present.

(Upper Permian.)

(4) Order DIPTERA.

Rs and *M* both archetypically with four branches, but many forms show reduction. Anal veins at most two, generally only one. Cu_2 obsolescent or obsolete, usually indicated merely by a faint groove just below Cu_1. Hindwing reduced to a halter or balancer.

(Upper Triassic to Recent.)

In the above evolutionary sequence, it is important to notice that the first cubitus (Cu_1) is a simple, unbranched vein right through from (1) to (3) and also for the earliest types within the Diptera, but that, soon after the establishment of this latter order, the capture of vein M_4 by way of the cross-vein *mcu* produced a large number of forms (most of the recent Diptera) in which, as in the Trichoptera and Lepidoptera, the vein Cu_1 appears to be forked.

As the gaps in the fossil record are now all but filled, it is impossible to continue to maintain the Paratrichoptera and Protodiptera as fundamentally distinct from true Mecoptera. I therefore consider it advisable to treat these groups henceforth as specialized suborders of an enlarged order Mecoptera, to which all the four-winged forms with a simple Cu_1 are now relegated.

R. J. TILLYARD.

Canberra, Australia.
Oct. 25.

Combustion Levels

THEORETICAL flame temperatures and explosion pressures calculated upon the basis of the quantum specific heats (which have been shown to be substantially correct[1]) are never reached in flames and explosions. Even when measurements of the actual flame temperatures and explosion pressures are postponed for such length of time as to make it certain that chemical combination is complete and full allowance is made for heat loss, there is still a defect of the measured temperatures and pressures below the calculated—a defect which remains constant in amount during the whole of this time. In short, in flames and explosions, definite ceiling temperatures and ceiling pressures are reached which fall short of the calculated temperatures and pressures.

The defect of the ceiling flame temperatures and explosion pressures below the calculated has been shown[2] to be dependent upon the nature of the combustible gas, the nature of the diluent gases and notably the pressure at which combustion takes place—the higher the pressure the less the defect.

The defect in the explosion pressures is much less than the defect in the flame temperatures. (In ordinary flames the defect of temperature amounts to many hundreds of degrees centigrade.) A completely satisfactory correlation is obtained, however, if it be assumed that the pressure that really matters is the instantaneous pressure in the flame front[3].

Demonstration of the correctness of this view is provided by some photographic studies by Bone and Frazer of flame travel in long tubes closed at one end only—the firing end. Two of these will suffice for our purpose, namely, Figs. 1 and 4, plates 13 and 14, *Phil. Trans. Roy. Soc.*, A, **230**, 363 (1931). These relate to flame travel in $2CO + O_2$ mixtures and are reproduced here in Fig. 1 through the courtesy of Prof. W. A. Bone and Mr. R. P. Frazer.

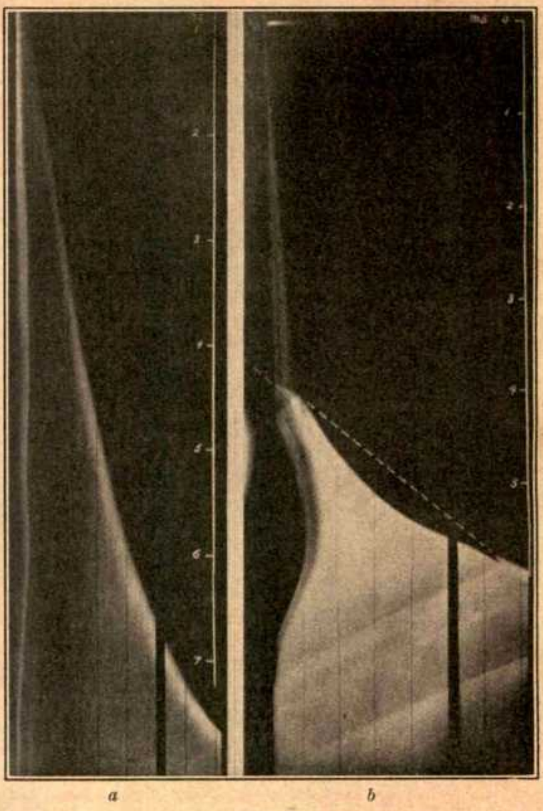

Fig. 1.

It will be seen from Fig. 1, *a*, that not only the flame front luminosity, but also the intensity of the after-glow in the flame gases left behind, increases with distance of travel of the flame front and therefore with pressure in the flame front. The intensity of the after-glow has been shown to be dominated by the temperature of the flame gases[4] and it may fairly be inferred that the temperature of the flame gases resulting from the combustion of any given inflammable mixture increases as the pressure in the flame front increases. This is very vividly demonstrated in Fig. 1, *b*, in which the pressure in the flame front after travelling some short distance is artificially increased by an overtaking shock wave. It will be seen that not only is there a marked and sudden increase in the luminosity of the flame front but in the after-glow also.

The combination of the mixture $2CO + O_2$ is complicated by dissociation in the flame gases, but this does not affect the interpretation of the photographs given above.

It has been suggested that a long-lived and stable form of latent energy resides in flame gases (as long as they remain in the homogeneous phase) which is probably located in metastable molecules of some kind or other formed in the flame front[5]. For many purposes the term 'combustion level' is a more convenient one, by which is meant the ratio of the energy which can be accounted for in flame gases on the assumption that they are normal gases to the heat of combustion of the inflammable gaseous mixture.

Measurements show that the combustion level in ordinary flame gases (which are assumed to be similar to those left behind the initial slow movement of flame during its passage through inflammable mixtures at atmospheric pressure) is of the order of 72 per cent in carbon monoxide – oxygen – argon mixtures, 80 per cent in carbon monoxide – air mixtures, 83 per cent in methane – air mixtures and 85 per cent in acetylene – air mixtures[6]. The combustion level in flame gases left behind a 'detonating' flame front would approach 100 per cent owing to the high pressure in the flame front.

The combustion level in any given mixture may apparently have any value between some lower limit and a higher limit approaching 100 per cent. The not very intense luminosity of many oxy-gas flames suggests much lower combustion levels than those measured in air-gas flames.

W. T. DAVID.

Engineering Department,
University,
Leeds.
Dec. 9.

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[1] *Phil. Mag.*, **18**, 307 (1934); **22**, 513 (footnote) (1936).

[2] *Phil. Mag.*, **21**, 280 (1936); **22**, 513 (1936); and in press.

[3] NATURE, **130**, 930 (1932); and *Phil. Mag.* (in press).

[4] *Phil. Mag.*, **9**, 390 (1930).

[5] NATURE, **138**, 930 (1936); also *Phil. Mag.* (in press).

[6] *Proc. South Wales Inst. Eng.*, 375 (1936).

Wave Mechanics of Couples (Neutron – Neutrino)

FERMI considers the β-decay as the transition of a 'heavy' particle from the neutral state (neutron) into a charged state (proton) with simultaneous emission of two light particles (electron, neutrino). I consider correspondingly the β-decay as a special case of processes in which a *couple of particles* (neutron – neutrino) are involved. The principal feature of these processes is the fact that the rest-mass of the single particle is not conserved, but only that of a couple as a whole. The accepted methods of quantum mechanics do not apply to this case; some new principle is required.

I reject the idea of introducing rest-mass as a *new* observable, since there is no variable known on which the corresponding operator should be applied. I shall show that a straightforward generalization of Dirac's method leads to a consistent theory of a couple of particles.

Let the co-ordinates of the two particles (in four dimensions; $x_4 = ict$) be x_k, X_k ($k = 1, 2, 3, 4$), the corresponding momenta $p_k = 1/i\ \delta/\delta x_k$, $P_k = 1/i\ \delta/\delta X_k$. Let $\gamma_1, \gamma_2, \gamma_3, \gamma_4$ be four Dirac matrices, $\gamma_k\gamma_l + \gamma_l\gamma_k = 0$ ($k \neq l$; $k, l = 1, 2, 3, 4$), chosen as real ($\gamma_k^+ = \gamma_k$) and normalized ($\gamma_k^2 = 1$).

Then the quantities $\gamma_{kl} = i\gamma_k\gamma_l$, $\Gamma = -\gamma_1\gamma_2\gamma_3\gamma_4$, $\Gamma_k = i\Gamma\gamma_k$ are also real and normalized. We construct the most general operator Ω which is (1) a real number in the hyper-complex algebra of the γ's, (2) linear in the p_k, (3) linear in the P_k, and for which (4) $\Psi^+\Omega\Psi$ is a relativistic invariant ($\Psi(x,X)$ is a wave function with four components forming a column, Ψ^+ its adjoint, forming a row); the form of Ω is uniquely determined, as

$$\Omega = A + B\,\Sigma_k\gamma_k p_k + C\,\Sigma'_{kl}\gamma_{kl}(p_k P_l - p_l P_k) + D\,\Sigma_k\Gamma_k P_k + E\Gamma,$$

where A, B, C, D, E are real constants.

In analogy with Dirac's theory, we subject Ω further to the

Postulate: Ω^2 is free from spin quantities.

Since Ω^2 must be invariant, it must have the form

$$\Omega^2 = A^2 + B^2\Sigma_k p_k^2 + C^2\Sigma'_{kl}(p_k P_l - p_l P_k)^2 + D^2\Sigma_k P_k^2 + E^2.$$

The analysis of this postulate leads to the

Theorem: The necessary and sufficient condition for Ω^2 being free from spin quantities are the relations

$$A = 0,\ BD - CE = 0.$$

They reduce the five constants to three. As the dimensions of Ω do not matter, we can choose one constant as unity, say, $E = 1$. For the only two arbitrary constants left we introduce the notations $B = \lambda_0$, $D = \Lambda_0$ (Compton wave-lengths); then $C = \lambda_0\Lambda_0$, and

$$\Omega = \Gamma + \Lambda_0\Sigma_k\Gamma_k P_k + \lambda_0\Sigma_k\gamma_k p_k + \lambda_0\Lambda_0\Sigma'_{kl}\gamma_{kl}(p_k P_l - p_l P_k).$$

Here p_k and P_k have to be replaced by $p_k + \alpha\Phi_k$ and $P_k + \beta\Phi_k$, where the electromagnetic potentials Φ_k are symmetric functions of $x_k - X_k$ and α, β operators which transform any function of x_k, X_k into its symmetric resp. antisymmetric part. Then the wave equation can be derived from the variation principle

$$\delta\int\Psi^+\Omega\Psi\,dx\,dX = 0.$$

For treating an assembly of particles one has to consider Ψ, Ψ^+ as observables (non-commuting quantities), and to apply the method of second quantization.

I have proved that this theory represents the electromagnetic forces and the nuclear 'exchange' forces by the same formalism.

MAX BORN.

University,
Edinburgh.
Nov. 26.

Interaction by Resonance of Radio Waves

DR. MARTYN and I have already given a quantitative theory of the phenomenon known as the interaction of radio waves[1]. This theory has been found to be in good agreement with observation, and has in particular led to conclusions about the acoustic distortion of the impressed modulation which the subsequent observations of van der Pol and van der Mark adequately confirmed. There is, however, in this theory an inaccuracy of which I became aware about a year ago while engaged in a related investigation, and which at first sight appears of no great importance.

On revising the theory and establishing it on a more rigorous foundation, however, an unexpected and interesting consequence emerged, namely: that in regard to the amount of modulation which a wave W can impress on another wave W', there may occur a notable degree of *resonance* when the angular frequency ω of the wave W passes through the value Ω, where $\Omega = He/m$ is the 'gyro-frequency' corresponding to the total terrestrial magnetic force H in the part of the ionosphere concerned.

The theory also deduces, from the generally accepted body of knowledge about the propagation of radio waves and about the motions of electrons in air, that a radio-station the wave of which has an angular frequency within about 5 per cent of the local gyro-frequency can produce observable interaction with suitable medium and long waves when this station radiates power at the rate of about one or two kilowatts.

Among conditions favourable to the occurrence of such resonance-interaction the following are indicated: The received sky wave W' should be reflected from a region of the ionosphere the horizontal projection of which lies within about 200 kilometres from a 'gyro-station' and should have a minimum wave-length λ_m which depends on the distance D, between the radiator of W' and the receiver, somewhat as follows:

D (km.)	400	600	1,200
λ_m (metres)	2,000	1,200	500

These estimates of λ_m are made for the average nocturnal circumstances which Martyn[2] supposes to occur in the lower part of the E-layer, and much lower values of λ_m may be expected to correspond to certain abnormal conditions which are known to occur occasionally[3].

After reaching these conclusions, I looked over some old issues of *World Radio* and was agreeably surprised to find the following report[4] by the secretary of the World Radio Research League: "Mr. L. Thompson, of Ambleside, Westmorland, reports a background of Dublin (222·6 m., 0·2 kW.) on Athlone (531 m., 60 kW.). Here is apparently a shorter-wave affecting a longer-wave station. This was observed by Mr. Thompson on another occasion".

From such magnetic data as are available to me at present, the resonant wave-length in the E-layer half-way between Athlone and Ambleside is estimated to be about 232 metres, which differs by only 4 per cent from the wave-length of Dublin's radiation. Also the power radiated at the time of Mr. Thompson's observations might well have been 0·5 kilowatt, for that is the power officially assigned to Dublin's station in the issue of *World Radio* published two weeks after that in which the observations were reported.

The fact that the radiation interfered with has a wave-length as low as 531 metres leads to the conclusion that in those parts of the E-layer concerned with the interaction, a gradient of ionization existed which considerably exceeds those adopted by Martyn[2].

A survey of contemporary European and American wave-lengths and powers shows that among others the following broadcasting stations may be found to produce by resonance-interaction observable backgrounds in the waves received from other [illegible] Monte Ceneri (257·1 m.), Freiburg (25[illegible] (251), Lille (247·3), Radio Marco[illegible] (241·9), Saarbrücken (240·2[illegible] Klagenfurt (231·8), Vorarlb[illegible] Kiel (225·6), Hano[illegible] of NATURE have already observed this interaction by resonance, or can observe it in connexion with any of the stations given above.

If observations could be made with a station the frequency of which may be varied about the gyro-frequency, they could be used to determine at least two important quantities, namely, the values in the E-layer of the electron collision frequency and of the earth's magnetic force. In Australia there are unfortunately no stations suitable for this purpose, but I hope shortly to visit Europe and would be glad to have reports, on any relevant observations that may be made, addressed to me at the Queen's College, Oxford.

A fuller discussion of the theory will be published elsewhere in due course.

V. A. BAILEY.

Department of Experimental Physics,
University, Sydney.
Nov. 5.

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[1] Bailey, V. A., and Martyn, D. F., NATURE, 133 (Feb. 10, 1934); *Phil Mag.*, 18 (Aug. 1934).

[2] Martyn, D. F., *Proc. Phys. Soc.*, 47, 323 (1935).

[3] Appleton, E. V., *Proc. Roy Soc.*, A, 126, 567 (1930).

[4] *World Radio*, Feb. 8, 1935, p. 22.

Radio and Magnetic Observations at North-East Land during the Total Solar Eclipse of June 19, 1936

RADIO observations on the solar eclipse of June 19, 1936, were made by the Oxford University Arctic Expedition 1935–36 in North-East Land at 80° 23′ N., 19° 31′ E. in accordance with the programme arranged by a sub-commission of the U.R.S.I. One complete record showing the relationship between the equivalent height of reflection and the frequency of the exploring wave was obtained in steps of 0·2 mc./sec. The records, each of which took ten minutes to secure, were centred on each hour and half-hour from 03.30 to 07.30 G.M.T. on June 18, 19 and 20, 1936 (Fig. 1). Short-period variations would not therefore be observed.

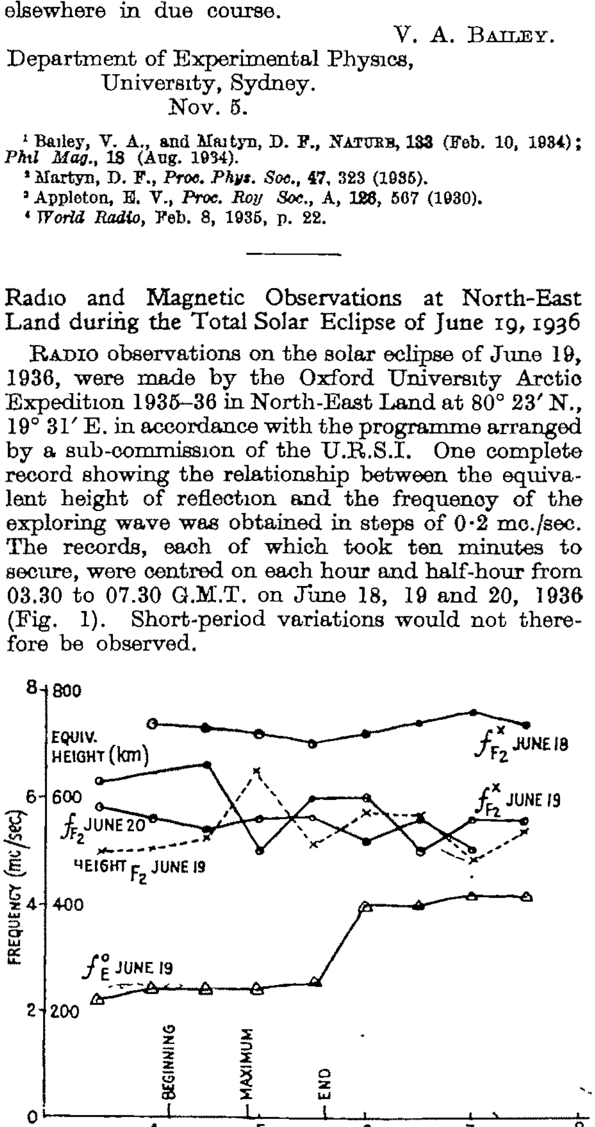

Fig. 1.

[illegible]ipse began at 04.10, was a maximum, 25 per [illegible]ea, at 04.54 and ended at 05.40. At the in the declination traces (Fig. 2), and this fact makes it difficult to interpret the exact effects of the eclipse. The magnetic disturbance is reported on a world-wide scale and appears to have begun about 17.45 G.M.T. on June 18. The most significant facts emerging from our observations are:

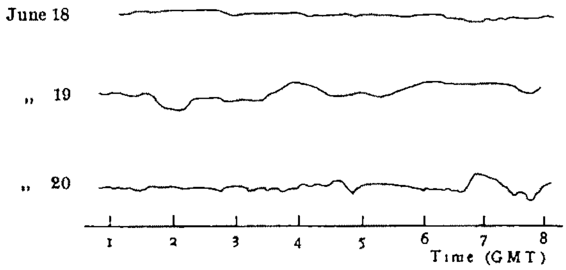

Fig. 2.

(1) On June 18 and 20, f^0_E rose fairly steadily from 03.30 to 07.30, but on June 19 it was below the average before and during the eclipse, and rose suddenly to a value above the average of June 18 and 20 immediately after the eclipse. Previous eclipse results have shown that f^0_E decreases when the ultra-violet light is cut off, but it is probable that in our case it was from the abnormal Region *E* that echoes were obtained. The persistence of echoes from the region beyond the critical frequency makes the determination of the exact value of this frequency difficult.

(2) On June 18 and 20 the ionization density of Region *F* increased as the day advanced. On June 19, however, after 05.30 it became vestigial and remained so until 07.30, but the ionization had increased again by 10.30, local noon.

(3) The height of Region F_2 was greater on the morning of the eclipse than on the other two mornings. At the time of maximum eclipse, it showed a marked increase in height, and $f^0_{F_2}$ decreased appreciably, showing a marked minimum.

A. B. WHATMAN.

Royal Signals Mess,
Catterick Camp,
Yorkshire.

R. A. HAMILTON.

Electrical Laboratory,
Oxford.

The 2·73 μ Absorption Band of Fused Silica

DR. D. G. DRUMMOND, in commenting[1] upon his own and our suggestions[2] that the 2·73 μ band of fused quartz is possibly produced by dissolved carbon dioxide, suggests that it would be of interest to know whether the quartz specimens which we used were prepared without contact with carbon. This interest arises from the fact that in none of our specimens did we find a trace of the band in question, whereas other investigators always have found such a band. Inasmuch as we had made a particularly careful study of a 5 mm. plate furnished us by the Hanovia Chemical and Manufacturing Company, of [illegible] N.J., we wrote to this company and wish [illegible] them as follows: "Quartz specimens of o [illegible] facture are prepared between carbon bl [illegible] [illegible] with flames containing carb [illegible] some methods of manufacture must be other than carbon dioxide. We made observations on several other samples, some of which were probably furnished by other companies, but we are unable to make a complete trace of the records of purchase.

In our previous letter[2], we gave our reasons for believing that the impurity involved may be water-vapour. Evidence for the existence of either carbon dioxide or water vapour could doubtless be obtained either by Dr. Drummond or by some other experimenter possessing a fused quartz specimen several centimetres in thickness which shows the 2·73 μ band. This could be done by locating higher overtone bands in the region of waves shorter than 2·7 μ. In support of the water vapour hypothesis, we wish to point out that if this appeared as an impurity to the extent of only a few tenths of one per cent, it would account for the depths of the 2·73 μ absorption band even in the cases of those earlier investigations in which the bands appeared with considerable intensity.

J. W. ELLIS.
W. K. LYON.

University of California
at Los Angeles.

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[1] Drummond, NATURE, 138, 248 (1936)

[2] Ellis and Lyon, NATURE, 137, 1031 (1936).

THE note by Drs. Ellis and Lyon appears to leave no longer tenable the hypothesis of carbon dioxide impurity as the cause of the 2·73 μ absorption band in fused silica. They suggest searching for higher overtone bands as a method of identifying the impurity. From my published curves[1] in the shorter wave-length region, it will be seen that though the 2·73 μ band appears with considerable intensity in Section *C* (29·85 mm. thickness) the water vapour bands near 1·36 μ and also 1·87 μ are absent, though they might have been expected with intensities of the order of 10–20 per cent. The water vapour band near 6 μ would not be expected to show, even if present, in Section *H* (0·109 mm. thickness), since here the thickness of material is much too small.

I should mention that in curve *A*, in my paper quoted, the resolving power was too low to decide whether narrow bands were present, the great length of this specimen preventing the utilization of the full resolving power of the apparatus.

I have observed this 2·73 μ band also in emission from hot fused silica, and intend publishing a note to describe this work.

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[1] Drummond, *Proc. Roy. Soc.*, A, 153, 328 (1936).

Mechanism of the Diastole of Contractile Vacuoles

IT is still not known what causes the passage of fluid from the cytoplasm into the contractile vacuole of a protozoan. In a recently published paper[1], [illegible] claimed that the rate of this "infiltration" [illegible] the vacuole will be proportional, among [illegible] the difference between the hydro- [illegible] cytoplasm (which is maintained [illegible] and the colloid osmotic [illegible] former tending to

Under an inversion OP.OP′ = K, if P is on a sphere with centre C and radius r, bend $b = 1/r$, then P' is on a sphere with bend

$$b' = b(OC^2 - r^2)/K.$$

If P is on a plane (directed of course) at a distance δ from O, then P' is on a sphere with bend $b' = 2\delta/K$.

Hence

$$Kb'_1 = OC_1^2 - 1$$
$$K(b'_2 + b'_3) = 4$$
$$Kb'_4 = OC_4^2 - 1$$
$$Kb'_7 = OC_7^2 - 1.$$

Also since C_1 is the mid-point of C_4 and C_7 and at a distance ± 2 from them,

$$OC_4^2 + OC_7^2 = 2(OC_1^2 + 4).$$

Hence, in general,

$$b'_4 + b'_7 = 2(b'_1 + b'_2 + b'_3).$$

Similarly,

$$b'_4 + b'_6 + b'_8 = b'_5 + b'_7 + b'_9 = 3(b'_1 + b'_2 + b'_3).$$

The argument in this form is only good for a flat space.

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[1] NATURE, 138, 958 (Dec. 5, 1936).

Points from Foregoing Letters

THE discovery of a fossil insect (a protodipteron from the Upper Permian of Warner's Bay, N.S.W.) which throws light on the evolution of two-winged insects (Diptera) from four-winged ones, is reported by Dr. R. J. Tillyard. The author gives a list of the stages which have led to the evolution of Diptera during the period between the Upper Permian and the Upper Trias.

To explain the discrepancy between the temperatures and pressures observed in gaseous explosions (neither of which reach the calculated values), Prof. W. T. David assumes that the effective pressure is the instantaneous pressure in the flame front. He reproduces two photographs of flame travel by Bone and Frazer, from which he infers that the temperature of the flame increases as the pressure in the flame front increases. Prof. David introduces the concept of 'combustion level'—the ratio of the energy which can be accounted for in the flame gases, to the theoretical heat of combustion.

By a generalization of Dirac's method, Prof. Max Born develops a theory of the emission of electrons in atomic transformations, as a special case of processes in which a pair of particles (neutron and neutrino) is evolved, the principal feature being that the rest-mass of a single particle is not conserved, but only that of the pair as a whole. The theory represents the electromagnetic forces and the nuclear 'exchange' forces by the same formalism.

Further developments of the theory of the interaction of radio waves leads Prof. V. A. Bailey to the conclusion that a notable degree of resonance may occur when the angular frequency of the wave which causes interaction approximates to the 'gyro-frequency', corresponding to the total terrestrial magnetic force in the part of the ionosphere concerned. He further deduces that observable interaction may be caused by a station which radiates power at the rate of 1 or 2 kilowatts when its frequency is within 5 per cent of the relevant gyro-frequency. A list is given of stations which may be found to produce resonance-interaction.

Radio and magnetic observations made during the solar eclipse last June at North-East Land are reported by A. B. Whatman and R. A. Hamilton. The ionization density of the F region became very small during the eclipse. The f_E^0 layer of the ionosphere was below the average before and during the eclipse but rose above the average after the eclipse, and the height of the $f_{F_1}^x$ layer was at a minimum during the eclipse while that of the F_2 region increased.

The origin of the absorption band at 2·73 μ in certain specimens of fused silica remains unexplained. Dr. J. W. Ellis and Dr. W. K. Lyon state that a specimen which did not show this absorption band nevertheless probably contained carbon dioxide, so that carbon dioxide cannot be the cause of the absorption band. On the other hand, Dr. D. G. Drummond reports that a specimen which shows the band at 2·73 μ does not show the water vapour bands at 1·36 and 1·87 μ, which rules out water as the source of the former band.

The expansion of the contractile vacuoles of Protozoa cannot be explained, according to Dr. J. A. Kitching, merely by reference to the hydrostatic pressure of the cytoplasm. Experiments on freshwater Protozoa give further support to the osmoregulatory theory, which implies an active secretion at the vacuolar surface.

Dr. E. Ashby and L. C. Luckwill find that when a dwarf strain of the tomato is crossed with a tall variety of a nearly related species (*Lycopersicum racemigerum*), the growth-ratio between stem-weight and leaf-weight in the hybrid is not intermediate between that of the parents but is inherited in the manner of a 'simple dominant'. In this it resembles other physiological characteristics, namely, the efficiency index, the assimilation rate and the respiration rate.

A marked growth response of plants to permanganates has been further investigated by M. E. Webster and Dr. I. M. Robertson by means of controlled pot experiments with the cactus, *Opuntia Leucholricha*.

Dr. E. G. Cox, A. J. Shorter and Dr. W. Wardlaw state that X-ray studies of several quadricovalent derivatives of bivalent tin and lead show that those metals can possess a planar distribution of four valencies. As tin and lead with a principal valency of four have a tetrahedral distribution of bonds, it appears that in these cases, as with copper, silver and platinum, the principal valency determines the arrangement of their atoms.

Dr. J. Newton Friend suggests that realgar (arsenic disulphide) found with Roman remains at Wookey Hole, Somerset, had probably been imported for medicinal purposes.

Dr. F. Morley gives a formal proof of the hexlet, which should be read in conjunction with Prof. Soddy's article (p. 77) and the note on p. 62.

Research Items

Races on the North-West Frontier of India

THE physical anthropology of the inhabitants of central Asia is known only from the measurements taken by Sir Aurel Stein on his various journeys of exploration. To three series already recorded a fourth has now been added—measurements of the inhabitants of the valleys of Hunza in the Gilgit Agency and Swat in the North-West Frontier Province. These have been subjected to statistical analysis by Dr. G. B. Morant (*J. Roy. Anthrop. Inst.*, 66, Pt. 1). The series from the Swat Valley consists of 54 men of Torwal (classified on linguistic grounds as Dards) and 25 Pathans. The people of Hunza, which lies at the junction of India, Chinese Turkestan and Afghanistan, are the people speaking Burushaski, a tongue related to no known language. Part of their valley has been occupied by Wakhi. 75 Hunza men and 25 Wakhi were measured. The principal measurements are as follows: Torwali, cephalic index 75·3, nasal index 68·1, stature 1,688·8; Pathan, cephalic index 76·9, nasal index 72·0, stature 1,654·8; Hunza, cephalic index 79·6, nasal index 71·4, stature 1,688·1. Dr. Morant from his analysis of the material concludes that the Pathans differ from the Torwali in having smaller head-lengths, facial height and stature and relatively broader faces and noses. Between the Hunza and Torwali the significant differences are the head length, head breadth, and cephalic index, nasal height and nasal breadth. The men of Hunza have the smaller head length and the larger head breadth, so that the mean cephalic index is apparently the larger and nasal height and breadth the smaller. The Hunza-Pathan series differs significantly in head breadth, cephalic index, nasal height, nasal breadth, stature and facial height. The two elements in the Swat valley are more nearly akin to one another than either to the men of the Hunza valley. The Pathan is less variable than the Torwali and both are less variable than the Hunza—a remarkable and unexpected result.

Ivory Arrow-Straightener from Alaska

AN ivory arrow-straightener of considerable interest has recently been presented to the British Museum (Bloomsbury) by the Trustees of the Christy Fund. It has been described and figured by Mr. A. Digby (*Brit. Mus. Quarterly*, 11, 1). It resembles a spanner with an oblique rhomboid hole at one end. The handle terminates in a bear's head, the eyes of which are inlaid with wood; while at the other end beyond the hole are two smaller bear's heads. On all four surfaces small figures have been scratched with a stone point, or perhaps an iron nail. They depict either individual animals, seals and caribou, or scenes from Eskimo life. The back shows large and small deer, two of which leave footprints, an unusual feature in Eskimo art, and a hunting scene on the right-hand edge. A man paddling a kayak and flourishing a lance chases five caribou, while behind him are the floating carcases of three more. On one edge of the left-hand side is a similar scene. These scenes depict a method of hunting frequently adopted in autumn. The other figures on this side are a lone caribou, a row of dancing figures, three conical tents, such as are used in summer, and an Alaskan sledge. On the other side is a village scene showing summer tents, drying frames and human figures. A man is shooting at a row of birds represented by crosses. The front, or lower surface, is covered with figures, which may be seal or walrus. There are two human figures; at the lower end is the figure of a crawling man; and at the other end a man attacking a seal. The straightener is probably a tally recording the kill of the owner. The date is difficult to determine, but comparison with a drill bow in the Barrow Collection suggests the beginning of the nineteenth century.

Physiology of Flute Playing

THE rumour that players of wind instruments run the risk of respiratory diseases is still current in musical circles, although there has never been much scientific foundation. Jagic and Lipinfr (Wien, *Klin. Wschr.*, 32, 683 and 714; 1919) examined medically (including X-ray) 46 professional wind players who had played 4–5 hours a day for periods varying from 10 to 50 years. They found no case of emphysema or other lung disease among them. Dr. J. Roos ("The Physiology of Playing the Flute", *Arch. Néerland. Phon. Exp.*, 12, 1; 1936) reports data of interest bearing on the same question. Three professional flautists were submitted to a number of physiological tests while playing. The air pressure exerted was measured, in relation to the pitch of the note, and its loudness, on both of which factors it depends. The range of pressures was of the same order as those found by other workers for singing. The mechanism of giving air at well-regulated pressures through the lips is discussed. The velocity of the air leaving the flautist's mouth was equal to that of a hurricane, even for low notes.

A New Nemertine

IN 1931, W. J. Dakin and M. G. C. Fordham announced the discovery of a new type of nemertine worm with a multibranched proboscis, *Gorgonorhynchus repens*. Now a complete description of this unusual animal is furnished by the same authors (*Proc. Zool. Soc.*, 1936). It is shown that while it undoubtedly represents a new and remarkable genus, it is a member of the family Lineidæ of the Heteronemertini. When introverted, the proboscis lies in a closed cavity, the rhynchocœlom, on the dorsal side of the alimentary canal. When everted, the proboscis is a hollow dichotomously branched dendriform structure. At the beginning of the eversion, a single stump appears; this divides into two, four and finally a large number of fine branches. The tips of fine ends can be seen during retraction through the transparent walls. It is this much-branched proboscis, without parallel in the nemertines, that is the outstanding feature of the species. In spite of this, however, the general structure of *G. repens* shows clearly its relationship. The first specimens were found on the coast of New South Wales but afterwards from farther north on the same coast, from islands in the Great Barrier Reef, from India, and recently a worm of the same genus, if not indeed conspecific, has been sent to the authors from Bermuda.

Pycnogonids from Puget Sound

The above is the title of a paper by Harriet I. Exline (*Proc. United States Nat. Mus.*, 83, No. 2991; 1936) in which five species are described, three of which are new. All were collected on dredging expeditions of the University of Washington's research ship *Catalyst*. Pycnogonids are not commonly dredged in Puget Sound, but they are sometimes found in large numbers in certain isolated localities. In the waters around the San Juan Islands, which have been quite thoroughly investigated, probably only half a dozen specimens have been collected in the past ten years. On the other hand, with the investigation of the waters south of the San Juan, especially in the vicinity of McNeils Island, pycnogonids have been collected in large numbers among hydroids dredged from rocky bottoms. Two of the new species belong to the genus *Nymphon* and one to *Ammothea*.

Virus Diseases of the Potato

The number of virus diseases which attack the potato, with their permutations and combinations, render the study of this branch of science rather complicated. Viruses are, fortunately, capable of classification into definite groups, and with exchange of material between the workers in Holland, Great Britain and America, the relations of the different virus complexes are gradually being elucidated. A recent paper by Prof. P. A. Murphy and J. B. Loughnane (*Sci. Proc. Roy. Dub. Soc.*, 21, No. 40; Sept. 1936) compares some Dutch and Irish potato mosaic viruses. The diseases from Holland show the presence of the viruses designated X, B, Y, A, F, and vein-bending virus, and they occur either alone or in combinations. Slight variants from the forms A and Y were found, and the viruses X, Y and F did not always produce symptoms upon their hosts. Complex-diseases included veinal mosaic (Y or A), rugose mosaic or leaf-drop ($X + Y$), crinkle ($X + A$), and interveinal mosaic ($X + F$). The paper should make a material contribution to an international understanding of potato virus nomenclature. It should be read in conjunction with the American work upon the same subject (K. Koch and J. Johnson, *Ann. App. Biol.*, 22, 37; 1935). The potato virus known as aucuba mosaic has received detailed study from Dr. Phyllis Clinch, J. B. Loughnane and Prof. P. A. Murphy (*Sci. Proc. Roy. Dub. Soc.*, 21, No. 41; Sept. 1936). The aucuba virus produces a typical yellow mottle upon the leaves, but this type of symptom also appears with two other viruses, namely, the 'tuber-blotch' virus, and a virus latent in the Dutch potato Monocraat. These last two are probably identical, and it is proposed to designate them virus F, whilst virus G shall denote the active principle of aucuba mosaic.

Economic Effects of Sugar Cane Streak Disease

Wherever the effects of a virus disease upon a crop of economic importance have been investigated, some striking figures are brought to light. Messrs. A. P. D. McClean and R. H. Halse have made a large-scale survey of the sugar-cane districts of South Africa, which should leave no one in any doubt about the economic significance of the streak disease (*Proc. S. Afr. Sugar Technologists' Assoc.*, 1936). Approximately 241,220 tons of cane, with a value of £170,864, were lost in 1934–35, as a result of its ravages. Zululand had the heaviest infection, more than ninety per cent, the Natal districts south of Durban had 62 per cent on ratoon cane, and 48 per cent on plant cane. North of Durban, the disease was less severe, with 26 per cent and 19 per cent on ratoon and plant cane, respectively. The paper also makes some constructive investigation of several of the new varieties which have recently found favour in commercial practice. Those designated Co 290 and POJ 2725 are moderately resistant, whilst the POJ varieties 2714, 2722, and 2878, with Co 281, are highly resistant. One is left with the impression that the streak disease may well be controlled in the near future.

Time Discharge of Condensers

Everyone who has experimented with electric condensers knows that some types absorb a certain amount of electricity which does not come back immediately when the condenser is discharged. It is gradually liberated and accumulates on the plates as a residual discharge. This 'oozing out' effect is sometimes explained by assuming that a process analogous to viscous action is taking place, and that this prevents the immediate return to the normal state. The amount of the residual charge and the relaxation rate at which it is freed are of importance to the telephone engineer owing to the large number of condensers used in telephone apparatus. The explanation of the effect usually given starts with the assumption that dielectric absorption is due to an action of the molecular structure which takes place uniformly throughout the material. In a paper on this subject by W. A. Yager in the *Bell Laboratories Record* of November, it is shown that the relaxation effect is much too complicated to be explained in this simple way. The results show that the residual current involves a combination of relaxation times. A successful explanation has been made by K. W. Wagner, who postulates that the number and magnitude of the relaxation times are determined by the laws of chance. For the simple theory we get fair agreement for dielectrics, like pure liquids, of relatively simple constitution. But for dielectrics of even moderate complexity the simple formula is practically worthless. Wagner's equations appear to be applicable to systems of all degrees of complexity and it is concluded that a helpful advance in the theory of dielectric action has been made.

High-Permeability "Furukawa Magnetic Alloy"

In the September issue of the quarterly journal *Nippon Electrical Communication Engineering*, published in English by the Institute of Telegraph and Telephone Engineers of Japan, there is an important article on the new high-permeability magnetic alloy made by the Furukawa Electric Co., Ltd. In low magnetic fields it is known that this new alloy has a much higher permeability than the English mumetal. Its composition is now described, and we are told that its manufacture is protected by Japanese patents. It is manufactured in four grades called A, B, C and D respectively, each being suitable for specific purposes. These alloys are uniform and easy to work at any temperature. They can be rolled into transformer sheets as thin as 0·1 mm. or drawn into very fine wire. The time required for the heat treatment of these alloys is very short, and after taking the metal from the furnace it can be cooled in the air. The *A* alloy is of very high electric resistance, and is specially suited for the magnetic core of high-frequency devices. The characteristics of the *B* and *C* alloys show that they would be very suitable for use with audio-frequency transformers. The alloy *D* has extraordinarily high permeability, and is highly recommended for the iron cores of very sensitive relays and ammeters for use in electric power lines. By using the alloys for the cores of the transformers employed in aeroplanes, their weight has been reduced to one fifth of the ordinary values. A photograph is shown of a transformer core made of stalloy having a weight of 1,010 gm. and of another made of the new magnetic alloy fulfilling the same functions and weighing only 75 gm.

Atomic Weight of Arsenic

IN 1933 Baxter and Shaefer carried out two series of estimations of the atomic weight of arsenic by analysis of the tribromide and obtained the values 74·919 and 74·901 respectively. This led to the acceptance of the value 74·91 for the atomic weight of arsenic. This is 0·02 units below that found by Křepelka in 1930, which was adopted at the time by the International Committee for Atomic Weights. Křepelka and Kočnar have now (*Coll. Czech. Chem. Comm.*, 8, 485 ; 1936) synthesized arsenic tribromide from specially pure bromine and arsenic, and from determinations of the ratios $AsBr_3 : 3Ag$ and $AsBr_3 : 3\,AgBr$ they arrive at the new value 74·923, which thus lies between what were hitherto regarded as the most trustworthy determinations. This new value agrees better with Aston's value derived from the mass spectrum (As = 74·934, or 74·925 according to Babcock and Naudé) than the value found by Baxter and his collaborators. Křepelka and Kočnar have taken every precaution to use highly purified materials throughout their work, and whilst the new value lessens the discrepancy between the earlier values of Křepelka and Baxter respectively, there is still a difference of 0·01 unit. The same journal contains a paper from Prof. Moles of the Madrid Instituto Nacional de Física y Quimica dealing with the atomic weight of iodine and advocating the value I = 126·917.

Locomotive Fuel Economy

INVESTIGATIONS into the problems of combustion in locomotive boilers and prevention of fuel wastage have in the past been hampered by lack of a method for determination of unburnt fuel loss. A suitable technique has, however, now been evolved on the basis of a suggestion put forward by A. C. G. Egerton, and this was described in a paper by Dr. P. Lewis-Dale at a meeting of the Institute of Fuel on November 25. The principle of the technique is to carry out experiments similar to those usually employed for stationary boilers on the locomotive boiler while it is actually in service. This involves analysis of the exhaust gas, measurements of rate of combustion, amount of unburnt carbon and temperature of exhaust gases. In addition, analyses of the coal used, weighing and analysis of the ashpan ashes and various temperature measurements are essential to accurate interpretation of results. The investigation is in every case designed to last throughout a complete journey of the engine, and thus varying conditions of gradient, curves and wind are taken into account. A number of valuable observations have been made as a result of investigations of this description, the most valuable conclusion reached being that under certain working conditions the loss of heat due to unburnt carbon approximates 30 per cent of the heat which would have been generated by complete combustion of all coal fed to the furnace.

Automatic Starting Resistances

ON switching on electrical machines, very large currents may be obtained initially unless suitable starting 'resisters' are used. These resisters are varied by hand, being large resistance at the start when the counter electromotive force due to the rotating armature is zero and being all cut out when the machine is running at full speed. In the *Philips Technical Review* (Eindhoven) of July a description is given of new automatic starting resistances manufactured by the firm. The starting tubes, which have the trade name of 'starto' tubes, have a large negative resistance coefficient, that is, the higher their temperature the less their resistance. In this respect they are similar to the filament of an electric lamp or to a glass rod, which at ordinary temperatures has a very high resistance but when red hot has comparatively a very low one. These tubes work on the exactly opposite principle to the hydrogen-filled iron filament resisters, sometimes used as regulators, the resistance of which increases rapidly with the temperature. In starto tubes the semi-conductor used is a mixture of silicon and a ceramic 'binder'. The silicon itself does not possess a pronounced negative temperature coefficient, but on diluting with a suitable binder it has a large negative resistance coefficient. The resistance material is formed in the shape of a rod which is fixed inside a glass tube filled with argon. This filling is required because the silicon of the rod reacts with oxygen and hydrogen. The tubes are designed for different maximum currents of between one and a hundred amperes. On full load the rod is raised to red heat and its temperature is then about 800° C. Starting tubes can also be used to switch on lamps automatically when it is desired, as in theatres and cinemas, to light them up gradually. These starting tubes can be used for many other applications in electrical working.

The Galaxy

IN the issue of *Scientia* of December, Dr. J. S. Plaskett, of the Astrophysical Laboratory, Victoria, British Columbia, describes the progress made recently in our knowledge of the extent of, and the distribution of stars in, the Galaxy, and sums up the results obtained. In its main features it resembles the Andromeda Nebula—that is, a flat disk nearly circular 30,000 parsecs (each 3¼ light years) in diameter and 1,000–2,000 parsecs in thickness, in rotation about its axis and containing about ninety per cent of the total mass. Within this disk the star density decreases from centre to circumference and rapidly near the edge. Throughout the disk and for 5,000 parsecs beyond its edge and 10,000 parsecs on either side of it are scattered high-velocity stars and clusters, and near its central plane is a light-absorbing medium 500 parsecs in thickness. The sun is situated in the central plane 10,000 parsecs from the centre (in a direction away from Vega ?) and has a velocity of 275 kilometres per second, which would give the period of rotation of the Galaxy as 224 million years.

The Bowl of Integers and the Hexlet[*]

By Prof. Frederick Soddy, F.R.S.

INTO a hollow sphere of unit radius, with a curvature or bend, therefore, -1, put two solid spheres of radius $\frac{1}{2}$, or bend $+2$. The two solid spheres then kiss each other at the exact centre of the bowl, and kiss the latter at the extremities of its diameter through all three centres, no other disposition being theoretically possible. This three-sphere assembly may be termed the 'bowl of integers', since it has the unique property that the bend of every sphere of the infinitely infinite number of spheres that theoretically can be packed into it, so that each is located by its neighbours, is an exact integer which can be written down at once from those of its neighbours. It enables the nature of the 'hexlet' to be elucidated without either trigonometry or the algebra of irrationals.

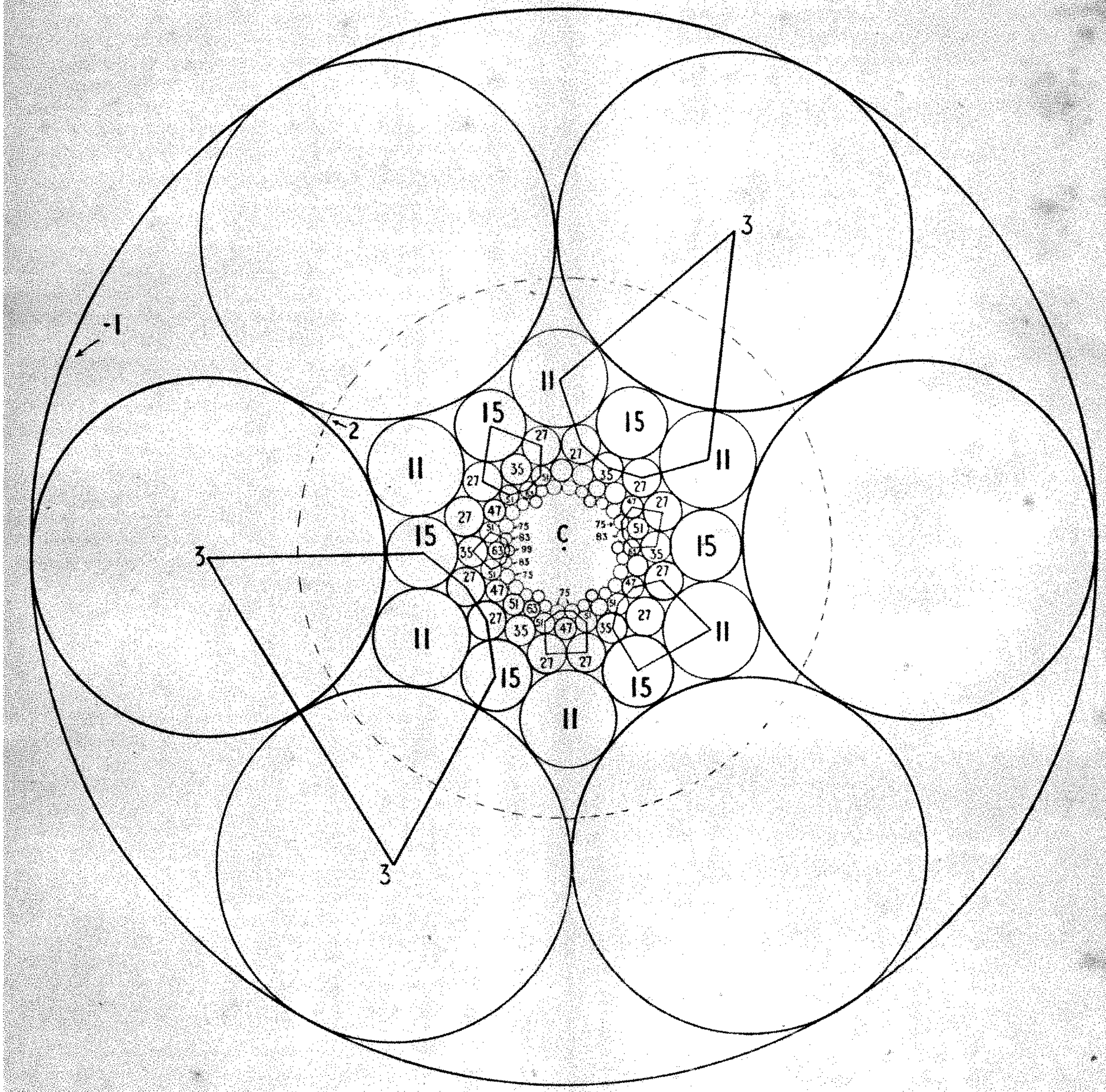

Fig. 1.

Fig. 1 shows a section through the bowl of integers through its centre, *C*, in the plane of the paper, which is also the point of contact of the two 2-spheres, one of which is above and one below it, the centres of the latter and their points of contact with the bowl being on the line through *C* vertical to the plane of the paper. The circle shown by a dotted line is the 2-sphere below the plane of the paper, and the figures labelling the circles are the bends, or reciprocals of the radii, of the spheres centred in the plane of the paper, of which they are sections. The space between the two 2-spheres and the bowl has been packed by successive rings of spheres, each ring in passing inwards consisting of ever larger and larger numbers of smaller and smaller spheres, until as we approach *C* they become infinitely small and infinitely numerous. All are in contact with the two equal 2-spheres above and below the plane of the paper, and all, being centred in this plane, are accurately represented by circles. So we may imagine similar rings of spheres above and below the plane of the paper, each in contact with the bowl and with one of the two 2-spheres, and then begin all over again to fill up the remaining spaces and so on *ad infinitum*, every sphere added increasing the number that have to be added to fill it up!

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[*] *Vide* "The Kiss Precise" and "The Hexlet" (NATURE, **137**, 1021, June 20, and **138**, 958, December 5, 1936).

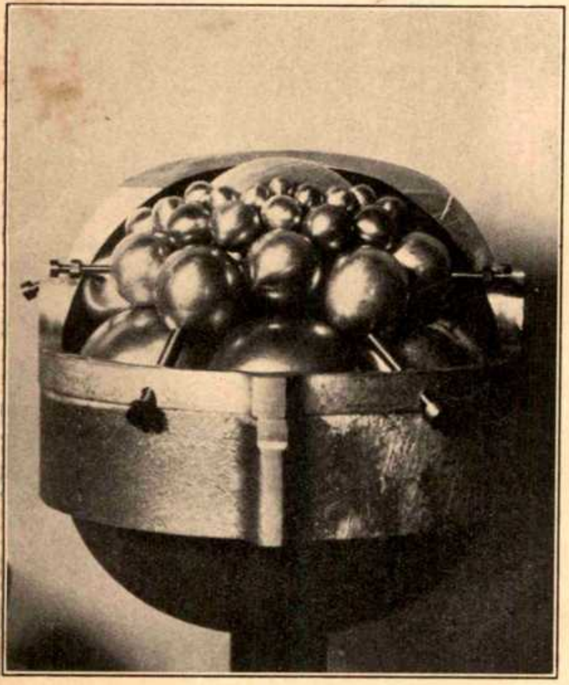

Fig. 2.

These further spheres being spaced in three dimensions cannot be accurately represented by a drawing, but they are all characterized by exactly integral bends. I discovered this years ago for the simpler case of cylinders, or circles, in connexion with the design of an actual mechanism, but it is true also for the spherical analogue. So long as the sum of the two radii of the two largest equals that of the enclosure, the bends are always rational, and when the largest two are equal in radius, integral with respect to that of the enclosure as unit. So far as I am aware, this has not before been observed.

From the case illustrated, the principles of the hexlet are easily exhibited. The largest spheres that can be fitted in after the two of radius 1/2 are a ring of six of radius 1/3, the centres of which are at the corners of a regular hexagon. It is the simplest case of the hexlet; all six spheres being equal, the bend, 3, is simply the sum of those of the common trio, namely, $2 + 2 - 1$. Going inward towards *C* the next ring has twelve spheres, six 11's alternating with six 15's; the next has 18, six contiguous pairs of 27's alternating with six single 35's; the next twenty-four, the series, 63, 51, 47, 51 being six times repeated round the periphery; and the last to be shown in the diagram has thirty, the unit series being 75, 83, 99, 83, 75.

Seven different hexlets belonging to the pair of 2-spheres and, respectively, to the 11, 15, 27, 35, 47, 51 and 63 spheres are indicated by the irregular hexagons formed by the six lines joining the centres of the hexlet. In every case the sum of the bends of any two opposite members is twice that of the central member plus 4, the latter being the sum of the bends of the two 2-spheres common to all the hexlets. Thus to take the last and smallest,

$$99 + 35 = 83 + 51 = 51 + 83 = 2(63 + 2 + 2).$$

In the same way each of the six 3-spheres is the centre of a hexlet, -1, 3, 11, 15, 11, 3, opposite members of which sum to $2(3 + 2 + 2)$. Three being given, the other three may be written down without further calculation. The hexlet round the 27- and 51-spheres are unsymmetrical. The others exhibit three different types of symmetry.

Fig. 2 shows a model of the bowl of integers with the tangential hexlets of the upper half, each sphere being in contact with the bowl and upper of the two 2-spheres. The unit series, six times repeated round the periphery, are for the successive rings I, 3; II, 6, 5; III, 11, 9, 9; IV, 18, 15, 14, 15; V, 27, 23, 21, 21, 23; VI, 38, 33, 30, 29, 30, 33 and so on.

In complete generality, the hexlet derives as follows. As a corollary of Euclid (ii, props. 11 and 12) that the centres and point of contact of kissing circles are collinear, *any* three spheres can make mutual contact, all three centres being necessarily in one plane, forming a triangle any two sides of which are necessarily greater than the third. But a fourth sphere may make mutual contact with them only if its size is between a maximum and minimum limit, which values apply when the centres are co-planar. Its size and position in space relatively to the others are dependent variables. The centre of the fourth, at its maximum say, may move out of the plane containing the centres of the trio, and the fourth sphere may retain contact with the trio anywhere in a closed orbit cutting the plane twice per revolution at the maximum and minimum, but only by shrinking or swelling in size between these two limits. These maximum and minimum values are those for the particular case when the hexlet round the trio is symmetrical (as in the hexlets in Fig. 1 round spheres 15, 35 and 63), and is divided into symmetrical halves by the plane containing the three centres of the trio and the two of the opposite largest and smallest beads. These values are, since for this case the centres are co-planar, the two roots of the quadratic equation for four *circles* in mutual contact ("The Kiss Precise", verse 2):

$$2(\varphi^2 + \alpha^2 + \beta^2 + \gamma^2) = (\varphi + \alpha + \beta + \gamma)^2,$$
$$\text{or } \varphi \pm = \alpha + \beta + \gamma \pm 2\sqrt{\alpha\beta + \alpha\gamma + \beta\gamma} \qquad (1)$$

where φ stands for the bend of the fourth sphere and α, β and γ for those of the trio, the sum of which will be termed σ. Equation (1) may be written $\varphi_{\pm} = \sigma \pm 2\rho$, where ρ is the bend of the circle inscribed in the triangle formed by joining the centres of the trio. $\varphi_{+} + \varphi_{-} = 2\sigma$.

But if the fourth sphere has any other value, say δ, between the maximum and minimum, the centres are no longer co-planar, but four bends being fixed, the fifth is determined by and can be found from the quadratic equation for five spheres in mutual contact (*ibid.*, verse 3).

$$3(\varphi^2 + \alpha^2 + \beta^2 + \gamma^2 + \delta^2) = (\varphi + \alpha + \beta + \gamma + \delta)^2$$
$$\text{or } \varphi \pm = \tfrac{1}{2}[\alpha + \beta + \gamma + \delta \pm \{6(\alpha\beta + \alpha\gamma + \alpha\delta + \beta\gamma + \beta\delta + \gamma\delta) - 3(\alpha^2 + \beta^2 + \gamma^2 + \delta^2)\}^{1/2}] \qquad (2)$$

As always, we get two real roots, which refer, not to opposite beads of the hexlet as in the two-dimensional equation, but to the two on either side of the one to which the bend, δ, has been assigned. Hence we have

$$\varphi_{+} + \varphi_{-} = \sigma + \delta\,; \text{ or } \varphi_{N+1} + \varphi_{N-1} = \sigma + \varphi_N\,; \text{ or } \varphi_3 = \sigma + \varphi_2 - \varphi_1,$$

where φ_{N+1}, φ_N and φ_{N-1} refer to the bends of any three consecutive beads. From this, any two consecutive beads being known, all the others can be written down at once, when it will be found, quite unexpectedly I think, that this simple relation conceals a periodic function, with a period of six, or $\varphi_{N+6} = \varphi_N$. Thus the six beads have values, in terms of those of any two consecutive beads, φ_1 and φ_2, (1) φ_1; (2) φ_2; (3) $\varphi_3 = \sigma + \varphi_2 - \varphi_1$; (4) $\varphi_4 = \sigma + \varphi_3 - \varphi_2 = 2\sigma - \varphi_1$; (5) $\varphi_5 = \sigma + \varphi_4 - \varphi_3 = 2\sigma - \varphi_2$; (6) $\varphi_6 = \sigma + \varphi_5 - \varphi_4 = \sigma + \varphi_1 - \varphi_2$; (7) $\varphi_7 = \sigma + \varphi_6 - \varphi_5 = \varphi_1$.

It will be seen that the sum of the bends of each opposite pair remains constant at 2σ, though *any* value δ between limits was given to the one bend arbitrarily fixed. The hexlet in fact is free to revolve round the trio without loss of serial contact, or separation of its several beads each from contact with all three of the trio. Similarly any given hexlet may be fixed and the trio varied through a definite cycle in which σ remains unchanged but the three individual bends vary interdependently.

The primary hexlet of the bowl of integers *is* free to revolve in its tri-spherically sided annulus without change of grade, because exceptionally all its beads are identical, and this property is not due to two of the spheres of the trio being equal, but derives from the sum of their radii being equal to that of the bowl. Using Roman letters for radii, A and B may have any values so long as they sum to C, or using Greek letters for bends, so long as $1/\alpha + 1/\beta + 1/\gamma = 0$. When we introduce this value for γ into the surd of equation (1) for four circles in mutual contact $\alpha\beta + \alpha\gamma + \beta\gamma$, it vanishes and $\varphi_{+} = \varphi_{-} = \sigma$. When we introduce these values for γ and δ, δ being the φ of equation (1) when $\varphi_{+} = \varphi_{-}$, into equation (2), its surd

$$6(\alpha\beta + \alpha\gamma + \alpha\delta + \beta\gamma + \beta\delta + \gamma\delta) - 3(\alpha^2 + \beta^2 + \gamma^2 + \delta^2), \text{ or } (\varphi_{+} - \varphi_{-})^2,$$

also becomes zero, and $\varphi_{+} = \varphi_{-}$. That involves that all the six spheres of the hexlet are identical, because the opposite members as well as those on each side of them are all equal.

In conclusion, one point of really fascinating historical interest emerges. The Greeks, in their study of the αρβηλος or "shoemaker's knife", obtained by pure geometry the radius of the fourth circle that will make mutual contact with a mutually tangent trio for which $A + B = C$, whatever the ratio $A : B$. The proposition from the Arabic "Liber Assumptorum" will be found in full with notes in Sir Thomas Heath's "Works of Archimedes", p. 307 (Camb. Univ. Press, 1897). In the actual figure by which the proof was demonstrated A/B was 3/2, which gives for the radius in question 6/19, in terms of C as unity, when, therefore, A is 3/5 and B is 2/5. Since $\varphi = \sigma$,

$$\varphi = 5/3 + 5/2 - 1 = 19/6\,!$$

It is curious this should have remained unnoticed for thousands of years. Possibly when a mental arithmetic of reciprocals becomes as natural as that of number we may hope to learn the real secret of the circle and the sphere.

Climatic Discomfort

MR. W. F. TYLER, an engineer interested in meteorology, was led to make an investigation into the connexion between climatic discomfort and the state of the atmosphere in regard to temperature and humidity. A summary of his work is to be found in a reprint of a paper read before Section J (Psychology) of the British Association at Blackpool.

Mr. Tyler began his work at Shanghai more than thirty years ago. He was helped by the late Father Froc, then director of Siccawei Observatory, Shanghai, and by twelve observers—well-educated, intelligent men, one gathers—who during the month of August 1902 made an observation at every noon of their sensation of discomfort from the heat and dampness while sitting quietly in their offices, cooled by the punkah or fan to which they were accustomed. Their sensations were recorded on an arbitrary scale extending from 1 to 10; the numbers on the scale have been called hythers, hyther 10 being taken to represent an "unbearable condition". As the result of these determinations we have a very interesting diagram in which the hythers are shown as sloping, nearly parallel, slightly curved lines derived from plottings of the individual observations with temperatures as abscissæ and the differences between the dry and wet bulb thermometers as ordinates. The course of each hyther shows how much change in the depression of the wet bulb was required on an average to prevent any given change of temperature from altering the discomfort appropriate to that hyther.

One is tempted to criticize this fundamental diagram, on which a number of climatic studies have been based, on the grounds that the data are too meagre, that one individual differs greatly from another in response to atmospheric conditions, and that each varies according to health, state of mind and other influences, but Mr. Tyler surely deserves credit for trying to bring more precision into the psychology of hot climates, and his work should be of practical value in problems of air conditioning in such climates. Hythers suitable for temperate climates might be useful to European weather forecasters in more scientific times in the future, when air temperature and discomfort may be forecast separately. The general public does not know that in present-day forecasts the forecaster's references to temperature apply to temperature recorded in a screen designed to remove the vitally important effects of radiation. This fact results often in the anomaly of the forecaster knowing that he has made a technically correct forecast while even intelligent readers of the forecast imagine that it has gone utterly astray. But the hyther system would be more likely to give useful results in the near future in the comparison of different climates with very large contrasts of temperature and humidity.

The usefulness of a scale of discomfort of the type used by Mr. Tyler is apparent from a recent article entitled "Temperature Profiles in Toronto" by W. E. Knowles Middleton and F. Graham Millar (*J. Roy. Ast. Soc. Canada*, Sept. 1936). It is an account of observations of air temperature made with a nickel resistance thermometer of small lag, well shielded from radiation, which was mounted two feet from the front of a car 27 inches above the road. The observations were made in a street that runs north-north-west from the shore of Lake Ontario to the northern limit of the town of Toronto and continues as a paved highway several miles farther in the same direction. Observations of this kind, it may be noted, were made by H. Tollner in Vienna in 1931 (*Sitz. Akad. Wiss. Wien, Math. Nat. Kl.*, Abt. II$_a$, 141, 1–13; 1932). The results of a few selected sets of observations are discussed. They are shown as graphs with temperature as ordinates and distances from the lake as abscissæ. The elevation of the land is also plotted, so that temperature variations can be related at a glance to the changes of elevation. On a hot sunny day with light southerly wind, a very sharp rise of temperature was observed in the first 200 yards from the lake front and then an average increase of 1·3° F. in each mile for five miles, after which temperature fell a few degrees in the more countrified surroundings. At such times workers in offices near the lake have the advantage in temperature but experience a higher humidity and dew point as compared with their families in the residential parts higher up and farther from the lake. In the absence of a sensitive scale of climatic discomfort on the lines of the scale obtained by Tyler, it is difficult to form an idea as to which of the two is the better off. Another graph for a clear winter night showed a difference of no less than 27° F. between the bottom of a valley and its crest, for a difference of height of about 120 feet.

Chemistry of Essential Oils

IN the nineteenth Streatfeild Memorial Lecture, delivered at the Institute of Chemistry on November 20, Prof. John Read, of the University of St. Andrews, described a chapter in organic chemistry of extraordinary fascination. He showed how the discovery by Captain Cook of Australia opened a new field of research in the related sciences of botany and chemistry, which was soon appreciated by the early settlers in that continent.

Dr. John White, Surgeon-General to the first settlement at Botany Bay under Governor Phillip, and First Assistant Surgeon D. Considen, both referred in or about 1788 to a large peppermint tree growing around Port Jackson, the essential oil of which bore a close resemblance to that obtained from peppermint (*Mentha piperita*) long grown in England. This Australian tree, now known as *Eucalyptus piperita* or the Sydney peppermint, was supposed to contain the same odoriferous constituent, menthone, as the English tree. But in 1900 this peppermint odour of the genus *Eucalyptus* was shown by H. G. Smith to be a distinct ketone to which he gave the appropriate name of piperitone.

Prof. Read compared Smith with Streatfeild as regards his Kentish origin and his unselfish devotion to practical organic chemistry. Migrating to Sydney for reasons of health, Smith took up the study of chemistry and devoted himself especially to the chemistry of the Australian flora. His most remarkable work on the chemical nature of the essential oils of the genus *Eucalyptus*, which includes three hundred species, has an important bearing on the development of the natural resources of Australia. Certain oils were found to be rich in cineole, phellandrene, geraniol, citral, pinene and piperitone, whereas others yielded new chemical constituents peculiar to the Australian flora. Some of these researches were carried out in collaboration with Profs. Read and J. C. Earl, both of whom were former pupils of Streatfeild.

Piperitone, which is a key to the stereochemistry of the menthones, menthols and related substances, is invariably lævorotatory when obtained from eucalyptus, whereas from a Himalayan grass *Andropogon Jwarancusa* it was isolated by Simonsen in the dextrorotatory variety (1921).

Prof. Read then showed how the systematic study of the piperitones as pursued at St. Andrews has disclosed a new approach to the menthols and their congeners. These stereochemical researches offer a clue to the biogenetic relationships of the constituents of essential oils, some of which were traced by Smith and his co-workers. According to Baker and Smith, the open chain, geranyl acetate, passed into *Eucalyptus* through *Angophora* (an Australian genus of Myrtaceæ) and probably runs through the whole of the eucalypts although sometimes present only in small amounts.

In most species of eucalypts, geraniol may be presumed to function as the precursor of *l*-piperitol, *l*-piperitone, α-phellandrene and allied substances. The delicate control of molecular mechanism takes, however, a different turn in the Indian grasses, where geraniol becomes transformed into the enantiomeric *d*-piperitol, *d*-piperitone and into Δ^4-carene. In the present stage of knowledge these subtle differentiations are beyond the powers of the chemical laboratory and appear to be inseparably bound up with vital processes. The systematic study of these biochemical phenomena is of wide scientific interest and also of considerable industrial significance. G. T. M.

Science News a Century Ago

A Visit to Mount Athos

AMONG the contributions read to the Royal Geographical Society on January 9, 1837, was "An Account of an Ascent of Mount Athos and a Visit to Mountains, in June 1836" by Lieut. Webber Smith, of the 48th Regiment. On the south-east shore of the district of Saloniki, he said, three remarkable peninsulas, twenty-five miles in length by about five miles breadth, project nearly parallel to each other, in a south-easterly direction into the Archipelago. The easternmost of these three promontories, Mount Athos, is joined to the mainland by a low sandy isthmus, about 5 miles long and nearly 1¼ broad; and through which the famous canal was cut by Xerxes. The height of the central plateau of the peninsula is 250–500 feet, and from this rises a giant peak of white limestone about 6,350 feet high. The peninsula contains twenty monasteries, the whole containing about 1,500 men including 300 mendicants. At the village of Kares, a weekly fair or market is held, which presents the uncommon scene of a fair without noise, and a crowd without women; no female is on any account admitted within the precincts of the mount, nor indeed anything it is said of the feminine gender.

Darwin's Gifts to the Zoological Society

ON January 10, 1837, at a meeting of the Zoological Society, "Mr. Reid described several Mammalia, which were on the table, forming part of an extensive collection in Natural History, presented to the Society by Mr. Darwin, who accompanied the surveying ship *Beagle*, in the capacity of naturalist to the expedition. The whole contains upwards of 80 varieties, whilst the birds consist of nearly 450 specimens, including about 150 species, eleven of which from the Gallapagos Islands, were described by Mr. Gould, as being of entirely new forms to this country" (*Athenæum*).

An Epidemic of Influenza

UNDER the date January 12, the *Annual Register* for 1837 said that an influenza of a peculiar character had been raging throughout the country, and particularly in the metropolis. It was attended by inflammation of the throat and lungs, with violent spasms, sickness and headache. So general was its effects, that business in numerous instances was entirely suspended. The greater number of clerks at the War Office, Admiralty, Navy Pay Office, Stamp Office, Treasury, Post Office and other Government offices were prevented from attending to their daily avocations. Of the police force, there were upwards of 800 incapable of doing duty.

Death of Rev. William Farish

ON January 12, 1837, the Rev. William Farish died at Little Stonham, Suffolk, at the age of seventy-eight years. Born in 1759, he was the son of a clergyman of Carlisle, and after attending Carlisle Grammar School entered Magdalene College, Cambridge, as a sizar. He graduated in 1778, and was senior wrangler and Smith's prizeman. In 1794 he was appointed professor of chemistry at Cambridge, and as such he made a point of showing the application of chemical science to the arts and manufactures. In 1813 he was appointed to the Jacksonian professorship of natural philosophy, being the successor of Francis John Hyde Wollaston (1762–1823) and the predecessor of Robert Willis (1800–75). In 1800, Farish became the incumbent of St. Giles's, Cambridge, and in 1836, rector of Little Stonham.

Dr. Roux on the Removal of Cataract

IN a note in the *Athenæum* of January 14, 1837, it is stated, "In making a report before the French Academy of Sciences, concerning the work of M. Maunoir, in favour of extraction of cataract from the eyes, M. Roux adduces the result of his own practice. Having registered all his operations during ten years, for the purpose of ascertaining which was the most efficacious method, he has been induced to give the preference to extraction. During this period he performed more than six hundred operations, as much as possible under similar circumstances, and the advantage gained by extraction was one-sixth".

Joseph Philibert Roux was born on April 26, 1780, and died on March 24, 1854, shortly after publishing "Quarante années de Pratique chirurgicale".

The British Medical Association

THE *Lancet* of January 14, 1837, contains the following notice. "The first public meeting of the members of the British Medical Association will be held at Exeter Hall in the Strand at six o'clock for seven precisely on Thursday evening next, the 19th inst. . . . This is essentially a NATIONAL association; it is open to the reception of all classes of medical practitioners; but it has been most prudently determined that the President shall always be a surgeon who is engaged in *general practice*, and that all the Councillors shall have been or shall be general practitioners. The thousands of our professional brethren have now only to unite in a spirit of cordial co-operation, under a governing body, thus qualified, constituted and interested in upholding their rights and within a very brief period the immense majority of surgeons in this country will find that they are enabled to take their proper station in Society. . . ."

Instances of Early Maturity

IN a lecture on forensic medicine delivered at the Aldersgate-School of Medicine and published in the *London Medical Gazette* of January 14, 1837, Dr. William Cummin remarked that though it was only the infant produced at the ninth month of intra-uterine life that could be considered completely mature, there were numerous instances of children born at earlier periods sufficiently mature to run the normal course of human existence. Numerous old writers such as Avicenna, Schenck, Spigelius, Valesneri, Ammianus and Diemerbroeck among others had recorded examples of children having lived to adult age and even to the ordinary limits of human life though born after only five months of conception. Fortunio Luceti, according to Capuron, though born at the age of five months, lived to the age of seventy years. When born he was no bigger than a man's head. Belloc recorded the case of a female infant born about the sixth month who was only a foot long and looked like a little skinned rabbit, yet she was carefully fed and lived to woman's estate. Marshal Richelieu was recognized as viable by the parliament of Paris, although born only at five months.

Societies and Academies

Dublin

Royal Irish Academy, November 30.

L. M. Ingold: Geology of the Currywongaun-Doughruagh Area, Co. Galway. The hills of Currywongaun and Doughruagh, north of Kylemore, are formed by an intrusion of basic plutonic rock of eucritic composition, which metamorphoses the schists and injection gneisses of the Connemara Series. This rock is particularly rich in rhombic pyroxene. On the coast west of these hills is a small intrusion of serpentine which also metamorphoses the schists. Evidence as to the age of both intrusions is inconclusive, but they are thought to be Pre-Cambrian.

W. B. Morton: Centred vortex polygons. The stability of the steady motion is considered for the case of a ring of equal vortices with another vortex of any strength at the centre of the circle which they describe. It is found that the motion is stable when the strength of this last lies between an upper and a lower limit for each case.

Paris

Academy of Sciences, December 7 (*C.R.*, 203, 1193–1300).

Louis de Launay, Clément Limb and Claudius Roux: The rectification of any arc of a circle smaller than the half circumference, by André Marie Ampère, aged thirteen years. Hitherto unpublished, dated July 8, 1788.

Lucien Cayeux: The existence of numerous bacteria in sedimentary phosphates of all ages. Consequences. Use was made in this work of photography with infra-red light. Previous conclusions were confirmed, and bacteria were found to exist in phosphates of all geological ages.

Charles Achard, Augustin Boutaric and Mme. Madeleine Roy: Study of the dilution of serums in weak solutions of different pH coefficients.

Georges Claude: The production of white light by means of a single luminescent tube. A mercury neon tube is coated internally with a phosphorescent mixture, such as calcium tungstate with a little samarium: the mixture may be fused into the wall of the tube.

André Weil: Remarks on the recent results of C. Chevalley.

Wolfgang Dœblin: The chains of Markoff.

J. Neyman: The law of limit probability of a system of aleatory variables.

Paul Delens: Generalities on the tetrahedron.

Augustin Delgleize: The transformations of Ribaucour.

Jean Mirguet: A family of surfaces with tangent plane defined by the second paratingent.

Arnaud Denjoy: Extensions of a continuum.

Ferdinand Beer: The study in complex space of the potential created by real bodies

René Lagrange: The addition theorems of Legendre functions.

A. E. Taylor: The theory of analytical functions in abstract spaces.

Léon Rebuffé: The measurement of the mean electrical resistance and the duration during the shock of two metallic bodies.

Charles Chartier: The hydrodynamic field around a marine three-bladed propeller.

Jean Luneau: The influence of pressure on the resistance to motion of obstacles in air. From the experiments described, it is concluded that for fairly high Reynolds numbers, the law of proportionality between the resistance to motion and the density of the fluid is verified within one per cent (the accuracy of the experiments), provided that in calculating the density the deviations from Boyle's law are taken into account.

J. Le Roux: The definition of distance in the theory of relativity.

Th. De Donder and J. Géhéniau: The electronic model of Dirac's wave theory.

Assène Datzeff: The relativistic quantum mechanics of the electron.

Georges Deflandre: A practical method of increasing the distance between the object and the objective of microscopes. A divergent achromatic lens of suitable focus is interposed immediately above the objective.

Pierre Barchewitz: The absorption spectrum of acyclic saturated alcohols in the near infra-red (6000 A.–9500 A.). Study of the OH band.

Marcel Servigne: Some phenomena of luminescence relating to the production of a sensibly white light. The light obtained from electrical discharge tubes containing mercury now used commercially in modern lighting can be modified by coating the walls with certain substances. A mixture of calcium tungstate containing samarium and synthetic willemite gives a photo-luminescent light with a spectrum approximating to that of sunlight.

Jacques Rabinovitch: The magnetic rotation and magnetic double refraction of some pure benzene derivatives in solution.

Gabriel Valensi: Introduction to the kinetics of the oxidation of metals giving two oxides. At fixed temperature and pressure, the oxidation of a metal possessing two valencies produces the two oxides simultaneously in a constant ratio. The square of the quantity of oxygen absorbed is proportional to the time, but the coefficients obtained at various temperatures do not satisfy the law of Arrhenius.

Louis Guitton: The potential of iron in hydrochloric acid.

Mlle. Jeanne Boulanger: The hydrates of the molecular combinations of zirconyl oxalate with oxalic acid and the alkaline oxalates.

Christian Aall: The solubility of the impurities silica, alumina and magnesia in commercial calcium carbide.

Louis Hackspill: The thermal decomposition of the calcium carbonates.

Pierre Jolibois and Georges Fouretier: The idea of basic salt in the hexavalent uranium series.

Victor Livovschi: 5.7-Dimethyloxindol.

Robert Forrer: The intensity of the orbital interaction in metals.

A. Fenaux: The extension of the Tertiary sea in the regions of Provençal and Languedoc.

Fernand Jacquet: The Eocene and the phosphates in the valley of the Senegal River.

Paul Queney: The evolution of the rains in Algeria since the French colonization. Since 1898, there has been a change in the distribution of the rains; before that date, the spring rains predominated; but after 1898, the autumn rains have increased. Taken over the whole year, there is no marked change.

Robert Bureau and J. Maire : Ionospheric anomalies with sudden commencement.

Robert Douin : The inversion of the geotropism of the peduncle of the carpophore of the Marchantiæ.

Henri Colin : Artificial inulogenesis in the Compositæ.

Raoul Combes : The glucidic nutrition of the rolla.

René Vandendries : The sexuality of the Basidiomycetes.

Robert Kühner : The reaction to iodine of the walls of the hyphæ of the carpophore of *Mycena*.

A. and R. Sartory and J. Meyer : The influences of a partial or high vacuum on the biochemical properties of some lower fungi.

Philippe Joyet-Lavergne : Experimental demonstration of the role of the chondriome in respiration.

Mlle. Camille Chatagnon : Bromine in the gastric juice. Bromine is a normal and constant constituent of the gastric juice. The mean ratio found for 1,000 Br/Cl was 2·43.

Maurice Doladilhe : A physical property of one of the constituents of the non-dialysable fraction of a blood serum.

Henri Jacotot : Swine fever is transmissible to the sheep and goat.

Amsterdam

Royal Academy (*Proc.*, 39, No. 9, Nov. 1936).

H. J. Jordan : Investigations on reaction retardation in the muscles of the snail, and their significance for the interaction between contraction and viscous tonus.

W. H. Keesom and G. Schmidt : Researches on heat conduction by rarified gases. (2) The thermal accommodation coefficient of helium, neon, hydrogen and nitrogen on glass at 70°–90° K.

L. S. Ornstein : Scattering of neutrons in matter (3).

J. G. van der Corput : (1) Generalization of an inequality of Knopp. (2) On Kummer's solutions of the hypergeometric differential equation.

J. A. Schouten and J. Haantjes : Conformal invariant form of the relativistic equations of motion.

G. van Iterson, jun. : Notes on the structure of the wall of Algæ of the genus *Halicystis*.

A. H. Blaauw, Ida Luyten and Annie M. Hartsema : The limit of flower formation and the growth of iris bulbs (2*b*).

L. S. Ornstein and J. F. Schouten : Age and rate of decrease of red blood corpuscles before and after liver treatment of pernicious anæmia.

J. J. Meihuizen and C. A. Crommelin : Vapour pressures of liquid krypton.

D. Vermeulen and J. G. Hagedoorn : Visual intensity measurement with the aid of successive contrast.

A. Erdélyi : Development of an analytical function in terms of Whittaker functions.

J. Gillis and J. Eeckhout : Quantitative investigation of the ion exchange produced by the addition of the nitrates of thorium, hexol and cerium to the negative sol of silver iodide.

H. G. Bungenberg de Jong and L. Teunissen-van Zijp : Further examples of unmixing in aqueous salt solutions.

L. Algera : Influence of temperature treatment on the carbohydrate metabolism, the respiration and the morphological development of the tulip (3).

J. Kuyper and L. K. Wiersum : Occurrence and transport of a substance causing flowering in the soya bean (Glycine Max L.).

J. Westerveld : Geology of North Banka, Djeboes (Dutch East Indies).

A. A. Thiadens : Some caprinids and a monopleurid from southern Santa Clara, Cuba.

J. L. Addens and T. Kurotsu : The pyramidal tracts of *Echidna*.

F. J. Nieuwenhuyzen : Chronic experimental catatonia produced by intermediate products of metabolism. Indolethylamine.

Cape Town

Royal Society of South Africa, September 16.

R. F. Lawrence : The external sexual characters of South African harvest spiders.

G. P. Lestrade : Notes on the political organization of certain Xhosa-speaking tribes in the Transkeian Territories The political organization of the Gcaleka, Mfengu and Thembu tribes in the Transkeian districts of Willowvale, Idutywa and Engcobo is described. An account is given of the territorial organization obtaining among these tribes ; and the various political units into which they are divided—the kraal, the ward, the tribal division, and the tribe—are described.

R. S. Adamson : Anomalous secondary thickening in *Ostrospermum*.

Moscow

Academy of Sciences (*C.R.*, 3, No. 9 ; 1936).

M. M. Greenblum : Geometrical structure of the symmetric transformation in Hilbertian space.

P. I. Lukirsky and T. Careva : Slowing-down of neutrons by the nuclei of heavy elements.

D. A. Čerenkov : Influence of a magnetic field on the visible luminosity of fluids produced by gamma-rays.

P. D. Lazarev, E. M. Klinkovstein, Z. V. Bulanova and S. S. Katznelson : Study of the visual adaptation in the normal and pathological state of the organism. (1) The influence of diabetes mellitus on adaptation in peripheral vision.

N. A. Slioskin : The problem of motion of a gas in two dimensions.

M. Michailov and J. A. Arbuzov : Thermal decomposition of olefinic hydrocarbons.

V. S. Butkevic : The formation of oxalic and citric acids by fungi.

R. A. Rubin : The biose/monose ratio as a biochemical varietal character in the onion.

A. Nikiforova : Boundary between the Permian and the Carboniferous in the reef limestones of the Urals established on the basis of the Bryozoa enclosed therein.

N. G. Cholodnyj : Hormonization of grains.

M. C. Čailachjan : The hormonal theory of plant development.

L. M. Šulpin : The faunal features of the north-west Tian Shan.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, January 11

Victoria Institute, at 4.30.—Sir Ambrose Fleming, F.R.S.: "On the Methods of Determining the Age of the Earth" (Presidential Address).

Royal Geographical Society, at 8.30.—E. T. D. Lambert: "From the Brahmaputra to the Chindwin".

Tuesday, January 12

Society for the Study of Inebriety and Drug Addiction, at 4.—Dr. H. M. Vernon: "Alcohol and Motor Accidents".

Warburg Institute, at 5.30.—Dr. Konrad Lorenz: "Biological Aspects of Play".*

Pharmaceutical Society, at 8.30.—Dr. F. B. Parsons: "Anæsthetic Agents".

Wednesday, January 13

Royal Society of Arts, at 8.—Olaf F. Bloch: "Applications of Photography to Scientific and Technical Problems".

Thursday, January 14

Royal Asiatic Society, at 4.30.—Prof. W. Perceval Yetts: "Chinese Bronze Mirrors".

Appointments Vacant

Assistant (Grade I, Engineering or Physics), ref. 305 E., and **Assistant (Grade III, Engineering)**, ref. 307 E., in the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (January 15).

Assistant Chemist in Somerset County Laboratory—The County Analyst, County Hall, Taunton (January 15).

Established Civil Engineering Assistants in the Headquarters and Divisional Road Engineers' Offices of the Roads Department of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, London, S.W.1 (January 15).

Inspector of **Live Stock** in the Department of Agriculture for Scotland—The Secretary (Establishment Branch), York Buildings, Queen Street, Edinburgh 2 (January 16).

Technical Officer (Mathematics or Physics) in the Meteorological Office—The Secretary (S.2.E.), Air Ministry, Adastral House, Kingsway, W.C.2 (January 18).

Organizer of **Agricultural Education** to the Lindsey County Council Education Committee—The Director of Education, County Offices, Lincoln (January 23).

Lecturer in Organic Chemistry in University College, Exeter—The Registrar (February 1).

Chemist in the A.I.D. Test House, Kidbrooke—The Secretary, Air Ministry, S.2.d., Adastral House, Kingsway, W.C.2.

Horticultural Adviser to the Land Settlement Association, Broadway Buildings, Broadway, Westminster, S.W.1.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1935. Part 1, with Report of the Geological Survey Board and Report of the Director. Pp. iii+98. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [1612

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Leeds University. Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing during the Session 1935–36. Pp. 20. (Leeds: The University.) [2112

New Forest Association. Annual Report and Statement of Accounts. Pp. 18+6 plates. (Brockenhurst: Capt. Cecil Sutton, Hon. Sec., The Estate Offices.) [2312

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U.S. Department of Agriculture. Miscellaneous Publication No. 253: Conservation Farming Practices and Flood Control. By H. H. Bennett. Pp. 16. (Washington, D.C.: Government Printing Office.) 10 cents. [2112

Studies in West Indian Soils. 10: The Cacao and Forest Soils of Trinidad. B: South-Central District. By F. Hardy, D. W. Duthie and G. Rodriguez. Pp. 56. (Trinidad: Government Printing Office.) 2*s.* [2112

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University. Čís. 225: O některých barytech Moravských (Über einige Barytvorkommen in Mahren). Napsala Božena Bobková. Pp. 15. Čís. 226: Akustická měření Rayleighovou deskou (Les mesures de vitesse par le disque de Rayleigh), napsala Marta Chytilová; Měření radioaktivity torsními vážkami, elektrometrem a fotočlánkem (Mesures de la radioactivité par la balance de torsion, par l'électromètre et par la photocellule), napsal Josef Zahradníček; Klesající charakteristika píšťalového jazýčku (Sur la caractèristique descendente de la languette d'un tuyau), napsal Josef Zahradníček. Pp. 27. Čís. 227: Über *Dorydrilus* (*Piguetia*) *mirabilis* N. subg. n.sp. aus einem Sodbrunnen in der Umgebung von Basel sowie uber *Dorydrilus* (*Dorydrilus*) *michælseni* Pig. und *Bichæta sanguinea* Bret. (O žížalicích *Dorydrilus* (*Piguetia*) *mirabilis* N. subg. n.sp., *Dorydrilus* (*Dorydrilus*) *michælseni* Pig. a *Bichæta sanguinea* Bret.). Napsal Sergěj Hrabě. Pp. 18. Čís. 228: Remarque pour l'étude des tremblements de terre en Tchécoslovaquie. Par F. Koláček. Pp. 5. Čís. 229: Energetické poměry v jazýčkových píšťalách (Energieverhältnisse in den Zungenpfeifen). Napsal Josef Zahradníček. Pp. 9. (Brno: A. Píša.) [2112

Sborník vysoké Školy Zemědělské v Brně, Fakulta Hospodářská. Sign. C. 31. Pokusy se sladováním nahého ječmene pro lihovary. Napsal V. Almendinger. Pp. 60. (Brno: A. Píša.) [2112

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Norges Svalbard- og Ishavs-Undersøkelser. Meddelelse Nr. 27: The Lichen-Genus *Acarospora* in Greenland and Spitsbergen. By A. H. Magnusson. Pp. 22. Meddelelse Nr. 32: Norges Svalbard- og Ishavs-Undersøkelsers Ekspedisjoner i årene 1934 og 1935. Av Anders K. Orvin. Pp. 18. Meddelelse Nr. 33: Dagbøker av Nordmenn på Grønland før 1814. Ved H. Ostermann. Pp. iii+246. Meddelelse Nr. 34. Luftkartleggingen på Svalbard 1936. Av Bernhard Luncke. Pp. 10. Skrifter om Svalbard og Ishavet, Nr. 67: Oceanographic Investigations in East Greenland Waters in the Summers of 1930–1932. By Anton Jakhelln. Pp. 79+2 plates. 7.00 kr. (Oslo: Jacob Dybwad.) [2212

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Human Problems of Progressive Industry

IN discussing the impact of science upon society in his presidential address at Blackpool to the British Association, Sir Josiah Stamp referred to the necessity of more science to cure the evils which resulted from the impact of science. Ordered knowledge and principles are wanted at every point, and particularly the type of work carried out by the National Institute of Industrial Psychology. Some of its inquiries attempt to improve existing conditions of work. Other investigations endeavour to determine the conditions which allow greater output and efficiency, but much of the work of the Institute is directly designed to combat the evils arising from the new conditions created by modern demands—speed, accuracy and intensity.

While the work of the National Institute of Industrial Psychology thus invokes the aid of many branches of science and is designed to assist in the adjustment of society to the changes caused by technical development, its support is left to personal advocacy. The financial resources of the Institute are only a fraction of the expenditure on research in a single industry, such as rayon, although the contribution of its work to human welfare is immeasurably greater. This absence of assured support to which Sir Josiah Stamp referred so pointedly greatly handicaps the Institute in the prosecution of many of its fundamental investigations. Even if particular industrial firms make use of the Institute's investigators to an increasing extent, industry and society as a whole cannot in this way reap anything like the potential assistance which the Institute could give in smoothing over the transition and readjustment of society under the impact of science.

The endowment of the National Institute of Industrial Psychology, to enable it to carry out its investigations on a scale commensurate with its potentialities in the field of social and industrial welfare, should prove a profitable investment from the point of view of industrial as well as social efficiency, and might well form one of the first objectives of scientific workers in the field of social science. Moreover, the potentialities of vocational guidance, in which field the Institute has carried out such admirable work, as a factor in avoiding misfits and checking juvenile unemployment, can scarcely be said as yet to have received anything like adequate appreciation, although the impending shortage of juvenile labour makes the work the more important.

The importance of research of this type was stressed by Sir Kenneth Lee in an address to the Bradford Textile Society on November 17. Sir Kenneth urged that research on the human side is just as important in modern industry as research on the chemical and physical properties of the products being manufactured. Discontent and unrest are often due largely to working conditions, and a central co-operative research association should give its attention to the investigation of problems of this type. Causes of workers leaving, abnormal labour turnover, absenteeism, or high sickness incidence demand as rigorous attention and investigation as a fall in the efficiency of a manufacturing process, and fatigue and incentives are fields which should amply repay any research carried out in them.

Like so many other speakers on this question, Sir Kenneth Lee once more emphasized the significance of management in industrial efficiency.

The very rapidity of change and development in industry to-day tends to make plant and machinery of secondary importance. The greatest asset of a business is increasingly the ability of its staff. Significantly enough, this is essentially the first point emphasized in the report of an inquiry into vocational education after general education up to sixteen years of age carried out by a Committee on Commercial and Industrial Education of the British Association.

This Committee in its report emphasizes the growing tendency of firms to recruit university graduates, not for their technical knowledge but because of their disciplined mind and trained intelligence, for some of the higher administrative posts in business. Thus increasing use of the university graduate in technical capacities is likely to be paralleled in his employment in administrative capacities. Similarly the Committee notes the tendency of the larger firms to select an increasing proportion of boys from secondary and public schools at the age of eighteen years.

These factors alone indicate the way in which the standard of recruitment is being raised in industry. They also intensify the problem of vocational guidance, the use of which to prevent misfits either at the start or in selection for promotion to higher managerial posts becomes increasingly desirable and important. One of the arguments in favour of part-time education is, in fact, that entrance to employment at sixteen years of age results in fewer ultimate misfits than entry at eighteen years, when valuable time may have been spent in preparing for a particular occupation.

That more strenuous efforts should be made to eliminate or rather prevent misfits occurring in all ranks of industry is undoubtedly true, if we are to attain the standard of efficiency visualized both by Sir Josiah Stamp and Sir Kenneth Lee, and part-time education may be an important factor in that effort. The report makes it clear that the part-time education required to-day is not of the evening-class type upon which such reliance was formerly put and upon which severe comments have been made in recent years. It is part-time day education in which industry has arranged for the release of its young employees during working hours. Moreover, it is suggested that the sandwich type of vocational education, under which alternate periods of, for example, six months, are spent in the works and at school, should be adopted more frequently as a means of training suitable candidates for posts of higher responsibility.

This suggestion is, of course, essentially similar to the seconding of selected individuals of proved ability and sufficient experience for special training in management and administration with the view of recruiting them for the higher managerial posts as vacancies and opportunities occur. The recently announced staff college to be established near Derby by the London, Midland and Scottish Railway is essentially a development on these lines.

Such developments tend to diminish the importance of, and demand for, full-time vocational training for recruits for industry up to sixteen years of age, although at the same time the need for vocational guidance is enhanced and also the efficiency of vocational training after that age. The later age of entry to industry, whether from school or university, will increasingly be accompanied by a short intensive course of training after entering industry, designed to assist in the transition from school to work and in the application of the disciplined mind and scientific principles acquired in a liberal education to the particular problems characteristic of the branch of industry involved.

One important effect of the rising standard of management should undoubtedly be increasingly felt. The management of to-morrow will, as Sir Kenneth Lee suggests, attach increasing importance to the human factor. It will accordingly make much fuller use of methods of vocational selection and guidance, and may be expected to support much more generously and widely investigations on the long-range and practical problems involved, whether the research is initiated within a particular firm or by a research association or by such an organization as the National Institute of Industrial Psychology. Management of this type will not tolerate the position so strongly criticized by Sir Josiah Stamp, but it should not be necessary to wait for the rising standard of administration in industry to secure any important modification of the present anomalous position.

At the present time, apart from the National Institute of Industrial Psychology and the work of the Industrial Health Research Board, little attack is being made on the broader and more general problems akin to the long-range and fundamental work in the physical sciences which is at present so largely the domain of the universities. Even if the work done in the field of industrial relations in different universities were extended to cover the study of social change and of new leys proceeds depends partly on how well the seeds mixture has been designed to suit the system and standard of farming for which it is intended, and how well that standard is maintained.

The *unenclosed grazings* are divided into seven types which include the 'maritime association' in addition to fescue-*Agrostis*, mountain fescue, *Mollinia-Nardus*, cotton-grass moor, heather moor and heather 'fell'; of these, *Mollinia-Nardus* is most widespread (17 per cent of total agricultural land), and is next in area after the cultivated *Agrostis* land.

An important feature of some of this land is the occurrence of mature or immature peat, the latter often referred to as 'mat'. This mat is one of the greatest drawbacks to land improvement. It proved probably the worst impediment to rapid cultivation of grassland ploughed out during the Great War for corn production. These 'mats' are common not only on hill pastures, but also on lowland pastures with acid soils. They are often worst where this acidity is emphasized by the acid-polluted atmosphere of industrial districts. Liming is a cure, but an expensive one in hill areas. On Cahn Hill Professor Stapledon has done valuable work in dealing with these 'mats' mechanically. To get them out of the way so that seed and manures can be brought into immediate contact with the soil is essential to complete success. Comparatively light implements or the plough will deal with very immature 'mats', but the thick tough 'mats' found in the worst cases need some kind of heavy rotary tiller, followed by complete destruction of the 'mat' by burning.

The improvement of these unenclosed types of land has been tried with success at Cahn Hill, where there is a series of experiments that will be of enormous interest for some years. They are not merely trials of methods but also severe tests of the value of those pedigree strains of grasses painstakingly produced by the Aberystwyth workers over a large number of years.

These grassy moors with their mixed associations occupy a very low place in the scale of productivity. Here again Wales has no monopoly; in the Cheviots they are thinly populated by sheep which in spite of low stocking often suffer severe losses from disease. How far this disease is due to parasites or under-nutrition or both is a point under investigation on the Cheviots at the present time. In spite of careful herding, the area closely grazed by the sheep is small. Where it is grazed and trodden there is usually an association of finer grasses occupying perhaps scarcely 10 per cent of the whole grazings, and maybe giving conditions conducive to that parasitic infestation so frequent in these hill sheep. Under-nutrition, especially so far as minerals are concerned, is undoubtedly a factor of importance on these hills, and herbage with extraordinarily low calcium and phosphoric acid has been collected in the Cheviots. Prof. Stapledon's call for more lime, more phosphate, is more than justified, but what is the economical way of supplying it, direct or through the grass? The second alternative is very costly on areas so inaccessible, and, so far as some results go, it is questionable whether basic slag will serve the dual purpose of increasing adequately both calcium and phosphate in the herbage.

But of all these low-grade grazings in their unimproved condition, perhaps a well-tended heather moor is the most valuable possession. Only proper attention, mainly periodical burning, will keep down the inevitable encroachment of *Nardus* or—as William Davies prefers to regard heather as the trespasser—will encourage the heather to take complete possession of fresh areas. Speaking generally, good heather moors are worth attention from the sheep as well as the game point of view. Heather has an extraordinary ability to take up lime even from soils of low base status. The younger shoots of heather may have a calcium content as high as good pasture grass, although the phosphate content is low. Other plants like cotton-grass (*Eriphorum vaginatum*) often associated with the heather are rich in phosplate and poor in calcium. Moreover, the heather has little seasonal variation in composition.

The most striking figure in the tables is the proportion of *Agrostis* pasture (38 per cent) and that on cultivated land. It suggests immediately land once reclaimed and now partially derelict. It represents probably the most promising of the unimproved land—promising, that is, from the economic point of view.

By means of specimen maps of zones of the various grassland types, tables of typical pasture analyses with explanatory notes facing them and the description of procedure in the field, the directions to the ecologist who would deal similarly with some other part of the country are clear; and because of these tables and the maps, not forgetting the main map, the book should prove a most useful book of reference.

If Prof. Stapledon's method of approaching this national problem by simply grading up pastures of one class to the next better class were appreciated and understood, the problem of the better utilization of our land would appear much less fearsome. Soil fertility is most securely locked up in good, well-tended grassland, and it can be drawn upon very quickly. More live-stock, especially cattle, are needed to increase and maintain this fertility and they are also needed to apply those extra fresh foods, meat and milk, demanded by research workers in human nutrition.

J. A. H.

Bio-Climatology

The Patient and the Weather
By Dr. William F. Petersen, with the assistance of Margaret E. Milliken. Vol. 1, Part 1: The Footprint of Asclepius. Pp. xx+127. 3.75 dollars. Vol. 1. Part 2: Autonomic Integration. Pp. xxxi+781. 9 dollars. Vol. 2. Autonomic Dysintegration. Pp. xx+530. 6.50 dollars. Vol. 3. Mental and Nervous Diseases. Pp. xvi+375. 5 dollars. (Ann Arbor, Mich.: Edward Brothers, Inc., 1934–1936.)

IN these volumes Dr. W. F. Petersen, of the Department of Pathology and Bacteriology of the University of Illinois, discusses and illustrates the age-old doctrine of the influence of the weather upon health.

The picturesque thesis which runs through this work, that man is a "cosmic resonator", is only a modern expression of man's relation to Nature as taught by Hippocrates. It belongs to all countries and times, in one shape or another, and sometimes in strange forms, as in astrology. It is usually more conspicuous in popular than in academic medicine. In our own time it has had many powerful exponents—meteorologists and physicians—and has already acquired a sound basis through the work of Loewy, Dorno, de Rudder, Leonard Hill, Hāberlin, Kestner and others in the new science of bio-climatology. There is much to say for the author's criticism that the schools of medicine, with their thought centred on infection, have failed to recognize the cardinal importance of atmospheric environment and inherited constitution. Haldane pointed out that many germs of disease, like the tubercle bacillus, are harmless to the average person, and attack others for unknown reasons. Why? It is time that medical thought turned from the micro-organism to the patient. Man has been described as a nucleus of mentality in a material environment. Certainly the fact cannot be ignored that a long range of physical impressions is continually falling on a corresponding keyboard of receptor organs.

A president of the Royal College of Physicians once remarked to the reviewer that he was unable to believe in the alleged effects of a 'change of air' because chemical analysis had shown that the composition of the atmosphere was everywhere the same. There is, however, abundant evidence to the contrary in the behaviour of plants. Many an 'air taster', highly sensitized no doubt, declares that he feels the influence of the air in one direction or another (stimulant or relaxing) even when halted for a few minutes on a railway platform. There is also the common experience of the cessation of catarrh, and increased appetite and energy, on arrival at a coast that 'agrees with you'. Such reactions occur in normal persons. How much greater sensitiveness may be expected in illness? Hāberlin and his school have demonstrated and measured a series of reactions occurring in delicate children from atmospheric causes. Dr. Petersen holds that in different constitutional states the normal biological reactions are accentuated or modified. The operating mechanism is the autonomic nervous system, which, especially in sensitive subjects, is liable to lose its normal balance and pass into imbalance or dysfunction, and eventually permanent disease. The normal reactions occur in two successive phases, indicated as *ARS* and *COD*. In the former *A* stands for *a*nabolic and (in general) alkalinity, *R* for preponderating *r*eduction and *S* for *s*pasm—the systolic blood pressure rising, with a supposed preponderance of adrenal influence. The tissues are increasingly anoxæmic, with accumulation of carbon dioxide. The *ARS* phase gradually or abruptly gives place to its opposite *COD*—in which *C* stands for catabolism and relative acidosis, *O* for *o*xidation and *D* for *d*ilatation, with falling diastolic blood pressure and supposed thyroid preponderance, the reaction changing to alkaline and carbon dioxide diminishing. These phases may be general throughout the body, more commonly perhaps regional. In a state of health (autonomic balance) the rhythm is normal, but in autonomic dysfunction the peaks and troughs are exaggerated. It is the aim of the present work to relate these abnormal reactions to external physical causes over a wide field of disease.

The degree of temperature and its variability are naturally the cardinal factors in atmospheric environment. Cold regions make large demands on metabolism, increase body heat and a tendency to acidosis. Hot regions evoke minimum metabolism and a tendency to alkalosis. But, unexpectedly perhaps, the tropical climate predisposes to chill, for when occasionally the temperature falls, chill may result because the power of accommodation, so little called upon, is found to be wanting. American experts in heating have shown that temperature by itself is no measure of physiological reaction. What has been called 'effective temperature' in defining 'comfort zones' is an "arbitrary index of the degree of warmth or cold felt in response to temperature, humidity and air movement". Composite impressions of this kind are characteristic of climate, and are especially worthy of study, especially on the path of anticyclones, to a description of which much space is devoted. The author agrees with Huntington in his "Civilisation and Climate" that frequent storms, with decided changes from day to day, are the most favourable to health and mental activity, and that the effective temperature is largely conditioned by latitude, winds and expanses of water. The statement that climate and weather are the most important of environmental factors will now be largely accepted: also that, being too familiar and unimpressive, they are unfortunately generally overlooked by the physician. To speak, however, of atmospheric influences as always stimulating is at least misleading. In England especially, it is now held that sedative effects are equally obvious and important, especially in climatic treatment; and it is certain that these external influences, whether accelerating or retarding, ought not to be disregarded, for they are powerful enough to affect not only the organic but also the psychic functions, and even the social and economic conditions of those who are habitually exposed to them.

The greater part of these volumes is occupied with minute investigation of the reactions of many groups of individuals, exposed to the atmospheric changes exhibited in meteorographs. As bearing on these data, the well-known fact is quoted that sub-minimal stimuli, producing no obvious effect, increase the lability of the cell and when repeated may produce important summation effects. The importance of more precise study of the reactions induced by atmospheric environment is properly emphasized. Many disorders connected with autonomic instability are increasing in the United States. A rational therapeutic principle must be not merely palliative but also must take account of the profound influence of physical influences and dietetics, and their great possibilities in the control of disease.

The author modestly states that these three volumes, extending to 1,800 pages, are only a "puny entering wedge". The reviewer may be forgiven a sigh of relief that every treatise is not framed on such generous lines.

Study of Fungi

A Text-Book of Mycology
By Prof E. A. Bessey. Pp. xv+495. (Philadelphia: P. Blakiston's Son and Co., Inc., 1935.) 4 dollars.

A TEXT-BOOK of mycology that will satisfy all demands is perhaps impossible of attainment by one writer and in a reasonably small volume, so wide is the field now covered by the subject. Prof. Bessey has attempted to meet the need for guidance through the vast amount of work on structure, life-histories and classification of the fungi, and in many respects the result is admirable.

The book opens in the usual way with a general account of the fungi, and this is followed by a brief history of work on the classification of the group. Chapter ii deals with the non-filamentous fungi, and also the Mycetozoa and allied groups, these being included not because the author agrees that they are fungi but because they are still so regarded by many workers, and usually come to the mycologist for identification. Chapters iii—v deal with the Phycomycetes, and Chapters vi—xiii with the higher fungi, three being devoted to Ascomycetes, one to rusts and smuts (as a special class Teliosporeæ), and three to the Basidiomycetes proper. Chapter xiv is concerned with the Fungi Imperfecti. While the space devoted to the latter is a little more than that given in most botanical text-books, the treatment is not as satisfying as is that of other groups. In this case Prof. Bessey has relied for his information on an unpublished thesis by a student of Yale University, H. B. Bender. It is unlikely, on the face of it, that such a work can be anything more than a very uncritical compilation, since even an experienced mycologist would be daunted by the task of revising the whole of this huge assemblage of forms, many of them little known and imperfectly described.

The space given to Phycomycetes may seem disproportionate to the size of the group, but is accounted for by the great interest of these fungi from the points of view of cytology, biology and phylogeny. The author throughout has endeavoured to indicate possible phylogenetic relationships. One may not always agree with his views, but the method of treatment is essential if the student is to attain a grasp of the ultimate ideals of morphology and taxonomy. It is fair to point out that the author indicates alternative views, and in general stimulates the student to think for himself.

In a book of this type, errors and omissions are inevitable, and no doubt any specialist might find small points at which to cavil. To the present writer it occurs that there is no mention of *Sporobolomyces*, the yeast which has called forth so much controversy as to its systematic position. Again, on p. 338 the author assumes that all segregates from the genus *Fomes*, as treated in Saccardo's "Sylloge", produce successive layers of pores, which is certainly not the case either in *Amauroderma* or in most species of *Ganoderma*. Typographical errors are very few; *Dœdalia* and *Cantherellus* (both on p. 351) may be pointed out as unfortunate. The figures are the least satisfactory part of the work in that they are in many cases very poor and coarse reproductions. A comparison of Figs. 17 (p. 46) or 22 (p. 62) with the originals from which they are taken is sufficient to indicate the character of the work in this respect. It is to be hoped that these faults may be remedied in a future edition.

The book is to be recommended for the very full references to literature. At the end of each chapter is a list of relevant books and papers, and Chapter xv is given up to a "guide to the literature for the identification of fungi", the titles being classified into those covering the whole field and those dealing with special groups. It is not and does not claim to be complete, but is undoubtedly a valuable guide to those who may have little idea (and what beginner has?) where to look for information as to the fungi in which they are interested.

E. M. W.

Refining of Petroleum

Petroleum Refinery Engineering
By Prof. W. L. Nelson. (Chemical Engineering Series.) Pp. viii+647. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36*s*.

IT has been frequently urged that the refining of petroleum constitutes one of the most important branches of chemical engineering, and that Great Britain will be at a serious disadvantage so long as this industry is largely non-existent here. Ample evidence for such a claim is afforded by the contents of Prof. Nelson's compilation. He points out that the industry utilizes most of the unit operations of chemical engineering and that the great progress which oil refining is now making technically is due to the adoption of chemical engineering principles.

Petroleum refining in its many branches is a typical chemical process industry conceived on the largest operating scale; it is giving employment to more chemical engineering graduates than any other branch of the chemical industry and it affords likewise the largest single market for chemicals.

The first real refinery was built at Titusville, Pennsylvania, at a cost of £3,000 in 1860, and before many years several hundreds of small refineries were in operation, using the batch system. They were replaced by continuous plants, in which the principle was recognized of allowing the oil to flow continuously in a thin stream over the heating surface. The large modern distillation plants are built up of interconnected units with common heat-exchange systems. The next discovery was cracking both in the liquid and vapour phase, which materially adds to the amount of motor spirit produced from the crude oil. The quantity was still further increased by stripping natural gas and again by the application of the hydrogenation process. The development of distillation in vacuum and of solvent extraction has enabled superior lubricating oils to be produced.

It is perhaps of interest to follow the changes in the public demand for oil products. From 1860 until 1885, the demand was for kerosene or burning oil, and too much low flash-point spirit was looked upon as a disadvantage. In 1885–90 the mineral lubricating oils gradually displaced vegetable oils for all purposes. The advent of the motor-car made petrol the most useful product of the refinery, and after 1914 there was an urge to recover more of it from the crude. From 1920 onwards, fuel oil as a means of producing heat and power came into demand. During the last ten years the methods of producing lubricating oils have been radically changed, and quite recently much more stringent specifications have been imposed for these, adding greatly to their utility. The demand for anti-knock petrol led to further plant developments which, in their wider application, have resulted in improved road oil and asphalt products. The capacity of the oil refineries in the United States is at least four million barrels per day.

Prof. Nelson's book sets out what the refinery engineer may be expected to know. Naturally the fundamental data include a knowledge of the raw material and of the refinery products, including the evaluation of oil stocks. The principles of design demand attention to such matters as hydraulics, combustion, heat balances and transfer, vaporization and condensation, counter-current operations, corrosion and the theory of cracking.

Under the heading of plant processing comes a knowledge of the various sections of plant, of cracking processes, natural gasoline, chemical and earth treatment, dewaxing and much besides.

This has all to be handled in six hundred pages, a task involving much compression and an ability to confine the matter to essentials which only practical knowledge can give. The text is supplemented by numerous tables and diagrams.

The author writes from Tulsa, to-day an important city in the centre of the Oklahoma oil-field, though it was non-existent a few years back: he has had the help and advice of many of the well-known men in oil technology.

E. F. A.

Physico-chemical Tables

Landolt-Börnstein Physikalisch-chemische Tabellen

Fünfte, umgearbeitete und vermehrte Auflage. Ergänzungsband 3. Herausgegeben von Prof. Dr. W. A. Roth und Prof. Dr. K. Scheel. Teil 3, Hälfte 1. Pp. xvi+1815–2352. Teil 3, Hälfte 2. Pp. 2353–3039. (Berlin: Julius Springer, 1936.) 188 gold marks.

THIS volume completes the third supplement to the fifth edition of the well-known "Landolt-Börnstein" tables and makes available a mass of physical and chemical data including work published so late as March 1936. The growth of this standard work of reference demonstrates the remarkable expansion of the physical sciences in our time. The fifth edition was first published in 1923; it occupied two volumes and 1,695 pages. The first supplement appeared in 1927 with 919 pages, the second in 1931 consisted of two volumes and 1,707 pages, whilst the third supplement which began to appear in 1935 has grown to three volumes and 3,039 pages. Prof. Roth and Prof. Scheele, to whom we are indebted for this work, must feel the satisfaction of a great task well accomplished; at the same time they must view with some dismay the probable dimensions of the next supplement in 1939–40.

The first two parts of the third supplement have already been reviewed in NATURE; this third part is concerned with data classified under the headings of electricity, magnetism, thermochemistry and thermodynamics. Only a few of the numerous tables can be mentioned. There are many new data on dielectrics, including a number of tables and diagrams on the properties of solid dielectrics. The section on electromotive force and on conductivity covers many pages, and a particularly valuable feature of this part of the volume is a series of tables of activity coefficients. This extends to more than thirty pages and gives values of γ over a range of concentrations for many aqueous and non-aqueous solutions. The growing interest in magnetism is reflected in the tables of new measurements of dia- and para-magnetic susceptibility, whilst the section on thermochemistry includes important new tables dealing with the energy of chemical bonds and the ignition temperatures of gases. The index covers the eight volumes of the complete work and is accompanied by an index of the properties of common substances.

The literature of science continues to grow at an ever-increasing rate, and presents a more difficult and complex problem in each generation to those who construct really comprehensive works of reference. The mere size of these tables, which deal only with numerical data in two related sciences, helps one to apprehend the magnitude of the general problem of the indexing of scientific literature, upon which much has been written both in NATURE and elsewhere. The team of devoted workers who under the direction of Prof. Roth and Prof. Scheele have brought into being this third supplement to "Landolt–Börnstein" have rendered a notable service to science and to industry all over the world.

Works of this kind must of necessity be expensive, but the increasing cost of these tables has been felt even by colleges and institutions, and is a very heavy burden on those who maintain a private library. It is therefore pleasant to find this last volume accompanied by a pamphlet announcing the twenty-five per cent reduction in price to countries outside Germany, with the exception of Switzerland and Palestine, to which German books are now subject.

S. S.

Psycho-Analysis and Social Psychology

By Prof. William McDougall. Pp. ix+207. (London: Methuen and Co., Ltd., 1936.) 7*s*. 6*d*. net.

PROF. MCDOUGALL says in his preface that he has "returned to the always interesting, but generally quite futile, task of criticizing the teachings of Professor Sigmund Freud and his school. . . . I have realized too late that I might have done much more for my chosen science, had I from the first spoken with a less modest voice. It seems to me probable that, had I at the outset put forward my views in a more self-assertive and clamant fashion, I might have been acknowledged as the leader of a powerful and perhaps dominant school of psychology; instead of remaining a well-nigh solitary outsider playing a lone hand".

Such a personal note, in the preface and even more in the three Lectures (delivered in the University of London, May 1935) which form the nucleus of the book, rather impedes the author in a critical handling of his subject. He holds that Freud is right in regarding human nature and behaviour as always and everywhere purposive, conative, hormic, but that in almost everything else Freud is in confusion or in error. On several points, the author makes pertinent criticisms, particularly in respect to the 'death-instinct' about which Freud himself writes with scepticism, though nothing constructive is offered in their place. But the concepts of unconscious mental processes which affect not only neurotics but also normal people; of the persistence of infantile modes of thinking in this unconscious part of the mind; of an *interplay* between loving or tender and aggressive or destructive impulses which only slowly reach stability; the important part played by anxiety and guilt in the development of the personality, particularly in infancy—these and other characteristically Freudian concepts are either profoundly misinterpreted in the author's exposition, or ignored.

An understanding of social psychology is an urgent need at the present time, for never has propaganda been so rapid and intense as in Europe to-day. It is a matter for great regret that the opportunity offered to a pioneer in social psychology by a university and by publication should have been spent in a "futile task" rather than in developing the present state of knowledge by addition to theory or by new observation. JOHN RICKMAN.

Aural Therapy in Relation to Deafness

By Prof. D. F. Fraser-Harris. Pp. 45. (London: The Sterling Medical Publishing Co., n.d.) 7*s*. 6*d*.

THIS little book, which is introduced by forewords from Sir James Purves-Stewart and an anonymous professor of the faculty of medicine in an English university, consists of six chapters. In the first, in which a short account is given of the varieties of deafness, the author points out that deafness is very rarely the result of a direct infection of the central organ of hearing but is nearly always the secondary result of generalized infections, such as measles, scarlet fever, typhoid fever, rheumatism and some forms of catarrh of the nose and throat.

In the second chapter the various causes of deafness are described, such as obstruction in the external ear by a polypus or wax, perforation of the tympanic membrane and otosclerosis. In the third chapter, which is devoted to the diagnosis of deafness, a description is given of the audiograph, an instrument designed for the accurate measurement of sound. The result of its use has been that with certain exceptions the various types of deafness have been found to present characteristic audiographic charts of their own, which are reproduced. The remaining chapters are concerned with treatment, especially by hearing aids and the thermal catheter.

In conclusion, the author acknowledges the indebtedness of otology to the physicists who, from the time of Graham Bell, by their intensive study of the measurement of sound, have rendered possible the delicate acoustical instruments which have so advanced otology.

Biological Time

By Lecomte du Nouy. Pp. x+180. (London: Methuen and Co., Ltd., 1936.) 7*s*. 6*d*. net.

THAT the biological aspects of the conception of time form a real problem cannot be doubted. Even the expression 'biological time' may have a meaning, if judiciously defined. The present book is built around three experimental facts closely connected with the flow of time: (1) the very regular falling off in the rate of healing (the cicatrization index) of wounds according to the age of the organism; (2) the regular fall in the growth-promoting power of serum for explanted cells with the age of the donor; and (3) the dependence of the subjective estimation of time on experimentally alterable factors, especially temperature. The book, however, has many disadvantages. At least one third of it is not at all germane to the principal issue, and in many places we miss citations of the relevant literature, even where it is French, the language in which this book was first published. It is concluded, *inter alia*, that there is a physiological time which does not flow uniformly like physical time, and that time has a discontinuous or atomic nature. The book is unfortunately marred by numerous errors of translation which in some cases may lead to confusion.

Television Optics:

an Introduction. By L. M. Myers. Pp. x+338. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 30*s*. net.

IN view of the many discursive books on the practice of television, this text is opportune, in that it sets out for the first time in book form the relevant physical data on lenses, Kerr cells, and electron focusing, and the relative effectiveness of various methods of scanning. More significant is its scientific accuracy and completeness; no important detail seems to be omitted which has a bearing on the optical performance of the many types of system. With its extensive bibliography and logical layout, Mr. Myers's book should prove to be a very valuable source of reference for students for many years to come.

L. E. C. H.

The Spectroscope and the Atom*

By Prof. Alfred Fowler, C.B.E., F.R.S.

IN his Thomas Hawksley Lecture of 1932, Lord Rutherford recounted the experiments with atomic projectiles which had given so much insight into the structure of atomic nuclei. My principal aim now will be to indicate how the spectroscope has contributed to our knowledge of the systems of electrons surrounding the nuclei of atoms, on which chemical and other properties are dependent.

Spectrum of Hydrogen

The simplest spectrum of all is that of hydrogen, showing the well-known Balmer series of lines in the visible region, in which the wave-numbers, ν, are represented by the formula,

$$\nu = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$$

where $n=3$, 4, and so on, and the *Rydberg constant* $R=109,678$ as calculated from the lines themselves.

Other series of hydrogen lines similar in appearance to the Balmer series were afterwards discovered, and it was found that the entire spectrum could be represented by the general formula

$$\nu = R/n_1^2 - R/n_2^2 \text{ when } n_1 < n_2.$$

$n_1=1$, $n_2=2$, 3, . . ., gives the Lyman series in the extreme ultra-violet; $n_1=2$, $n_2=3$, 4, . . ., the Balmer series; $n_1=3$, $n_2=4$, 5, . . ., the Paschen series in the infra-red, and so on. Theoretically, the number of series is infinite. The Rydberg constant R appears with slight modifications in the formulæ for series of lines in the spectra of elements other than hydrogen.

It is of special importance to note that the wave number of each spectrum line appears as the difference of two other numbers. These are the so-called *spectroscopic terms*, each of which, in accordance with Bohr's theory, is proportional to a particular energy state of the atom.

Series in other Spectra

Similar regularities occur in the spectra of elements other than hydrogen. Many of these spectra are built up by a number of superposed separate series, illustrated for lithium and sodium in Fig. 1. Four of the series have received special names—*principal*, *sharp*, *diffuse* and *fundamental*, respectively.

As in the case of hydrogen, each of the abovementioned series may be represented by the differences between a spectroscopic term representing the limit of the series and a *sequence of terms* given by a running number. In the simple form adopted in the classical work of Rydberg, a term R/n^2 in the formula for hydrogen is replaced by $R/(m+a)^2$, where m stands for a sequence of integers and a is a fraction special to the particular series. It is found that the different series are closely related to each other, so that the limit of one series is a member of one of the other sequences of terms. The sequences, as distinct from the lines, are named S, P, D, F, after the series in which they occur. If the first terms of the S, P, D sequences are assigned the number 3, as would be the case for sodium, the relations between the series may be shown as follows:

Principal series . .	$3S - nP$	$n = 3, 4, 5, \ldots$
Sharp series . .	$3P - nS$	$n = 3, 4, 5, \ldots$
Diffuse series . .	$3P - nD$	$n = 3, 4, 5, \ldots$
Fundamental series .	$3D - nF$	$n = 4, 5, 6, \ldots$

where n is known as the *principal quantum number*. The actual numbering of the terms in modern form is based upon theoretical considerations.

As first recognized by Ritz and expressed in his *combination principle*, other terms of a sequence besides the first may combine with terms from other sequences to produce subsidiary series, as, for example, $4P-nD$. The possible combinations in ordinary circumstances, however, are restricted by selection rules, one of which is that only terms from adjacent sequences in the order S, P, D, F, G, . . . combine to produce lines.

Multiple Terms

When a family of series consists of doublets or triplets, the specification of the spectroscopic terms requires additions to the scheme for a singlet system. These are the so-called *inner quantum numbers*, j, which were empirical in the first instance but have since become of profound theoretical importance. In modern form, the different types of terms are written as follows:

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* From the twenty-third Thomas Hawksley Lecture of the Institution of Mechanical Engineers, delivered on November 6, 1936.

Singlet terms .	$^1S_0$	$^1P_1$	$^1D_2$	$^1F_3$
Doublet terms .	$^2S_{1/2}$	$^2P_{3/2}$	$^2D_{5/2}$	$^2F_{7/2}$
		$^2P_{1/2}$	$^2D_{3/2}$	$^2F_{5/2}$
Triplet terms .	$^3S_1$	$^3P_2$	$^3D_3$	$^3F_4$
		$^3P_1$	$^3D_2$	$^3F_3$
		$^3P_0$	$^3D_1$	$^3F_2$

Here the index on the left of the symbol for each term indicates the multiplicity r of the system, while the suffix on the right is the inner quantum number j.

Terms of higher multiplicity than three occur in many spectra, giving quartets, quintets, sextets, septets, octets, or still greater complexities. Odd and even multiplicities, however, never appear together, but occur alternately in passing through successive groups of elements in the Periodic Table. As many as three systems may occur in the same spectrum. The names given to these higher multiplicities indicate the *maximum* number of j values assigned to any of the terms. S terms are always single, P terms have never more than three components, D terms not more than five, F terms not more than seven, and so on.

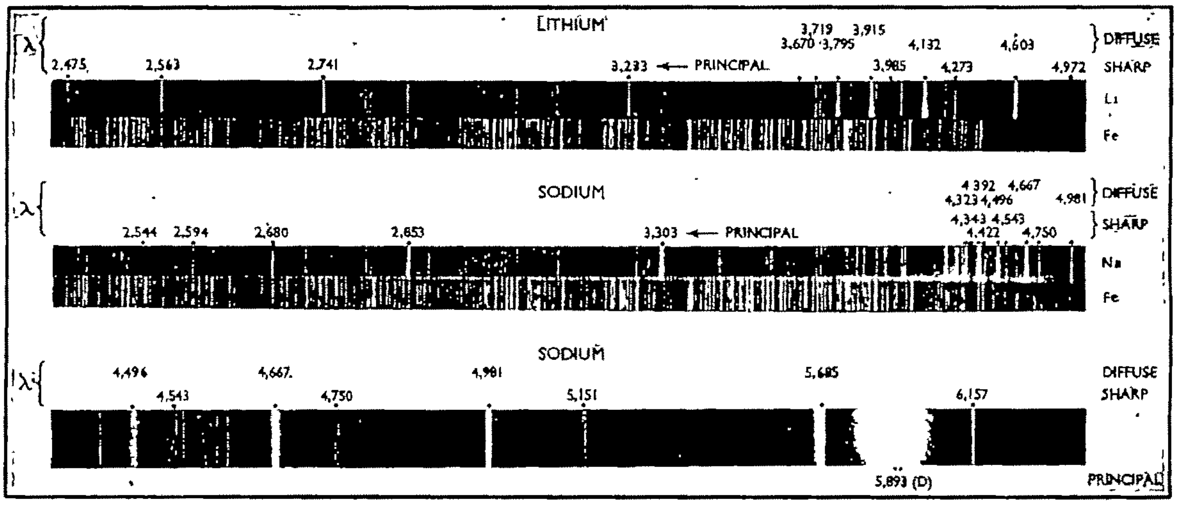

Fig. 1.

Series of lines in the spectra of lithium and sodium with iron arc comparisons.

Under ordinary conditions, combinations between different terms in the same spectrum are subject to two further selection rules, namely, $\Delta r = \pm 2$ or 0, and $\Delta j = \pm 1$ or 0, with $j=0$ to $j=0$ forbidden. This means that terms cannot combine to produce a line unless the r values differ by 2 or 0 and the j values by 1 or 0. The first selection rule already mentioned is expressed as $\Delta l = \pm 1$, where $l = 0, 1, 2, 3, \ldots$ for S, P, D, F, . . . terms.

Bohr's Theory

The significance of series of lines in spectra had not begun to be understood until Bohr launched the epoch-making quantum theory of atomic spectra in 1913. The normal hydrogen atom was assumed to consist of a minute nucleus of mass M and positive charge E, with a single electron of mass m and negative charge e moving round it. When the atom was excited by the absorption of energy, the electron was supposed to traverse larger orbits, specified by the quantum condition that the angular momentum must be an integral multiple of $h/2\pi$, where h is Planck's constant. On the further assumption that a quantum of radiation $h\bar{\nu}$ (where $\bar{\nu}$ = oscillation frequency) was emitted when the electron returned from one orbit to another of lower energy, Bohr derived an expression for the hydrogen spectrum which is in agreement with that determined experimentally, and in which R took the form, $\frac{2\pi^2E^2e^2}{ch^3} \cdot \frac{Mm}{M+m}$, where $E = e$ for hydrogen and c is the velocity of light.

A *term* represented an energy state of the atom, giving no radiation, and a *line* the emitted radiation when the atom passed from a state of higher to one of lower energy. This has been found to be applicable to all atoms, and the different states are regarded as *energy levels*, quite irrespective of any particular model of the atom.

Ionized Atoms

Strong support for the theory was given by its application to the spectrum of ionized helium, which is produced by intense electrical discharges through the gas. This spectrum is developed when the atom has lost one of its electrons, the remainder then being similar to a hydrogen atom, except that the nucleus has a double positive charge, and a mass four times greater. The spectrum should accordingly be similar to that of hydrogen, but relatively displaced, and this agrees with observation, even in quantitative details. Following this, it was foreseen that an atom of any element might be deprived of its electrons one by one through increasing excitation, and that the series constant would change through values of approximately $4R$, $9R$, $16R$, and so on, until, when only one electron remained, the spectrum would become similar to that of hydrogen. All this has been verified by experiment, and, as was expected, it has been found in general that when an atom has become ionized its spectrum resembles that of the element which precedes it in order of atomic number. If two electrons have been removed, the spectrum will resemble that of the element of atomic number $Z-2$, and so on indefinitely. It has been found convenient to represent the spectrum of a neutral atom by ZI, and the spectra at successive stages of ionization by ZII, ZIII, etc , the corresponding states of the atom itself being indicated by Z, Z^+, Z^{++}, etc

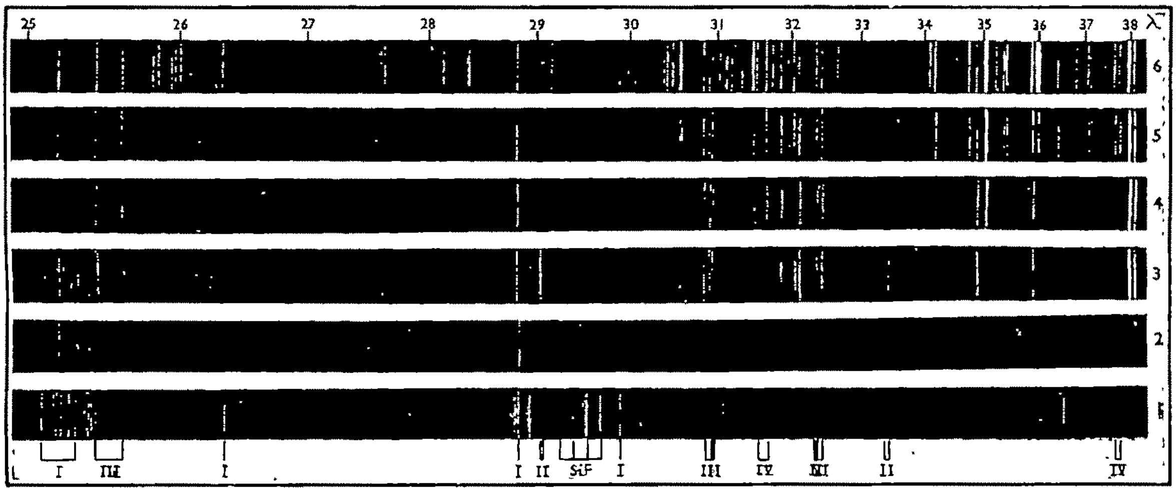

Fig. 2

SUCCESSIVE SPECTRA OF SILICON PRODUCED BY GRADUALLY INCREASING INTENSITY OF DISCHARGE THROUGH A VACUUM TUBE CONTAINING SILICON TETRAFLUORIDE.

A good illustration of the changing spectrum of an element is given by the photographs of silicon spectra reproduced in Fig. 2. The experiments were made on the vapour of silicon tetrafluoride in a vacuum tube, the intensity of the electric discharge increasing gradually from 1 to 6.

THE VECTOR MODEL

As the finer details of spectra were taken into consideration, the Bohr conception of the atom was found to require more elaboration. For an explanation of multiple terms, for example, it became necessary to suppose that the electron possessed a spin, the angular momentum of which, denoted by the quantum number s, was fixed at $\pm\frac{1}{2}$, according to the direction of rotation.

Despite such additions, however, it was ultimately realized that the orbital model was incapable of describing all the intricacies of spectra, and in more general considerations it was displaced in favour of a *vector model*, in which the various quantum numbers of the electron were no longer necessarily associated with orbits, but with angular momentum vectors the interpretation of which in the form of a picturable mechanism was not essential. In this model, five quantum numbers are used, n, l, s, j, and m, but only four of these are independent, since j is the quantized resultant of l and s. In the simpler cases in which the orbital model is adequate, these vectors correspond respectively with the quantum numbers n, l, s, and j already described; while the number m corresponds with the quantized projection of j along the magnetic axis of the atom. In the general case, however, although the names suggested by the orbital conception are often used, they cannot be applied with their literal meanings, and the quantum numbers are used in calculations merely as symbols obeying certain rules.

It is not possible here to enter into intricate details of spectra. It must suffice to state that on the supposition that an atom is so constituted that the angular momenta of all the rotary motions can only change by unit steps, a complete scheme has been worked out by Hund by which the types of terms associated with a given distribution of electrons around the nucleus can be calculated. The results of such calculations are in entire agreement with the types deduced from the numerous analyses of spectra which have now been made.

QUANTUM MECHANICS

These developments of the theory of atomic structure took place in intimate relation with spectroscopic research. The result was a conception of the atom, definite so far as application to experimental results was concerned, but containing basic *ad hoc* assumptions which violated the principles of classical mechanics. Throughout the development of the theory it was evident that some fundamental system of mechanics was required from which the assumptions of the existing quantum theory would follow as natural consequences.

The foundations of such a system were laid by Heisenberg, de Broglie and Schrödinger, and what is probably the most fundamental statement of the resulting quantum mechanics has been given by Dirac. In the derivation of this system, the knowledge gathered from the analysis of spectra has been supplemented by that obtained from other experimental work. It would therefore take us outside the scope of our subject to enter into these advances, and it only remains to indicate in general terms the reaction of quantum mechanics on the question of atomic structure. This may be summed up by the statement that, while the arbitrary postulates of the empirical theory have been expressed as necessary consequences of fundamental mechanical principles, the orbital picture and vector representation of the atom have been discarded, and no equally picturable substitute has been given. A partial picture is possible in terms of a rather indefinite distribution of electricity, one such distribution corresponding to each stationary state, or electron configuration, of the atom according to the earlier ideas. It is impossible, however, to locate the electron at a precise position in this distribution.

Nevertheless, for the practical purposes of spectroscopy, the vector model retains its usefulness. Many of the results obtained by its application are identical with those given by quantum mechanics, and where divergence occurs, a simple modification—as, for example, the substitution of $\sqrt{l(l+1)}$ for the l of the vector model—produces close agreement. The vector model is likely, therefore, to remain as a guide to spectroscopists for some time to come.

University of Heidelberg and New Conceptions of Science

From a Correspondent

THE general character of the changes in the German universities was expounded by Herr Rust, Reichsminister for Education, at the recent celebration of the 'jubilee' of the University of Heidelberg. His address is translated in the November issue of the *Universities Review*. Herr Rust believes the New Germany to be the true heir of Sparta and suggests that these changes are as though Sparta had triumphed over Athens. Had that calamity befallen the world, all that we could have inherited from Greece would have been 'discipline', for Sparta had no other gifts to bestow. But the new "Weltanschauung", Herr Rust assures us, "is the life-blood of a new science . . National Socialism has provided science with new principles from which she can derive the strength of self-confidence. . . The old idea of science based on the belief in the supremacy of the intellect is finished."

The effect on a university of the arbitrary treatment of its staff is not numerically expressible. Injustice to one teacher may overawe the entire faculty and deprive its work of all value. Staff changes at Heidelberg tell, therefore, of only a fraction of the injury to learning. We give, however, a summary of what has happened at Heidelberg; and it suggests what is going on throughout the universities of Germany.

The calendar of the University of Heidelberg for the academic year 1936–37 may be compared with that of 1932, the last year unaffected by the new regime. The historical account of the university, which opened previous calendars, is omitted this year. Any record of either benefactors or distinguished alumni would have to include names of many of Jewish or partly Jewish origin. The very title of the official head has been altered, and Rector Groh is now Führer Groh. The order and many of the titles of the staff are changed. After Führer Groh follows the *Leiter* of the body of dozents, Herr Schlüter, who, oddly enough, is not himself a dozent. Next is the undergraduate Herr Ernst Kreuzer, who is both a member of the Senate and "Officially designated Undergraduate Leader at

Heidelberg of the Nazi Student Union of the Nazi Party". (*Kommissarischer Hochschulgruppenführer der Hochschulgruppe Heidelberg des NSD Studentenbundes der NSDAP.*) After this student follow the deans and other members of the Senate. Six of the ten ordinary members and seven of the twelve deans and sub-deans were not members of the teaching staff in 1932. The academic authority that occupies the next place is the "Nazi Teachers' Union" (*Nationalsozialistische Dozentenbund*). Of this the "District Führer" (*Gaudozentenbund-Führer*) is Party Member Professor Dr. Ernst Krieck who, for a short time, held uneasily the rectorship of the University of Frankfort. The promotion of Dr. Krieck, not long ago teacher in a *Mittelschule*—that is what we should call the 'modern side' of a secondary school—has been very rapid.

There were 215 teachers at the University in 1932. There are now only 180*. Of these, 99 survive from the old regime, while 81 have come in with the new regime. The displacements do not imply promotion. On the contrary, many higher positions are now occupied by previously unknown men, and some by men who hold, in addition, ministerial office (*Ministerialrat*), a combination forbidden under the old regime. Nazi influence is most evident, however, in the lower ranks of university teachers, the list of whom teems with 'Party Members'. A few teachers have been permitted to keep nominal positions but deprived of stipend. Among those dismissed are, remarkably enough, a number who have been added to the staff since the advent of the present regime. The career of a professor in Germany has become, like the life of Hobbes's primitive man, "poore, nasty, brutish and short".

The actual causes of dismissal have not been published, and to ascertain them with accuracy would involve a long and a dangerous research. In the majority of cases doubtless the victim was a Jew or had some more or less distant Jewish affiliations. Nevertheless, in the Faculty of Medicine, where dismissals have been most numerous, only half of the dismissals seem explicable on such grounds. "Political unreliability", that is to say, connexion with any 'left' party before the advent of the present regime, or want of submissiveness to the present regime, is a common cause of dismissal. It is difficult to say in how many cases dismissal has been produced or stimulated by direct action by the students. These have violent national socialist leaders, and there can be no doubt that they have had and have a large share in the control of the University.

The constitution of the reduced staff may be learned from the following table:

Faculty	Percentage of new appointments
Science	31
Theology	36
Law	38
Philosophy	49
Medicine	56

The changes in the Faculty of Law are peculiarly significant. The Institute for Historical Jurisprudence has lost its former name "Rudolf-Mosse-Stiftung", which indicates that it is a Jewish benefaction. The Jewish endowment is retained. Important fields of legal knowledge are no longer represented. In the list of 1935–36 the subject of "International Law" still appeared under the reduced dignity of "Foreign Law" (*Ausserstaatliches Recht*) to be expounded by one undesignated. In the current list it has vanished and left not a wrack behind. A subject which makes its first bow to the learned public is "Reform of the Penal Law", but no room is found for "Penal Law" itself. The hand of the secret police is here discernible. Special instruction is provided in "Recent Political History", "Folk Elements in Law" (*Rechtliche Volkskunde*), "Family Heredity", "Folk and Race", and "German Military Law".

In the Philosophical Faculty there are new courses by new men on "Foundations of National Socialist Philosophy" as well as on "Folk Philosophy", "German Philosophy", "Educational Policy", "The Nature of the Folk Community", and "The Nature of Ancient German Religion". The Philosophical Faculty has now a new "Professor of Modern War History". His work would seem to overlap that of Herr Minister Schmidthenner, who is "Professor Ordinarius of History with special reference to the History of War and Military Knowledge" (*Wehrkunde*). Herr Professor Minister Schmidthenner will lecture on "The World War", "Politics and War Leadership", "The Total War", "Germany's Right to Colonies" and on "Political Geography of the German East". He holds a seminar on "Being and Action of the German Soldiery".

In the Faculty of Science the following are among the dismissed: the two ordinary professors of mathematics, Liebmann and Rosenthal, the professor of geology, Salomon-Calvi, honorary Professor Victor Goldschmidt, Extraordinary Professors Merton (Zoology) and Gerta von Ubisch (Genetics), Privatdozents Lemberg, Wolf and Schmitz. There is now no ordinary professor of mathematics at Heidelberg. Many courses in mathematical subjects are suspended or advertised as by teachers as yet undesignated.

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* The number of teachers is approximate. As in an English university, many members, for example, librarians, junior demonstrators or physical instructors, belong doubtfully to the teaching staff. The figures 215 and 180 are conservative.

In the Faculty of Medicine the dismissals have been very numerous. Among them are Ordinary Professors Baeyer, Bettmann, Blessing, Sachs, Willmanns; Honorary Professors Fränkel and Löwe; Extraordinary Professors Gruhle, Gyorgy, Klopstock, Meier-Grosz, Münter, Schreiber, Serr, Steiner, Zade; Privatdozents Laser, Pagel, Stern, Strauss, Wittebski and Wurm. Nearly the whole of the cancer research staff has been dismissed. The first medical lectures advertised are "Nazi Philosophy and Race Theory", "Folk and Race", "Medical Outlook on Physical Development", "First Aid with special reference to Military Sport and Gas Defence".

We cannot discuss student life at Heidelberg, but note that before matriculating a student must produce documentary evidence of the religion of both of his parents and of his four grandparents. The recession of learning and the significance of propaganda in the life of the University is revealed in the programme of the official "Students' Faculty Discussion Groups" (*Arbeitsgemeinschaften*). Subjects for debate there are "Self-consciousness of German Culture", "Education of Nazi Youth", "Labour Service and Military Law", "Claims of the Germans in Czecho-Slovakia", "Laws concerning Race", "Care for Healthy Inheritance", "Eastward Expansion of Germany", and "Professor Lenard and his Significance for German Science".

Faced with a series of unprecedented attacks on the interest of learning as well as on their own rights, no member of the staff has had the temerity to utter any word of public protest. There are several retired or very senior members of independent standing from whom one might have reasonably hoped for some sign of courage. But Germany has openly reinstated serfdom, the essence of which is to restrain the worker from marketing his labour as he will and to place him at the disposal of an overlord. It is, therefore, appropriate that the minds of Germans should be enslaved along with their bodies, for slavery mercifully provides its own spiritual anæsthesia. This, in truth, is the 'new principle' for science which Reichsminister Rust has discovered. But, to speak yet more plainly, science has been abolished in the German universities and its spirit has abdicated from the Reich.

Obituary Notices

Dr. A. A. Robb, F.R.S.

ALFRED ARTHUR ROBB, who died on December 14 at the age of sixty-three years, won distinction by his contributions to the theory of relativity during the early period of its development. His life-work is contained in a book "A Theory of Time and Space" first published in 1914; it is a happy circumstance that he lived to complete a revised edition which appeared a few months ago. This work consists of an axiomatic and logical development of the geometry (Minkowskian geometry) of the space-time of special relativity theory, arranged as a sequence of more than two hundred theorems. It is generally recognized to be a model of its kind.

To the analyst, the difference between Euclidean and Minkowskian geometry seems trivial, being merely the substitution of an imaginary for a real variable in one of the co-ordinates; but the formal simplicity of the change often causes insufficient attention to be paid to its implications, so that serious misconceptions arise later on. In an axiomatic treatment, the two geometries show little resemblance to one another; in particular, Robb's theory could not be applied to Euclidean space, nor could anything even remotely analogous be substituted. His work shows more clearly than any other how by dissecting space-time into spatial sections we lose the very essence of its constitution. Robb developed his theory on the sole basis of an irreversible relation of 'before' and 'after', which, as he pointed out, is simpler than the spatial relation of 'between'. This leads to the study of a type of order of points which he called 'conical order'. His work, which he attributed to the inspiration of Sir Joseph Larmor, was partially independent of that of Einstein and Minkowski; and, coming at a time when their theories were little known or discussed, it has been very helpful in elucidating the paradoxes that seemed to arise.

There was an unusual combination of the abstract and the practical in Robb's mental outlook. He took great trouble in designing models to illustrate his theory. Apart from relativity, he was interested in geometry and mechanics, not in a systematic way, but on the look-out for neat devices, subtleties and curiosities. He delighted in exposing the traps which catch unwary text-book writers, and was rather merciless to the victims. It was difficult to persuade him that a man might have a sound understanding of relativity in spite of his having described a geodesic in space-time as a track of minimum (instead of stationary) length. He was no less severe on those who too unguardedly assert the equivalence of electric circuits and magnetic shells, producing to confound them the example of a circuit bounding a surface which has only one side. But if he had to some extent the 'gadget mind', he had also exceptional critical insight and logical power. To discuss a problem with Robb was most stimulating; and he seldom failed to find some new angle leading to clearer vision. Being shy and reserved, he made comparatively few friends; but those whom he had, found him a most entertaining companion. They appreciated also his extreme conscientiousness and sense of duty. He was a man of strong convictions, which he urged with pugnacity tempered by a delightful sense of humour.

No account of Robb would be complete without reference to his gift for writing topical verse and parody. He wrote many of the songs sung at the annual dinners of the Cavendish Society. His feat of adapting Maxwell's equations as the chorus of a song must have earned the gratitude of many who, like the present writer, could never remember them otherwise.

Robb was a thorough Irishman, in voice, appearance and sentiment. Though his home and family connexions were in Belfast, his sympathies were generally with the South. After passing through Queen's College, Belfast, he became a research student at St. John's College, Cambridge; he afterwards studied at Göttingen, where he took a Ph.D. degree. Being possessed of independent means, he never sought a post; but his habit was to spend most of term-time in Cambridge, living very quietly in lodgings, seeing a few old friends, and mainly occupied with mathematical research.

When the Great War came, Robb voluntarily undertook chemical work in connexion with the supply of medical drugs. But after some time his suspicions were aroused, and being unable to obtain an assurance that his products were not intended for the production of poison gas, he resigned. Not to be deterred from medical service, he learned to drive a motor-car and served as an ambulance-driver in France. In later years he joined Emmanuel College and was made a member of the High Table. Sometimes by invitation of the Faculty Board of Mathematics he gave a course of lectures on his theory. He was elected to the Royal Society in 1921.

This quiet academic life was rudely broken about five years ago, when Robb was called by circumstances to assume the management of his family business—an important firm in Belfast. Through a series of deaths of near relations, he was left almost the sole adult representative of his family, and it depended on him to keep things going in the interests of the next generation. For him it was a most uncongenial change; but he appears to have adapted himself to it successfully. He retained his rooms in Cambridge, hoping to find opportunity to return; but his visits have been rare. The new edition of his book, which contains considerable changes, is evidence that he remained active in mathematical research up to his death.

A. S. E.

Sir Henry Hall, I.S.O.

It is with great regret that we have to record the death of Sir Henry Hall, who died at Brookside, Chester, on December 8, at the ripe age of ninety years; he was born, therefore, in 1846, and was the youngest son of Mr. John Hall, of Sedgefield, Co. Durham. He served his time at the old Haswell Colliery Co., Durham, and got an appointment in the Swansea district in 1873. About 1875 he was appointed inspector of mines in that district, and was afterwards transferred to Lancashire, and was in addition given the care of North Wales when districts were reorganized a few years later (about 1910).

According to his own account, an accident at Wynnstay Colliery, North Wales, about the year 1874, first directed Sir Henry's attention to the danger of coal dust, and in 1890 he was appointed to experiment on the subject by the Royal Commission, which sat under the Right Hon. Joseph Chamberlain, M.P., as chairman, and consisted of a number of men well versed in explosions and mining, who altogether examined thirty-nine witnesses. According to his own statement, three different collieries were experimented on, in shafts ranging from 50 yd. to 200 yd. deep, and in a gallery some 45 yd. deep, using dust from the various districts of the country and no firedamp. It was not a new idea of Mr. (as he then was) Henry Hall's, the original idea being due to Faraday and Mr. Lyell, according to Mr. Godfrey Lushington (in Answer 66) in 1844. It was then revived by Mr. William Galloway and Messrs. W. N. and J. B. Atkinson, in which an explosion in a hopper, where no firedamp was present, was cited.

Mr. Henry Hall's results were accepted by the industry, but his remedies for this state of affairs, namely, watering and the use of high explosives (not gunpowder), were not followed up, because watering was not a complete remedy and often produced 'creep', and Sir William Edward Garforth's further experiment on the use of stone dust, finely divided, has been accepted by the industry in general and is now confirmed by legislation. The remedial suggestion decidedly advocated by Mr. Henry Hall was the use of the safety lamp, according to Mr. J. B. Atkinson, which has since been made compulsory by legislation.

For this service and his numerous papers read before the North of England Institute of Mining and Mechanical Engineers, and before the Institution of Mining Engineers—these among other services to the mining industry—Hall was given the medal of the Institution of Mining Engineers in 1928, whilst he was awarded the Imperial Service Order, and afterwards received the honour of knighthood. His death removes a man whose name is a household word in the mining industry, and who has ever, even after his retirement from the inspectorship, taken the keenest possible interest in the industry.

Dr. E. S. Cobbold

The ranks of the amateur geologists have been seriously thinned by the death of Edgar Sterling Cobbold on November 20, in his eighty-sixth year. The son of a surgeon who was greatly interested in natural history, he studied engineering at the Owens College and, after some fifteen years' practice, retired to Church Stretton in 1886. Here he at once threw himself into the study of the district, taking an active part in the proceedings of local natural history societies, and contributing extensively on archæology and geology to both scientific and popular guides to the area.

Cobbold's first contribution to geology here was the description of a Silurian outlier of much tectonic significance under Caer Caradoc. He soon came under the spell of the thoroughness and accuracy of Charles Lapworth's work, and became infected with his enthusiasm for the ancient rocks. Lapworth's discovery of the *Olenellus* fauna in Shropshire, and Groom's find of *Paradoxides*, having demonstrated the existence of Lower and Middle Cambrian rocks in the Stretton and Wrekin areas, Cobbold proceeded to collect from these rocks inch by inch. His reward was the discovery of many forms new to Great Britain and to science. He described a dozen new genera and more than a hundred new species from them, and was able to divide the Lower Cambrian into eleven, and the Middle into nine divisions, mostly definite life zones.

Thus Cobbold made his area the type-section for Britain, correlated the rocks with those of America and the Continent, and demonstrated the existence of breaks in the sequence caused by earth movements. He became our leading authority on Cambrian faunas, and was called in by the Geological Survey to determine the fossils collected by himself and others from the considerable Cambrian area between the Wrekin and Charlton Hill. His type-fossils have been lodged in the British Museum, the Geological Survey Museum, or the Sedgwick Museum.

The work that Cobbold accomplished with such conspicuous success could only have been carried out by one living on the spot, with abundant leisure and the knack of using it effectively, with remarkable energy, industry, devotion, and perseverance, with wide knowledge of his subject and its literature in many languages, and with the hand and eye of an artist.

W. W. W.

We regret to announce the following deaths:

Mr. Thomas Crook, O.B.E., since 1928 principal of the Mineral Resources Department, Imperial Institute, London, on January 6.

Mr. P. A. Ellis Richards, president of the Society of Public Analysts in 1922–23, aged sixty-eight years.

Sir David Semple, founder and first director (1900–5), of the Pasteur Institute of India on January 7, aged eighty years.

News and Views

Prof. E. B. Bailey, F.R.S.

The Lord President of the Council has appointed Prof. E. B. Bailey, professor of geology in the University of Glasgow, to be director of the Geological Survey of Great Britain and of the Museum of Practical Geology, a post rendered vacant by the untimely death last year of Dr. Bernard Smith. Prof. Bailey previously served on the staff of the Survey for some twenty-seven years. After a distinguished career at Cambridge, where he gained the Harkness scholarship in geology, in 1902 he was appointed geologist to the Geological Survey of Scotland, with headquarters in Edinburgh, where he remained until 1929. During the years he served in Scotland, Prof. Bailey made a special study of the tectonics of the Dalradian schists, a subject in which he became an acknowledged leader. He also took an important part in the survey of the tertiary igneous rocks in Mull, and edited the Survey memoir on this area. Other duties carried out during his years on the Survey included much work on the Carboniferous rocks in the Midland Valley of Scotland. His experience was further widened by visits abroad from time to time. Prof. Bailey's Survey career was interrupted by the Great War, during which he saw much service in France with the Royal Artillery, receiving the Military Cross, the Legion d'Honneur and the Croix de Guerre as rewards for distinguished services. His enthusiasm for geology was such that he even found time to publish papers on this subject during the time he was engaged on military service.

In 1929, Prof. Bailey resigned from the post of district-director in Scotland, to take up his appointment to the chair of geology in Glasgow. During his tenure of this post, he has continued his researches into Highland tectonics, and has also developed the application of current- and graded-bedding to the question of the age of the Highland schists. Among the academic and other distinctions received by Prof. Bailey may be mentioned the following: from the Geological Society of London, in 1923 the Bigsby Medal, and in 1935 the Murchison Medal; in 1928, president of Section C (Geology) of the British Association; in 1930, elected fellow of the Royal Society; in 1936, awarded the honorary degree of D.Sc. by Harvard University at its tercentenary celebration. The results of the official work carried out by Prof. Bailey, and of his private researches, are contained in numerous memoirs of the Geological Survey, and in the publications of various learned societies. He is also the author of "Tectonic Essays: Mainly Alpine".

The Piltdown Jaw

In another column of this issue of NATURE (see p. 120) reference is made to the reaffirmation by Prof. F. Weidenreich of the Cenozoic Research Laboratory, Peiping, of the orang-like character of the Piltdown jaw, which he relegates to the group orang-chimpanzee-gorilla, standing outside the line of human descent. In this connexion attention may be directed to another attack on the human character of the Piltdown relic by Mr. Alvan T. Marston, which appears in *Discovery* of January. Here the basis of argument is the character and arrangement of the teeth, in which it is maintained the jaw is anthropoid and not human. The form of the canines, it is said, points to a gap between canines and incisors and an outside bite of the former, such as are found in the apes, but never appear in man, even in such an early and primitive form as Peking man. Similarly, such indications as are afforded by the Piltdown jaw on the order of eruption of the teeth point to the anthropoid, rather than the human, character of the dentition. The canine, instead of preceding the second molar, as in man, was here the last to erupt, and indeed, Mr. Marston infers, was still incompletely formed. Further, he concludes, the jaw shows no evidences of the adaptations for speech, for which capacity is to be inferred from the advanced character of the brain. When Prof. Weidenreich's promised monograph on the teeth of *Sinanthropus* appears, in view of the relatively large amount of evidence at his disposal, it may be anticipated that we shall learn whether the teeth show the variability, which he has found in the mandible, and whether it supports the evidence already available to Mr. Marston, on which he relies to no little extent in stating his case.

France and its People

IN "France: a Handbook for Beginners in French" (Cambridge: W. Heffer and Sons, Ltd. Pp. 48. 1*s*. net) are reproduced three lectures by Dr. Cloudesley Brereton, originally broadcast in Great Britain in December 1935 and January 1936 and afterwards repeated, at the invitation of the French Government, from Paris. The sub-title, in so far as it may tend to suggest that the pamphlet is unlikely to appeal to the general public, is misleading, for here is no mere catalogue of dry facts but a lively appreciation of the genius, to quote the author's own words, of a hard-working, cheerful, amiable, keen-witted, polished, social, artistic and, at bottom, spiritually-minded people. That it is eminently fitted to promote that mutual understanding and appreciation between nations which a strident modern nationalism threatens to stifle has been recognized by the judges entrusted with the awarding of the recently instituted "Prix internationaux du Tourisme". They have awarded to the author the second prize of 15,000 francs; the first prize, of 25,000 francs, having been awarded to Mrs. Brangwyn, an American, for "Everybody in Paris". As an example of Dr. Brereton's method may be quoted his comparison between French and English science teaching in secondary schools. Practical science is, he holds, rather neglected in the French *lycée*. "In the more abstract side of science, however, a very high standard is attained. Our schools possibly err in the other direction—somehow the glamour of science has rather been overshadowed by the excessive cult of the test tube in this country".

Archæological Expedition to Nubia

SIR ROBERT MOND's appeal on behalf of the archæological expedition to Nubia projected by the Egypt Exploration Society merits, and no doubt will receive, full measure of support. The valuable work of investigation which the Society has carried out at Tell el-Amarna under its present concession from the Egyptian Government, on a site which might have been thought already to have yielded its precious material to the excavator, is a warrant that the expedition will spare no pains on the new sites to secure that nothing of moment is overlooked which may throw light on the history and culture of this little-known part of ancient Egyptian rule. As Sir Robert points out in his letter to *The Times* of January 4, the two sites which have been reserved provisionally for the Society, Sulb (Soleb) and Sesebi in Upper Nubia in the region of the Third Cataract of the Nile, will both throw further light on the Amarna age, upon which the Society has been engaged now for some years. Their comparative inaccessibility accounts for the fact that they have been little studied; but it is known that at both these fortress cities there are remains which date from the reigns of Amenophis III and Akhnaton. The temple of Sulb is in fact described by Breasted, as quoted by Sir Robert, as "the most important monument surviving in the Sudan, and one of the two greatest architectural works surviving in the Nile Valley, the other being the temple of Luxor . . . We have in Soleb, therefore, one of the first creations of the Empire". As the temple has on its walls running reliefs which depict scenes from the Sed festival, to celebrate which Amenophis caused this temple to be built, its investigation will supply information as to ritual and belief which is unique. Further, as the two fortresses probably occupied the sites of earlier Nubian towns, some data, at least, should be forthcoming bearing upon the earlier population of Nubia, which, it will be remembered, the late Sir Grafton Elliot Smith held to be of considerable moment in the understanding of the early racial history of ancient Egypt.

Academy of Natural Sciences, Philadelphia

IN the course of the current month, the Academy of Natural Sciences, Philadelphia, will issue invitations to an international symposium on early man and the origins of the human race which is to be held in Philadelphia on March 18–20. This symposium will form part of the proceedings celebrating the one hundred and twenty-fifth anniversary of the foundation of the Academy. Among those who have already promised to contribute to the symposium are Dr. P. Teilhard de Chardin of China, Dr. Ralph von Koenigswald of Java, Dr. R. Broom of South Africa, Miss D. A. E. Garrod of Great Britain, and Dr. Kaj Birket-Smith of Denmark. The arrangement of the programme is in the hands of a committee which includes Dr. John C. Merriam, president of the Carnegie Institution, Washington, D.C., Dr. Edwin C. Conklin, vice-president of the Academy and president of the American Association for the Advancement of Science, Dr. George G. MacCurdy, director of the American School of Prehistoric Research, Dr. Hellmut de Terra of the Carnegie Institution and Dr. E. B. Howard, acting curator of the Academy's Department of Geology and Palæontology, who will act as secretary of the Committee. An attraction additional to the original papers which will be presented at the symposium is a "Hall of Prehistory" in which will be represented all the fossil remains of early man and his weapons and tools, as well as replicas of the principal sites of discovery. Among the exhibits for which arrangements have already been made is a cast of *Homo Modjokertensis*, the recent discovery from Java, which has been claimed to be "the earliest datable human fossil". This will be exhibited by Dr. von Koenigswald. Dr. E. B. Howard will be responsible for a reproduction of the site of Folsom man at Clovis, New Mexico, and casts of the recently discovered relics of Peking man will be shown by Dr. Teilhard de Chardin.

Wool Industries Research Association

AN apologia on a research association's work and policy is an unenviable task for any of its officials to essay. Mr. Wilsdon, director of the Wool Industries Research Association, in his recently issued annual report, has frankly stated those especial difficulties which beset his and other research associations in endeavouring to establish and increase the confidence and support of its members, whose subscriptions are on a voluntary basis, whose individual interests are widely divergent and, with the many subdivisions of the industry, even competitive, and whose expectations, apart from some particular information yielding direct financial benefit, are largely nebulous in character. Such associations are for these reasons an easy mark for destructive criticism, always louder than the praise for specific individual benefits, which is too often uttered unobtrusively, if at all. Standardization, on which Mr. Wilsdon rightly puts insistence, has an undoubted place within this, as other, industries. There is also much to be said in favour of pooling information for the general raising of manufacturing excellence; but there are limiting factors which make the effective bounds much narrower than in most manufactures. As the architect puts his individual skill and experience, as well as his knowledge of fitness of material, design and colour, into the creation of the structure, so is cloth-making largely a 'creation' in this sense. The devising of woollen blends and of worsted tops is of similar complexity, and such circumstances tend to narrow the field within which the personal factor can be replaced or even checked by scientific classification.

ON the other hand, the trade should give wholehearted adherence to the dictum that "research on the fundamental properties of the wool fibre is the surest way of maintaining its pre-eminence among the textile fibres". Of the two discoveries referred to, the neutral bleach and the new unshrinkable process for wool initiated by Prof. A. T. King, of the University of Leeds, while chief chemist of the Association, the latter now promises to take front rank in modern textile developments, but might well have languished in face of incredulity and prejudice in some quarters. The Director of Research and his committee are to be congratulated on having brought it to the point of imminent release, against the considerable inertia which revolutionary changes have to overcome. Discoveries of this kind, however, which cannot be expected to occur frequently, should not, as Mr. Wilsdon has cogently reasoned, constitute the only means of bringing conviction to the trade of the Association's usefulness.

Artificial Thallium Moult in Sheep

IT has been known in medicine since 1898 that thallium compounds taken internally will cause loss of the hair. This method has recently been used to produce moulting of the fleece in sheep, instead of shearing. Prof. N. A. Iljin (*J. Genet.*, **33**, No. 2) gives a short account of experiments in which the sheep's fleece becomes loose a few days after treatment and can be removed whole with the hands in a few minutes. Sheep with coarse and mixed wool have a natural annual moult which is absent from fine-woolled breeds such as the merino. Hybrids are found to exhibit segregation of this character of natural moulting. By thallium treatment, the moult may be induced in merinos and their naturally non-moulting hybrids. Extensive experiments with this method have been carried out on Soviet State Farms in the Crimea, Ukraine, Caucasus and the Moscow district, but as a considerable number of sheep were killed by an overdose during the experiments, it is evident that the effects of repeated doses on the animal will need to be known before the treatment can come into practical use.

Development of Crystal Analysis

SIR WILLIAM BRAGG, delivering the Sir Henry Trueman Wood lecture before the Royal Society of Arts on December 16, gave an account of the development of crystal analysis by X-rays during the last decade. The X-ray data may now be made to give a 'shadow picture' of the molecular structure which can be compared with chemical ideas of structural grouping. The dimensions of the structure can be determined with very considerable accuracy—the separation of atoms within about one per cent—and it is found that the characteristic separation of, say, carbon atoms persists in a number of related structures. Chemical ideas of valency, double and triple linkages, the benzene ring are all clarified by this method of study of the atomic separations. The investigation of structures is progressive in the sense that the information already gained can be used in the attack on more complicated structures. Important results have been obtained with proteins, and the properties of the protein chain explain the peculiarities of hair, muscle and similar biological structures. The X-ray diffraction patterns obtained from alloys show how a small quantity of an alloying element fits into the main lattice; while the progressive addition of alloy leads to the formation of new, characteristic lattices. The peculiar alloy structure called the γ-phase depends apparently on a fixed proportion (13:21) of atoms to valency electrons. X-rays, aided by electron diffraction, also give information about the crystal texture—the size and arrangement of the crystals as distinct from their inner structure; and the texture is the key to such different problems as the working of metals and the function of biological structures.

The Boulder Dam and its Equipment

IN *Engineering* for January 1 is a well-illustrated introduction to a series of articles which will deal with the mechanical, hydraulic and electrical features of Boulder Dam. These articles will be written by Mr. P. A. Kinzie, Mr. J. A. Winter and Mr. L. N. McClellan, who have each been responsible for some part of the equipment for the control and utilization of the water impounded by the Boulder Dam, which is not inappropriately described as "the greatest engineering effort of its kind in history". It was on December 21, 1928, that President Coolidge signed the Boulder Dam Act, which provided for the construction of a great dam on the Colorado River. The scheme had several objects. First, it was intended to prevent the serious floods which menaced the fertile district of the Imperial Valley; secondly, to conserve water for use in the same district during the hot dry summers; and thirdly, to provide a public water supply for the coastal cities of Southern California. The river has a length of approximately 1,700 miles, and drains an area slightly more than double the area of Great Britain. The site for the dam was chosen in Black Canyon about 300 miles upstream from the river mouth, a barren and inhospitable region, the character of which is well shown by the photographs in *Engineering*. The dam itself was completed in the summer of 1935. From the lowest portion of the foundation to roadway level it is 726 feet high; it is 660 feet thick at the base and 45 ft. thick at the crest, and contains about 6,600,000 tons of concrete. It is composed of massive vertical columns about 230 in number, interlocking both vertically and horizontally. Recently, the water impounded in the reservoir, Lake Mead, was estimated at ten billion gallons.

Electric Supply in Palestine

AN account of electric supply in Palestine since it was initiated in 1923, given in *Electrical Industries* of December 2, is of special interest in connexion with the political rioting which began last April. The pioneer of this supply was Mr. P. Rutenberg, who enlisted the support of the late Lord Melchett and the Baron E. de Rothschild. It was decided to have a national power supply from water-power, but as the rainfall for Palestine lasts only four months in the year, it was necessary to store the winter rainfall in reservoirs, the construction of which would take several years. It was advisable therefore to use temporary Diesel engine power stations at Haifa and Jaffa to begin the supply, whilst the Dagania dam across the River Jordan and the large one on the Tarmuck River were being constructed. In addition to these dams, Lake Tiberias, which forms a natural reservoir with a surface of 170 million square metres, was utilized. The water-power is converted into electrical power which by high-pressure electricity is distributed to Haifa and thence to the north and south of Palestine. In addition, a steam turbine power house was constructed in 1935 and a large power house called the 'Reading' (after the late Marquess of Reading) is being built in southern Palestine.

WHEN these plans are completed, the Holy Land will be as highly electrified as any territorial area in the British Empire. During the last three years, the consumption of electricity has quadrupled. There can be little doubt that industrialization is rapidly changing the character of Palestine and that electric power is the main factor in producing this change. Electric lighting, electric power driven machinery and all-mains wireless sets are to be found in small towns, villages and even in remote farming settlements. This is partly due to the fact that the immigrants who come from Germany, America, Czechoslovakia, Austria and the British Dominions, have been accustomed to the use of electric light in factory and home. It looks as if schemes for flooding the Dead Sea from the Mediterranean and so getting electric power possibly for sale to Egypt will soon be considered. One very beneficial effect would be that the constant evaporation from the greatly increased surface of water would humidify the atmosphere and so contribute to the fertility of the region.

Academic Freedom

THE report of the Conference on Academic Freedom at Oxford in August 1935 and the publication entitled "The Frustration of Science" form the text of a fine plea for academic freedom by M. J. Pelseneer in *Revue de l'Université de Bruxelles* of October–November. M. Pelseneer refers again to the various directions in which academic freedom is threatened and to the necessity for organized united resistance to those threats, and he emphasizes the way in which the freedom of the intellectual is linked up with the freedom of mankind. True liberty of thought is that which liberates mankind from the indignity of bondage. In particular, he pleads for tolerance in the matter of university appointments in the sense not merely of respecting the opinions of others but also in allowing them reasonable opportunity of expression. In this connexion it is interesting to note the conditions in the University of Heidelberg as set out on p. 98 of this issue of NATURE. M. Pelseneer, recognizing that human society must look to science for just laws and rational organization, even if their application to the distribution of production and government involves a social revolution, suggests that even within the limits of a given economic system, it is still worth while to discover the means of securing the minimum frustration of science.

Human Welfare and Human Efficiency

THE relation between industrial and social efficiency, discussed in a leading article in NATURE of October 3 dealing with Sir Josiah Stamp's address to the

British Association at Blackpool, has been further considered by Mr. W. H. Smyth in the *Berkeley Daily Gazette* of December 5. Mr. Smyth, protesting against the mechanical conception of efficiency, urges that ultimate human efficiency should imply the liberation of man rather than the efficient control of his actions, and that the former as it gains the creative interest of the worker is likely to be the best way of achieving, though indirectly, the latter. He suggests that an act of efficiency which deals with the human element incidentally but with products as its first consideration may inevitably involve disaster to the human element. The art of efficiency in fact is misdirected if it is concerned with production as an end in itself instead of with the development of men possessing vital initiative and creative powers. Mr. Smyth sees the issue as one between human worth and human productive efficiency and one that has a vital bearing on the evolution of alternatives to war. The very value which is now attached to the work of the National Institute of Industrial Psychology in reducing labour turnover, for example, lends powerful support to Mr. Smyth's other pleas that, even in industry, efficiency should be regarded in terms of human welfare as well as of mechanical output and processes.

Citizenship and the Universities

SHOULD training for citizenship be an integral part of every undergraduate's curriculum ? One of the smaller New England colleges, Hobart, announces a reorganization implying an affirmative answer to this question. Furthermore, the College hopes to make the bachelor's degree "represent less an aggregation of academic achievements and more an integration of intellect and of personality in the primary responsibilities of the citizen towards his community". The announcement is significant, according, as it does, with a growing tendency in the United States to emphasize the universities' obligation to the social order. In his inaugural address, published in *School and Society* of October 24, the president of the College explains that studies in economics, history, political science and social psychology will in future be so organized as to constitute a progressive four-year course culminating in its final year with a study of contemporary problems in American government and the means of social control. He points out that the 'orientation' courses commonly provided in colleges for the freshman year are well enough for opening the adolescent mind to a glimpse of the problems of the modern world, but are necessarily superficial and elementary compared with what is possible in the fourth year when the student has been equipped with a fairly comprehensive background of knowledge and is ready to envisage political and economic problems with interest as prospective factors in his own life. The dire need of the country for such stiffening as these reforms are calculated to provide is indicated by the statement that "Ballyhoo, the present and audible substitute for rational leadership, is well on the road to becoming the chief creator of American policy and politicians".

The National Botanic Garden of South Africa

KIRSTENBOSCH, part of the Groot Schuur Estate at Cape Town, South Africa, bequeathed to the nation by Cecil Rhodes, was set apart in 1913 for the purposes of a National Botanic Garden. The report of the Trustees for the year 1936 (issued August 1936) shows that, in spite of its small financial resources, a very gratifying amount of botanical, educational and economic work has been done. The objects of the Gardens are "the collection, cultivation and study of the indigenous flora of South Africa ; the preservation of the native vegetation of the areas under control ; and the introduction to cultivation in South Africa of selected economic plants, indigenous and exotic, and their preliminary trial". During the year under review, sixteen new species have been described, and many papers have been published. Large quantities of seeds of various species have been distributed to members of the South African Botanical Society and other institutions and the trade, and more than 200 lots of succulent plants have been propagated. Perhaps the Gardens' most useful activity is shown by the announcement that 1,108 lb. of *Barosma betulina* has been harvested, and also 102 lb. of *B. crenulata*, 1 oz. of Dalmatian insect powder flowers, 6 lb. of sumach, and 3 lb. of tansy—products which could be brought within the channels of commerce. Trials of lawn grasses are in progress, and many additions of fresh plants have been made to all parts of the garden. The report shows that the Gardens interpret every aspect of the flora of South Africa in a marked degree. Mr. F. W. Thorns has been appointed curator of the Garden, in succession to Mr. J. W. Mathews, who has held the post of curator since the foundation of the Garden in 1913.

British Empire Cancer Campaign

AT the sixty-first quarterly meeting of the Grand Council of the British Empire Cancer Campaign held at 12 Grosvenor Crescent on January 11, the following grants, in addition to those totalling £28,995 which were made at the annual general meeting in November, have been approved on the recommendation of the Scientific Advisory Committee of the Campaign : £200 to cover the cost of special physical investigations being carried out under the direction of Dr. F. G. Spear at the Strangeways Research Laboratory, Cambridge ; £500 for one year to Dr. H. J. Phelps, whilst carrying out experiments in connexion with Dr. Lumsden's anti-cancer serum under the supervision of Dr. Gye and Prof. McIntosh and £440 for one year to Miss C. F. Fischmann working in the Bernhard Baron Institute of Pathology at the London Hospital.

Tibet Earthquake of January 7

A GREAT earthquake was recorded in Great Britain at about 1.31 p.m. on January 7. At West Bromwich, as Mr. J. J. Shaw states, the needle of the seismograph was displaced by about 6½ in., or within half an inch of the amount produced by the Quetta earthquake of 1935. From the records obtained at Kew and Bombay observatories, it appears that the epicentre lay at distances of 4,700 and 1,850 miles from these stations. Thus, the earthquake must have occurred at 1.21 p.m., G.M.T., the epicentre being in eastern Tibet in about lat. 35° N., long. 97° E., a region about 500 miles north-east of the epicentres of the great earthquakes that occurred in southern Tibet on December 15, 1934, and January 3, 1935.

Announcements

THE Gold Medal of the Royal Astronomical Society has been awarded to Dr. Harold Jeffreys for his researches into the physics of the earth and other planets and for his contributions to the study of the origin and age of the solar system.

MR. D. L. EDWARDS has been appointed director of the Norman Lockyer Observatory at Salcombe Hill, in succession to the late Dr. W. J. S. Lockyer. Mr. Edwards joined the Observatory staff soon after the Great War, when the late Sir Norman Lockyer was in charge. The new assistant is Mr. D. R. Barber, of Exeter.

THE following appointments to the Colonial Service have recently been made: R. V. Burns, to be irrigation engineer, Ceylon; W. R. W. Ferguson, to be engineer, Water Supply Section, Geological Survey, Nigeria; F. W. Roe to be field geologist, Malaya; D. F. Stewart (inspector of plants and produce, Gold Coast), to be agricultural officer, Uganda; H. D. Tonking (assistant bacteriologist, Kenya), to be senior pathologist, Mauritius.

AT the invitation of the Royal Society, the International Council of Scientific Unions will hold its triennial General Assembly at Burlington House, London, on April 27–May 4. China, through the Academica Sinica of Nanking, has recently joined the Council, which now includes forty-two countries in addition to the International Unions of Astronomy, Geodesy and Geophysics, Chemistry, Scientific Radio, Physics, Geography and the Biological Sciences.

PROF. WALTER B. CANNON, George Higginson professor of physiology in the Harvard University Medical School, has been elected a corresponding member of the National Academy of Medicine of Buenos Aires.

PROF. WILTON MARION KROGMAN, associate professor of anthropology at the School of Medicine of the Western Reserve University, Cleveland, has been awarded the one thousand dollar prize of the *Readers Digest* for his article entitled "The Skeleton Speaks", in which he gave an account of some of his medico-legal interpretations of crime.

THE German Rontgen Society has nominated as honorary members Prof. Aristide Busi, director of the Radiological Institute of the University of Rome, and Prof. Arthur C. Christie, professor of clinical radiology, Gaytown University Medical School, Washington, D.C., and as corresponding members Dr. B. K. Kirklin of the Mayo Clinic, Rochester, U.S.A., and Dr. Emil Lazeanu, president of the Rumanian Radiological Society.

DR. LAWRENCE WADE BASS has recently been appointed assistant director of the Mellon Institute of Industrial Research. Dr. Bass, who previously distinguished himself by his researches in organic chemistry and biochemistry, has been devoting special attention to industrial research management and chemical economics. He has made many important contributions to chemical literature. He and Dr. P. A. Levene of the Rockefeller Institute published in 1931 a comprehensive treatise on "Nucleic Acids" as a monograph of the American Chemical Society. Dr. Bass and Dr. Levene have also written chapters for the "Biochemisches Handlexikon", a standard German reference work.

THE Institute for Science of Labour in Japan has removed from Kurashiki to Tokyo and will be reconstructed with the aid of the Imperial Government and of the Foundation for the Promotion of Scientific and Industrial Research of Japan. The director is G. Teruoka and the new address, Institute for Science of Labour, Aoyama 5 Chome, Tokyo, Japan.

A SCHOOL of criminological science attached to the faculty of law has recently been opened at the University of Brussels.

DR. OTTO GESNER has been nominated professor and director of the Institute of Pharmacology in the University of Halle.

PROF. PIETRUSKY has resigned his office of rector of the University of Bonn and has been succeeded by his nominee, Dr. Karl Schmidt, professor of ophthalmology at Bonn.

A NUMBER of reprints of many of the scientific papers of the late Prof. T. M. Lowry are still available, and may be had on application to Dr. C. B. Allsopp, The University Chemical Laboratory, Cambridge. Postage should be enclosed with each request.

H.M. STATIONERY OFFICE has undertaken the agency for the natural history publications of the British Museum (Natural History), South Kensington, S.W.7. Many of these are scientific monographs of the greatest value to students of the various branches of nature-study represented in the Museum. The economic series are of a more popular interest. A wide range of popular postcards is also on sale. These illustrate the various animals, birds and birds' eggs, butterflies, moths, bees, wasps, beetles, plants, etc., which can be studied in detail at the Museum itself. Inquiries relating to the Museum's publications may be addressed to any of the sale offices of H.M. Stationery Office.

ERRATUM.—In the article "Chemistry of Essential Oils" in NATURE of January 9, p. 80, par. 1, line 6, for "Australia" read "eastern coast of Australia".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 117.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Maturity and Fecundity of One-Year-Old English Native Oysters, *O. edulis*

BY the courtesy of Major A. Gardner, one of us (J. H. O.) was able to study the spawning, spatfall and growth of the native oyster, *O. edulis*, on the Blackwater and Roach oyster beds in 1935 and 1936. The summer of 1935 resembled that of 1921 in being continuously warm, and also in yielding heavy falls of spat on the Blackwater. In 1922, one of a small sample of one-year old oysters obtained there experimentally was found at this extremely early age carrying larvæ[1]. The prevalent notion is that English natives do not mature until they are three years old. In a lot of 104 selected well-grown 1935 spat from the Blackwater kindly supplied by Major Gardner on August 6, 1936, two were found with young, three were mature or nearly mature females and fourteen were ripe males. New evidence was therefore obtained of the possibility of English native oysters maturing as females and producing young at an age of a little more or less than one year after an exceptionally warm season.

There is virtual certainty that all the sample were 1935 spat although obtained from the beds, as (1) the 1934 spatfall was a failure so that mixture of 1934 spat is improbable; (2) the growth of the 1935 spat has been followed closely, rendering their identification practically certain; (3) the average weight of a hundred of the dried shells is 4·83 gm. and that of the spawning and ripe females respectively 5·8, 6·2, 3·9, 5·4 and 4·6 gm.; the average length and breadth of 104 shells is 42·6 mm. by 41·4 mm. and that of the females 43 mm. by 43 mm. The females have only slightly heavier shells on the average than the selected sample (see Fig. 1).

It is not possible to discuss here all the problems arising out of early female maturity, but it may be noted that the actual percentage of mature females at this early age was small in 1936; on the River Roach only one mature female occurred among 276 of the largest obtainable in August and September.

We estimated the number of shelled and just coloured larvæ borne by one of the two individuals with young and found approximately 240,000. By the same method of estimation, the larvæ obtained from the smaller one-year old oyster in 1922 were found to number at least 84,000. Dantan[2] found in six French one-year old *O. edulis* 69,000–144,000 and an average of about 95,000. In estimating the number of larvæ it was found that haphazard stirring in a concave bottomed bell-jar was not entirely satisfactory. Concordant results were obtained by using an almost flat-bottomed wide cylindrical glass jar (15 cm. in diameter) and a special stirrer of perforated zinc in the form of a cross with a hole in the centre, and at the opposite ends of one arm upturned limbs to allow the stirrer to be moved up and down while samples were actually being taken.

Successive samples taken in this way with a 2·5 c.c. Stempel pipette from 2,000 c.c. of suspension liquid containing the 1936 batch of young yielded 298 and 295 larvæ at the surface, 274, 277 and 287 in mid-water and 305, 313, 328 and 311 at the bottom; the last figure in each group referring to side samples and the others to central samples. 5,000 larvæ had previously been taken from the sample. As a check on the method, these 5,000 larvæ were transferred to 1,000 c.c. of 5 per cent formalin, and 2·5 c.c. samples taken as before with the Stempel pipette after and during stirring. The numbers obtained were respectively 13, 13, 11, 13 central surface, 22, 12, 14, 10 middle middle, and 15, 11, 14 central bottom. With uniform distribution 12 or 13 larvæ would be taken in such samples. In all these samplings with the exception of one, the 22 in the last lot, the variation from the mean is less than the square root of the mean. The mean gives therefore a good approximation; and the method of sampling is satisfactory. It is interesting that the high figure 22 was the first sample taken from the known number of 5,000 after a long period of settlement, indicating interlocking or inefficient mixing, and that it is advisable to omit sampling after the first mixing to ensure even distribution.

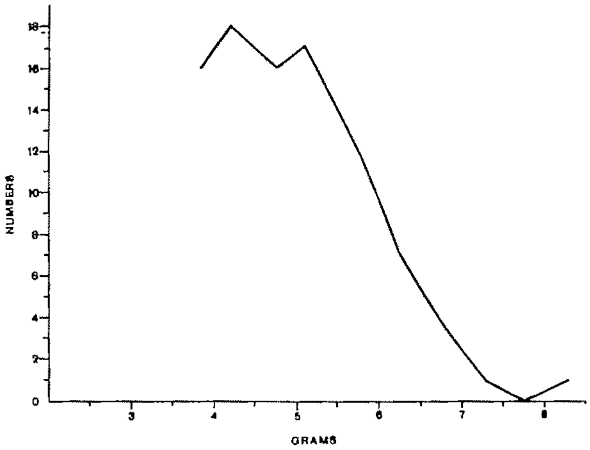

Fig. 1.

OPTIMAL GROWTH IN NATURAL ONE-YEAR OLD ENGLISH NATIVE OYSTERS, *O. edulis*; R. BLACKWATER, JULY 1936–AUGUST 1936; 92 SELECTED LARGEST SHELLS. (MEAN DRY SHELL-WEIGHT IN HALF-GRAM GROUPS IS GIVEN AFTER DRYING AT ABOUT 80° C. FOR ONE HOUR.)

The volume of the larvæ after one and three days settlement was found to be approximately 0·575 c.c., giving about 417,000 per c.c. after considerable shrinkage in 5 per cent formalin during four months. This result is considered not incompatible with an independent count of 11,928 larvæ (preserved in the slightly smaller trochosphere stage) in one drop of liquid, giving about 300,000 per c.c. without close packing.

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J. MCCLOY.
H. C. DAVIES.
F. B. J. EDMONDS.
J. H. ORTON.

Zoology Department,
University, Liverpool.
Dec. 21.

[1] Orton, J. H., NATURE, 110, 212 (1922).

[2] Dantan, J.-L., *C. R. Acad. Sci.*, 157, 871 (1913).

Interchange of Hydrogen Isotopes in Complex Cobaltammines

ERLENMEYER and Gartner[1] have reported that interchange of hydrogen isotopes takes place when hexammine cobaltic nitrate, $[Co(NH_3)_6](NO_3)_3$, is dissolved in heavy water, all the hydrogen atoms being replaceable. Bankowski[2], however, has stated that the hydrogen in complex ammines is only partially replaceable, one atom being interchanged in $[Co(NH_3)_4(H_2O)_2]Cl_3$, and three atoms in $[Co(NH_3)_4CO_3]Cl$.

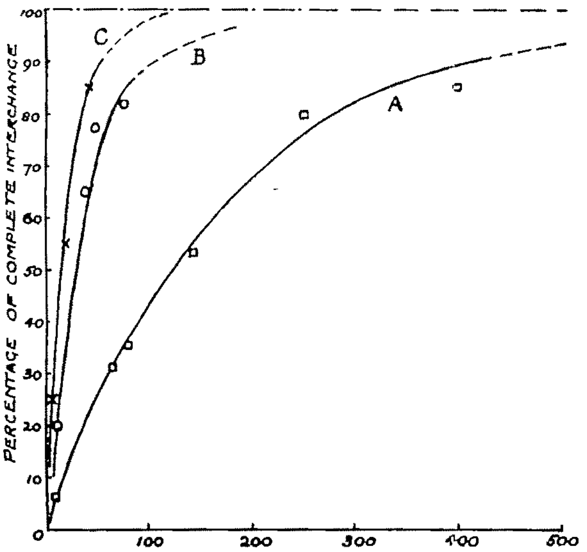

Fig. 1.

We have re-examined the question of isotope interchange with complex ammines in solution, with special reference to 1,6 dinitro tetrammine cobaltic nitrate, carbonato tetrammine cobaltic nitrate, hexammine cobaltic chloride and triethylene diamine cobaltic chloride. In agreement with Erlenmeyer's results, we find that all the amine hydrogen contained in the complex may be interchanged with deuterium; we also find, however, that at 25° and 35° the interchange proceeds quite slowly, the time of half change being several hours; and Bankowski's inherently improbable conclusion may be due to his failure to observe this fact.

In our experiments, which have been most fully worked out for hexammine cobaltic chloride, the salt was dissolved in approximately 3 per cent heavy water, and at suitable intervals a portion of the solution was removed and the extent of interchange was ascertained by separating the water therefrom and observing its density relative to that of the original heavy water by a micro-flotation method, giving relative densities within ± 0·5 γd on a sample of 0·25 c.c., which will be described elsewhere. The first experiments were made by distilling off the water from the samples *in vacuo* as rapidly as possible (Fig. 1, *A* and *B*). Afterwards, it was found to be preferable to add the samples to excess of dry, powdered, mercuric chloride, thus precipitating the complex cation as the mercurichloride, $[Co(NH_3)_6]Cl_3.HgCl_2$, and arresting the interchange quite sharply. After filtration, the water was purified by distillation and its density was determined as before (Fig. 1, *C*).

As may be seen from Fig. 1, complete interchange requires a considerable time, and the interchanges at shorter times lie on curves asymptotic to the line representing complete interchange.

By a further modification of the experimental method, it has been possible to make a full kinetic analysis of the reaction mechanism, and the results of this further work, which appear to be of considerable significance in relation to the theory of the co-ordination complex, will shortly be published in full.

F. W. JAMES.
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H. V. A. BRISCOE.

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[1] Erlenmeyer and Gartner, *Helv. chim. Acta*, 17, 1008 (1934).

[2] Bankowski, *Monats.*, 65, 266 (1935); cf. Erlenmeyer and Lobeck, *Helv. chim. Acta*, 18, 1213 (1935).

The Fifth Skull of Peking Man

A RECENT letter via the trans-Siberian mail brings the information that the fifth skull of Peking man, lately discovered, is the most complete specimen ever found at Choukoutien, near Peking.

It was discovered by Mr. L. P. Chia on November 26, 1936, in the same layer of the fossiliferous deposit as the other two skulls collected ten days before (see NATURE, Dec. 12, 1936, p. 1004, and Dec. 19, 1936, p. 1056), but about six metres farther south.

Except for the teeth, which are missing, this specimen is exceptionally well preserved and complete; the nasal bones and the left orbit are undamaged, and connected with the back parts, including the foramen magnum and other delicate bones, which are in very good condition. The middle vault of the skull has not been badly crushed in the brecciated matrix, which has made it possible for Prof. F. Weidenreich to remount it within a week of its transport from the field to the laboratory.

This skull (male type) does not belong to a fully adult individual, but to one who is evidently older than that represented by the No. 1 skull. The orbital ridges are more strongly developed than, but the general architecture remains the same as, the skull No. 1, described by the late Prof. Davidson Black.

Prof. Weidenreich is now preparing a short note which will appear in the near future, and will present his preliminary observations, with diagrams, on the last three skulls. Before the appearance of his official statement, I hope that scientific workers will withhold their judgment on the latest discoveries of *Sinanthropus*, and ignore the inaccurate rumours already circulated that the last three skulls of *Sinanthropus* are identical with the *Pithecanthropus* or *Homo neanderthalensis* skulls.

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Dec. 29.

A Simple Means of Checking the Michelson-Morley Experiment

THE epoch-making work of Prof. Dayton C. Miller, as reported two years ago in NATURE[1], has established that the small effect found by Michelson and Morley is a reality. In a paper read by me before the American Physical Society which has as yet only appeared in abstract form[2], it is shown that there is a v^2/c^2 effect in both arms of the interferometer (also shown by Voigt[3] in 1887). If, however, the ray of light is not perfectly normal to the end mirror, the ray is displaced during the motion and this displacement gives rise to a small effect (about one four-thousandth of v^2/c^2 in Miller's case—due to the ray having an angle of obliquity of about 1′). I find on applying my formula to his results, a value for the cosmic motion of 300 km./sec., while his method of computing the effect gives 200 km./sec. The discrepancy between these results was traced to his floating apparatus being unbalanced, causing the interferometer to be *very slightly* out of level. Secondary effects due to this slight unbalance may be seen in his results, as well as the effect due to the obliquity of the ray, and it has been found, by inclining one arm of the interferometer while the other remains level, that a very large displacement of the fringes may be produced, since it is the *component* of the cosmic velocity in each arm which affects the ray in that arm.

As shown by Miller, the cosmic velocity is nearly vertical at some time during the day, and at some other time nearly horizontal. Therefore twice a day the cosmic velocity makes an angle of 45° with the normal to the plane of the horizon, and by inclining one arm of the interferometer at 45° while the other arm remains level, rotation about a vertical axis will bring the 45° arm into the line of direction of the cosmic motion, and we shall have in this arm not merely a component of this velocity, but the full value of 300 km./sec. When rotated 180° from this position, the 45° arm will be at right angles to the cosmic motion and the component will have a zero value, and we therefore have a full shift of the fringes between two points 180° apart. In the level arm there will be no change because, as shown by Voigt, while the motion of the source gives us a v/c effect and a v^2/c^2 effect, the v/c effect is annulled by the motion of the observer, the v^2/c^2 effect remains and is independent of the orientation of the interferometer, the wave surfaces being spherical. (See page 50 of Voigt's Doppler effect paper[4].)

It would be rather difficult to incline a large interferometer like Miller's at 45°, but it can easily be done with a small one. A simple turntable may be used which may be tested for suitability by placing a level interferometer upon it, and noticing whether there is any appreciable fringe shift on rotation; if not it may be assumed that the turntable is satisfactory. A good carpenter can make a framework in two or three hours that will support the interferometer solidly and stably at the proper angle. Send the ray of light from the source along the horizontal arm, and the fringes from the 45° arm may be seen by means of an auxiliary plane mirror suitably mounted (an ordinary mirror will do), and after having properly adjusted the interferometer, a short focus horizontal telescope may be used to view the fringes reflected from the auxiliary mirror.

Preliminary measurements with an interferometer having equal arms 6¼ in. long gave a shift of approximately six tenths of a fringe, in agreement with the following calculations.

$$\delta F = \frac{2l}{\lambda}\cdot\frac{v^2}{c^2} = \frac{31\cdot75}{5\cdot461 \times 10^{-5}}\cdot\frac{9 \times 10^4}{9 \times 10^{10}} = 0\cdot581.$$

Contrary to expectation, the magnitude of the fringe shift seems to be practically the same at any time of day.

W. B. CARTMEL.

Laboratoire de Physique,
Université de Montréal.
Dec. 7.

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[1] Miller, Dayton C., NATURE, **133**, 162 (1934).

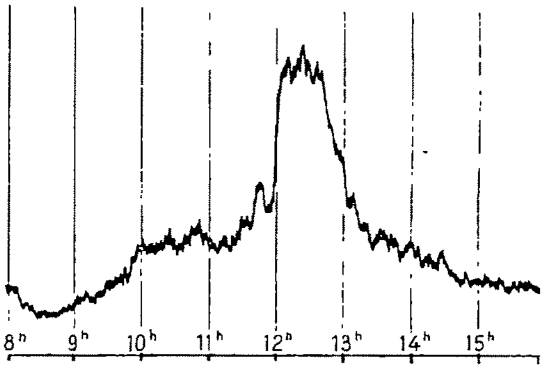
[2] Cartmel, W. B , *Phys. Rev* , **2**, 49, 647, 649 (1936).

[3] Voigt, W., *Goettinger Nach.*, 1–21, 233 (1887).

[4] Voigt, W., *Goettinger Nach.*, 1–21, 41 (1887).

Abnormalities of the Ionosphere and Bright Solar Eruptions

IN a letter published in NATURE of December 12, 1936, p. 1017, Mr. H. W. Newton states that in December a bright hydrogen eruption was observed at the Royal Observatory, Greenwich (beginning at 11h. 57m. U.T. and bright eruption at 12h. 03m.) and he directs attention to the fact that this eruption coincided with "a marked abnormality in the ionosphere".



St. Cyr, 27 kc./s. December 3, 1936.

Fig. 1.

On the same day and at the same time, I pointed out in Paris (St. Cyr) a large increase in the number of atmospherics on 27 kc./s. (11,500 m.). Fig. 1 is from a photograph of the interesting part of the St. Cyr record. African records (Tunis and Rabat) show the same phenomenon at the same time, but less intense. These sudden rises in the number of atmospherics are not new phenomena. I have already reported such increases, some even more sudden, and I have pointed out that they depend on modifications of the ionosphere[1].

The increase of the number of atmospherics received does not correspond with the number of atmospherics produced but with an improvement in the propagation of the long waves over a great distance.

The same ionospheric phenomenon is obvious as an opposite effect in the short-wave spectrum. M. Jouaux, secretary of the Comité Français de Radiotélégraphie scientifique, was the first to emphasize the interest[2] of the study of sudden fading in short-wave commercial traffic; they have since been observed on different continents. They coincide with the increase of atmospherics on long waves[3].

The study of atmospherics has now acquired a new interest. It seems certain that some peculiarities of these records are closely associated, in time, with ionospheric perturbations, which, at least in part, are the direct consequence of solar eruptions.

R. BUREAU.

Office National Météorologique,
Paris, 7e.
Jan 4.

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[1] Bureau, R., "Electricité atmosphérique et parasites atmosphériques". Communication faite à l'Association Internationale de Magnétisme et Electricité terrestres, Assemblée d'Edimbourg Septembre 1936. Document n°44

[2] "Rapport sur certains phénomènes d'évanouissements", 1935.

[3] Bureau, R., and Maire, J. "Anomalies Ionospheriques à début brusque", *C R Acad Sci.*, **203**, 1276 (1936).

Equivalent Particle-Observers

IN a letter to NATURE, Prof. Synge has pointed out[1] that the condition of equivalence of two distant particle-observers does not completely define the time-scale of either, and that *any* two distant particle-observers may be provided with clocks which satisfy the condition of equivalence and make the relative velocity of the two equal to zero. Synge concludes that the relativistic theories developed by Milne and by me fail to dispense with both the concept of rigid bodies and the concept of absolute clocks.

My approach to the relativistic kinematics differs from Milne's in that he employs the concept of equivalence to establish reference systems consisting of dense aggregates of synchronous particle-observers relatively at rest. Now Synge's analysis of the time-scales of two equivalent particle-observers whose world-lines do not intersect shows that all successive time intervals $F_{n+2,\,n+3} - F_{n,\,n+1} = 2k$ (Synge's notation) must be the same if the observers have no relative velocity. As k is the distance r between the particle-observers divided by the velocity c of light, this means that the time-scale of either observer is divided uniquely into successive intervals of magnitude $2r/c$, but that the subdivision of any one of these intervals into smaller intervals is arbitrary. As the distance r between the two observers is made smaller, however, the smallest interval $2r/c$ uniquely determined becomes proportionately smaller. Hence, even the smallest time intervals on the clocks of a dense assemblage of synchronous particle-observers constituting a reference system are completely determined.

Now consider two particle-observers P' and P'' whose world-lines cross, but neither of which intersects the world-line of P. As Synge indicates, with one pair of clocks we can make P and P' synchronous and relatively at rest, whereas with another pair we can make P and P'' synchronous and relatively at rest. Therefore we can associate with a single particle-observer P more than one *linear* reference system. This arbitrariness, however, disappears in the three-dimensional case, where we impose a geometry on a reference system. For the papers of Engstrom and Zorn[2] and of Robertson[3] show that we can associate at most a single Euclidean reference system with P. Hence it would seem that we are able to dispense with both the concept of the rigid measuring rod and that of the isochronous clock in this case, or, to put the matter the other way around, we have established an ideal criterion by which to test both the rigidity of material rods and the isochronism of material clocks.

The statement in my paper[4] which Synge criticizes should be taken to refer to the *relative* readings of the clocks of P and P'.

LEIGH PAGE.

Yale University.
Dec. 4.

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[1] Synge, J. L., NATURE, **138**, 28 (1936).

[2] Engstrom and Zorn, *Phys. Rev.*, **49**, 701 (1936)

[3] Robertson, H. P., *Phys. Rev.*, **49**, 755 (1936).

[4] Page, Leigh, *Phys. Rev.*, **49**, 254 (1936).

Microscopic Examination of Fog-, Cloud- and Rain-Droplets

OF the many methods proposed hitherto for the measurement of the size and concentration of droplets in fogs and clouds, none can be considered as quite satisfactory. The extensively used method of diffraction rings (corona) can be applied only in the relatively rare case of isodisperse fogs. The photographic method devised by Findeisen[1] is rather complicated, and can scarcely be used in field work. The direct measurement of the droplets collected on greased wires or on glass slides is hampered by very rapid evaporation of the droplets and distortion of their spherical shape. The method proposed recently by Hagemann[2], namely, collecting the droplets on a thin layer of castor oil and photographing them during their fall through the layer, has many disadvantages and can be used only for droplets with a radius less than 5 μ.

After having tried unsuccessfully many different methods, we discovered that quite satisfactory results can be obtained by collecting the droplets on glass slides coated with a freshly melted mixture of vaseline and light mineral oil. The proportion of the ingredients depends on the temperature of the air (about 1 : 3 at 20° C., 1 : 5 at 0° C., and so on).

This mixture has the property of instantly enveloping the water droplets as they settle with a thin film, which practically prevents both evaporation of the droplets and condensation of vapour on them, without affecting their spherical shape. The droplets thus collected on the slides can be preserved in a damp atmosphere for many hours without showing any perceptible diminution in size. The only condition which has to be observed is that the temperature at which the droplets are kept and measured is equal to or below that at which they were collected or, at any rate, does not exceed it by more than a few degrees. The smallest droplets, distinguishable only with a microscope objective of the highest resolving power, can be examined in this way, as well as rain-droplets of 2–3 mm. diameter. The thickness of the vaseline layer must, however, be greater than the diameter of the droplets.

Fig. 1 (left hand) shows a photomicrograph (magnification 1 : 50) of droplets collected during a 10-minute exposure of glass slides in a dense fog, which occurred in Moscow on the night of November 2 (air temperature, 5° C.). The size of the droplets lay within the limits of about 0·006–0·030 mm. radius. In order to determine the real distribution of the sizes of droplets, the glass slides would have to be put at the bottom of a chamber filled with the fog. All the droplets contained in the chamber should then be allowed to settle on the bottom. This could not be done, as fogs are very rare in Moscow and this one happened quite unexpectedly. Fig. 1 (right hand) shows a photomicrograph taken of rain droplets (magnification 1 : 10).

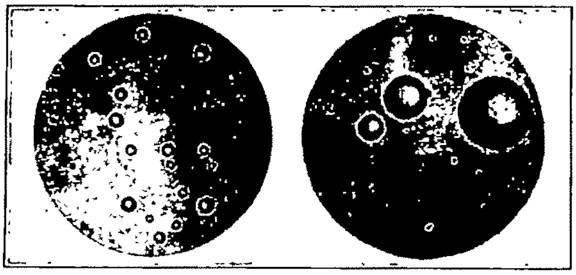

Fig. 1

FOG PARTICLES (LEFT), × 50; AND RAIN DROPLETS (RIGHT), × 10

All the apparatus needed for the visual or photomicrographic measurements of droplets (an electric battery for illumination included) weighs about 12 lb. and the method can be readily used in the field, during balloon flights, etc. Measurements made from a balloon continuously kept in equilibrium with the surrounding air would give invaluable information about the kinetics of the formation and precipitation of clouds—processes about which very little is as yet known.

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[1] Findeisen, *Gerlands Beiträge*, 35, 295 (1932)

[2] Hagemann, *Gerlands Beiträge*, 46 261 (1936)

Preparation of a Highly Active Alcohol Apo-dehydrogenase from Yeast

IT is generally recognized that an active dehydrogenase system consists of three principal components: (1) an apo-dehydrogenase, the non-dializable and thermo-labile colloidal carrier, protein in nature; (2) a co-enzyme, crystalloidal and comparatively thermostable; and (3) a flavo-protein, capable of reversible oxidations and reductions. Euler and others have advanced the view that the specificity of dehydrogenases is intimately associated with the specific protein or proteins constituting the apo-dehydrogenase, the isolation of which in a state of integral purity and high activity is necessary for an elucidation of the groups responsible for the enzymic activity. With this end in view, we have commenced a study of the isolation and purification of the alcohol apo-dehydrogenase from bottom yeast.

Dried yeast (one part), macerated with toluenated water (3 parts) at 30° C. for three hours, yields an extract which contains about 70–75 per cent of the apo-dehydrogenase, and this extract has been used as the starting material for the isolation and purification of the active protein. The activity or the concentration of the apo-dehydrogenase is expressed as seconds per milligram of protein nitrogen, required to decolourize 0·2 c.c. of a standard solution of methylene blue (1 in 5,000), in presence of an excess of the other components of the dehydrogenase system, the substrate, the cozymase and the flavo-protein. Measured on this standard, the crude extract has an activity which corresponds to 808 seconds per milligram of protein nitrogen.

The maceration extract, when treated with ammonium sulphate to full saturation, yields a precipitate centrifugible with difficulty which, however, easily dissolves in water giving a clear yellow solution.

When this solution is progressively saturated with ammonium sulphate, two distinct precipitates are obtained, one at half saturation and the other at full saturation. These precipitates, *A* and *B*, have activities respectively corresponding to 46 and 81 seconds per milligram of protein nitrogen, showing thereby that a purer preparation of the apo-dehydrogenase is obtained at half saturation. Preparation *B*, however, has been found to be comparatively free from the flavo-protein, as measured by its high response to the addition of the flavine enzyme.

Further purification of the preparation *A* is accomplished by re-dissolving the wet precipitate in water and carrying out an adsorption with zirconium hydroxide at *p*H 5. The active protein can be eluted from the adsorbate by Sørensen's *M*/15 phosphate buffer, *p*H 6·8, and a further purification can be effected by repeating the adsorption and elution under the same conditions. By adopting this procedure, it has been possible to obtain a preparation possessing an activity of 6 seconds per milligram of protein nitrogen and representing a 135-fold purification.

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Dec. 21.

Experimental Induction of Ovulation with Progesterone

THE injection of pregnancy urine extract or of anterior pituitary extract causes ovulation in *Xenopus lævis*, the South African clawed frog. Ovulation is accompanied by swelling and hyperæmia of the anal labia. In an attempt to analyse the hormonal control of the labial reaction, œstradiol (Progynon B oleosum forte) and progesterone (Proluton) were injected separately and together into a number of female frogs. Injection of both hormones together elicited the full labial reaction and in addition induced ovulation. Ovulation occurred on injection of progesterone alone but not with œstradiol alone. Progesterone also caused ovulation in hypophysectomized animals. Ovulation had previously been obtained only with pregnancy urine and anterior pituitary extracts. The results of this preliminary investigation were communicated to the Royal Society of South Africa in October, 1936. The following is an account of a more extensive investigation undertaken since then.

Large numbers of frogs were hypophysectomized. In some the whole pituitary (anterior and posterior lobes) was removed, in others the anterior lobe alone was removed. Ten days after the operation, progesterone in doses of 0·1 mgm. and 1·0 mgm. was injected into normal animals and into the two types of hypophysectomized animals. Twenty hours after injection, readings were taken (*a*) of the percentage positive response and (*b*) of the extent of ovulation in positive animals. The latter was placed on a quantitative basis by assigning arbitrary symbols to the degree of ovulation: 1 or 2 according to the number of eggs in the oviduct; 3 or 4 according to the number in the pars uteri; and 5 or 6 according to the number of eggs extruded from the cloaca into the water in the container. The total score of all positive animals divided by the number of positive animals gives a figure which has been called the ovulation index. When less than 10 per cent of animals ovulate, not much significance can be attached to the index. The maximum ovulation index is 6.

Immature normal animals (15–20 gm.) were also injected with progesterone. The average weight of the mature animals was 39 gm.

Type of animal	0·1 mgm. Progesterone		1·0 mgm. Progesterone	
	Percentage response	Ovulation index	Percentage response	Ovulation index
Normal	35	2·3	100	4·5
Anterior lobe removed	16	1·2	67	2·8
Both lobes removed	6·5	(1·5)	30	3·1
Immature normal	9·5	(2·0)	43	3·0

The results show that ovulation occurs in the absence of the pituitary, but that both the anterior and posterior lobes must be present before the maximum percentage of positive response can be obtained. On the other hand, an increase in the extent of ovulation is dependent upon some factor in the anterior lobe alone. Immature animals give a higher percentage response than completely hypophysectomized frogs but the same ovulation index.

Normal and completely hypophysectomized animals were injected with pregnancy urine extract. The dose chosen was that which just gave 100 per cent response when injected into normal animals. The hypophysectomized frogs gave 100 per cent response and an ovulation index of 5·5. The index in normal frogs was 5·0.

There was no significant difference in percentage response and ovulation index between completely hypophysectomized animals injected with progesterone alone and the same type of animal injected with progesterone and Parke, Davis pituitrin.

The ovulating effect of progesterone is strikingly demonstrated by its action on the excised ovaries of normal and hypophysectomized animals. The ovary is excised and placed in a glass dish containing Ringer's solution. The addition of 1 mgm. progesterone causes extrusion of numerous ova within 8–10 hours at a temperature of 21° C.

Coupling, ovulation and fertilization of eggs were induced by injecting males with anterior pituitary extract and females with progesterone. Ovulation and oviposition occur after injection of so small a dose as 0·05 mgm. progesterone.

Since the completion of these experiments, Shapiro[1], at the National Institute for Medical Research, Hampstead, has confirmed the findings for progesterone induced ovulation in *Xenopus* and has obtained the same result with the following steroids: methyltestosterone, testosterone, *allo*-pregnanedione, androstenedione, *trans*-dehydroandrosterone, *cis*-androstanediol, androsterone, Reichstein's adrenal substance J, "Eucortone" adrenal cortical extract.

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Dec. 9.

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[1] Shapiro, H. A., *Chem and Ind.*, **55**, 1031 (1936)

Segmental Interchange Lines in *Pisum sativum*

IN collaboration with Miss Pellew, crosses between a number of lines of spontaneous or natural origin, showing interchange of segments between non-homologous chromosomes in *Pisum sativum*, have been studied at the John Innes Horticultural Institution, Merton, and at the Botanical Department, University of Manchester.

As a result of the analysis of the chromosome associations at meiosis in these crosses (seven pairs or an association of four—not a ring—results when the same two chromosomes are concerned in the two interchanges, an association of six when one chromosome is common to both interchanges, and two rings of four when entirely different chromosomes are affected), seven types differing in chromosome structure and therefore called 'structural types' have been distinguished, and their interrelationships determined. The chromosomes taking part in these interchanges are as follows, where arbitrary numbers are given to the seven haploid chromosomes of the normal or standard type:

Structural type 1	The normal or standard type. Chromosomes 1, 2, 3, 4, 5, 6, 7.
Structural type 2.	Hammarlund's *K*-line. Chromosomes 1 and 2 interchanged.
Structural type 3	The Thibet interchanged line. Chromosomes 1 and 3 interchanged
Structural type 4.	Extra rapid. Chromosomes 3 and 5 interchanged.
Structural type 5.	An interchanged type from Miss de Winton's material Chromosomes 4 and 5 interchanged.
Structural type 6	Wing's line. Chromosomes 1 and 4 interchanged.
Structural type 7.	The doubly-interchanged type from structural type 2 × structural type 3. Chromosome 1 interchanged with 2 and 3

Structural type 7 when crossed with structural type 6 gives, as expected, an association of eight chromosomes at meiosis, the highest association yet reported in *Pisum*.

Nilsson[1] studied the relationships between structural type 4 and three other types which cannot be classified in relation to those recorded in the present communication until the necessary tests have been made.

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Dec. 16.

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[1] Nilsson, E., *Hereditas*, **21** (1935–36).

Linkage in Structural Hybrids in *Pisum sativum*

THE genetical analysis of some of the interchanged lines in *Pisum sativum*, reported on by Mrs. Sansome above, has given evidence on the distribution of the genes in the normal structural type. In plants of normal structure the genes *R* (R/r = round/wrinkled cotyledons) and *A* (A/a = coloured/white flowers) have been exhaustively studied in F_2 families from self-fertilization. By this method no clear indication of linkage was found. From back-crosses (453 plants from heterozygous females, and 418 plants from heterozygous males) 47 per cent of crossing-over was obtained[1]. Hence, in a recent summary of our knowledge of linkage in *Pisum*, these two genes are placed in different chromosomes[2].

Chromosome 1 of the normal structural type has undergone interchange with three other chromosomes in types 2, 3 and 6. When these three types are crossed with the normal, and the F_1 structural hybrids are also heterozygous for R and A, the F_2 progenies show either linkage between R and A, with about 30 per cent crossing-over (in hybrids 1 × 2 and 1 × 6), or linkage of both genes with the gametic sterility by which the position of the translocation is indicated (in hybrid 1 × 3). The evidence is derived, in hybrid 1 × 2, from back-cross ratios, and in hybrids 1 × 3 and 1 × 6[3] from F_2 ratios. Hence it follows that the genes R and A lie in the one chromosome of the normal type common to all three associations of chromosomes in the hybrids at meiosis, that is, in No. 1 of Mrs. Sansome's list.

That linkage may be shown in structural hybrids but not in homozygous types may be expected from the slight reduction in chiasma frequency observed by Sansome[4] and Sutton[5] and characteristic of such hybrids. Further, the incidence of gametic sterility in relation to other genes serves as a new locus. Hence the genetical analysis of structural hybrids may be a more effective method of studying the distribution of the genes than the analysis of structurally homozygous types.

CAROLINE PELLEW.

John Innes Horticultural Institution,
London, S.W.19.
Dec. 11.

[1] Pellew, C., *Z. Zucht. A, Pflanzenzücht.*, **17**, 90 (1931).

[2] Winge, Ö., *C R Trav. Lab Carlsb.*, (Ser. Physiol., 15), **21** (1936)

[3] Sansome, F. W., and E. R., unpublished

[4] Sansome, E. R., *Cytologia*, **3**, 200 (1932).

[5] Sutton, E., *Ann. Bot.*, **49**, 689 (1935)

Technique of the Painting Process in the Cave Temple at Sittannavasal

As an extension of my studies[1] on Indian paintings, I have had recently an opportunity of investigating the technique of the painting process adopted in the cave temple at Sittannavasal in the Pudukottah State, South India, situated at a distance of about 42 miles by road from Tanjore. This cave temple is very small, being about 24 feet long, 12 feet wide and 11 feet high. The interior was at one time fully painted, but at present the paintings are visible only on the ceilings, the capitals and the upper parts of the pillars. These paintings, which can be assigned to the time of the great Pallava king, Mahendravarman I (c. 600–625 A.D.)[2], represent the best specimens of Jain mural paintings of the classical or Ajanta school extant in India, and there can be no doubt about their æsthetic merit or high importance from the point of view of history.

From a study of the painted stucco, it is clear that the technique adopted in the execution of these paintings is one of *fresco-secco* or painting in lime medium on plaster. The stucco is composed of the *Rinzaffo* or rough coat of lime plaster with a fine lime wash thereon. The lime wash was probably given while the plaster was still wet. The thickness of the stucco depends on the nature of the surface of the wall and the ceilings, and varies from 1·9 mm. to 3·4 mm. and in certain places it goes up to about 8·9 mm.

The results of analysis of the stucco (excluding the lime-wash) were as follows:

	Per cent
Moisture	2·14
Silica, SiO_2	48·91
Iron and alumina, $Fe_2O_3 + Al_2O_3$	3·98
Carbon Dioxide, CO_2	18·07
Lime, CaO	24·37
Magnesia, MgO	0·35
Sulphuric anhydride, SO_3	0·11
Loss on ignition	0·65
Undetermined (mostly alkalis)	1·39
	99·97

The only inert material used with the lime is sand.

So far as pigments are concerned, lime has been used for the white, carbon for black, yellow and red ochres for yellow and red, lapis lazuli or ultramarine for blue, terre verte for green and a mixture of the last two for bluish-green.

Full details of the investigation will be published in the Technical Studies of the Fogg Art Museum of Harvard University.

S. PARAMASIVAN.

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Madras.
Dec. 19.

[1] NATURE, **137**, 867 (1936).

[2] Mehta, N. C., "Studies in Indian Painting" (Taraporevala, Bombay, 1926, p. 9).

Raman Spectrum of Benzene Vapour

MUCH interest is attached to the structure of benzene, and a series of important papers[1] dealing with this subject and based mainly on Raman, infra-red and emission spectra have recently appeared from University College, London. In this connexion it is very desirable to possess a knowledge of the Raman spectrum of benzene vapour, but no data are yet available. Fig. 1 (upper spectrum) shows the Raman spectrum of benzene vapour obtained by us at a pressure of 15 atm. and a temperature of 200° C.; the lower spectrum is the Raman spectrum of the liquid taken alongside, keeping the conditions regarding slit width, etc., unaltered but reducing the time of exposure. Fig. 2, *a* and *b*, are photometric records of the wings accompanying the λ 4077 and λ 4046 lines respectively in the vapour. Fig. 2, *c*, is the record of the wing accompanying the line λ 4046 in the liquid taken under identical conditions. Among other notable features, the following changes which take place as we pass from the liquid to the vapour are of special significance.

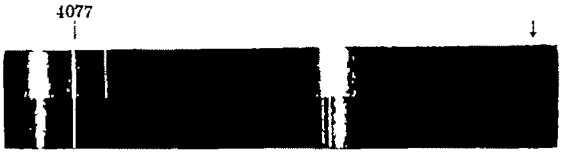

Fig. 1

RAMAN SPECTRUM OF BENZENE VAPOUR (ABOVE), LIQUID (BELOW).

The principal Raman line 992 shows no shift. 3061 shows a definite shift (see arrow in Fig 1) and has a value of 3069 in the vapour. 3047 has either completely disappeared or has been considerably weakened. The rotation wings accompanying the Rayleigh lines, which show no intensity maximum separated from the centre (Fig. 2, *c*) in the liquid, develop a distinct maximum at the expected position (Fig. 2, *a* and *b*) in the vapour. The absolute intensity of the rotation wing, as judged by comparing it with the 992 Raman line, increases enormously as we pass into the vapour state. For example, the wing accompanying the 4077 line has not been recorded at all in the liquid whereas it is quite intense in the gas (see Fig. 1), in spite of the fact that the 992 Raman line is recorded with greater intensity in the former than in the latter.

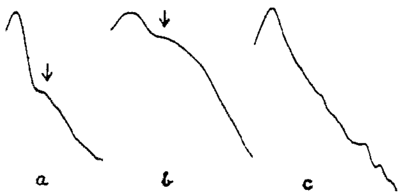

Fig. 2.

The significance of these and other features of the investigation will be discussed by us in detail elsewhere.

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Waltair.
Nov. 16.

[1] C. K Ingold and others, *J. Chem. Soc*, 912-987 (July 1936).

Active Nitrogen

IN their recent paper on the afterglow in active nitrogen, Cario and Stille[1] have doubted the reality of the production in the nitrogen afterglow of the N_2^+ first-negative bands and those bands of the N_2 first-positive system which originate on vibrational levels higher than $v' = 14$. It is suggested that my results were due to an accidental superposition of light from the exciting discharge on that of the afterglow.

An examination of the afterglow photographs published by Cario and Stille shows immediately the reasons for their failure to observe the above mentioned bands in the afterglow. Their nitrogen was not purified enough for the tube to reach what I have called the auroral stage. Their photographs show the bands due to nitric oxide and cyanogen in the spectrum of the afterglow, whereas these bands, as an examination of my published spectra will show, should have completely disappeared before the auroral stage is reached.

During the preparation of more than a score of tubes, I have passed through the stage photographed by Cario and Stille. There are, at the present time, two tubes in my laboratory which show the stage they have photographed, and several much purer tubes. In several of the latter type of tubes the negative bands are so strong that they can be observed visually on a direct vision spectroscope. In none of those tubes can we observe the nitric oxide or cyanogen bands. These have disappeared because of the purification of the nitrogen.

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[1] Cario and Stille, *Z. Phys.*, **102**, 317 (1936).

Reflection from the Ionosphere

THE conditions for the reflection of radio waves from the ionosphere are generally obtained by putting $\mu^2 \doteqdot 0$. But it is more correct, as was pointed out by Appleton[1], to obtain this condition by finding out when the group velocity vanishes. If we work out the conditions for the vanishing of the group velocity, neglecting friction, we find certain unexpected results. While for the ordinary wave there is only one condition of reflection given by

$$p = p_0 \quad . \quad . \quad . \quad . \quad (1)$$

(where p is pulsatance and $p_0^2 = 4\pi Ne^2/m$), the conditions for the extraordinary wave are found to be as follow:

$$p^2 - pp_H = p_0^2 \quad . \quad (2a),$$
$$p^2 + pp_H = p_0^2 \quad . \quad . \quad (2b),$$
$$p^2 - p_T^2 = p_0^2 \text{ (app)} \quad . \quad (2c),$$

where $p_H = eH/mc$, $p_T = eH_T/mc$, when we are using short waves. The first and second of these are those usually obtained for the extraordinary wave reflection. It is usually supposed that (2*a*) is the only one obtained, as (2*b*) is supposed to penetrate and to be absorbed. Toshniwal[2] was the first to observe and interpret the reflection corresponding to (2*b*). This has also been recently confirmed by Leiv Harang[3] working at Tromsø. The third is a new one and has not been so far reported.

It is well known that for the reflection corresponding to (2*a*), the difference between the penetration frequencies for the ordinary and the extraordinary waves is approximately 0·7 mc./sec. While this has been confirmed in this laboratory, Messrs. Pant and Bajpai, working after midnight, have several times observed the penetration frequency difference to be only about 0·14 mc./sec. This result at first appeared to be very puzzling, as it could not be accounted for on the existing theories. But it is easily explained as a reflection given by (2*c*). At Allahabad, $p_T^2 = 40{\cdot}5 \times 10^{12}$, and in the neighbourhood of 75 metres the difference between the penetration frequencies is 0·13 mc./sec. according to (2*c*). For higher latitudes (for example, England) this difference will be very small (for 4 megacycles, 0·03 mc./sec.) and it will be difficult to observe. It would be interesting to know whether similar results are obtained at other tropical stations.

Details of the calculation are being published in the proceedings of the National Institute of Sciences, India.

R. N. RAI.

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University, Allahabad.
Dec. 21.

[1] Appleton, NATURE, **122**, 879 (1928).
[2] Toshniwal, NATURE, **135**, 437 (1935).
[3] Leiv Harang, *Terr. Mag.*, June 1936.

Who were the Picts?

IN the note in NATURE of December 19 (p. 1061) upon Dr. Bachmakoff's discussion about the evidence of a pre-Aryan population of southern Russia, he is quoted as suggesting that in France the Veneti were a pre-Aryan people "possibly related to the Picts". This lands one in the vexed question whether there ever was a race or tribe that assumed and bore the name Pict.

The earliest occurrence of that name in literature is in the chronicle by Ammianus Marcellinus (A.D. 326–391) describing under the year 364 how the Roman province in North Britain was continually raided by "Picti Saxonesque et Scoti et Attecotti". The "Pictish Chronicle", composed in the fourteenth century, begins with a quotation from the "Origenes" of Isidore, Bishop of Seville (560–636), as follows:

"Picti propria lingua nomen habent a picto corpore"; but it is to be noted that Bishop Isidore wrote "Scoti" not "Picti"—painted.

Hostilities which Great Britain had to wage in defence of her colony in South Africa at frequent intervals between 1809 and 1877 are still commonly termed the Kaffir War; but Kāfir is only an Arabic term for infidel or stranger, and none of the native tribes engaged in that war call themselves Kaffirs.

Nicknames were bandied pretty freely in the late European War; British soldiers speaking of their German foe as Huns, while the French termed them Boches. So in the fourth century, Ammianus Marcellinus, who was never in or near Britain, would hear the Celtic foes of the Empire commonly referred to in Rome as Picti.

HERBERT MAXWELL.

Monreith.

Points from Foregoing Letters

STRONG indications that a few females of the native oyster, *O. edulis*, can produce young at an age of little more than a year, are reported by a group of investigators from the University of Liverpool. The number of shelled and just coloured larvæ born by one of the females was estimated at 240,000. About 12,000 larvæ (in the trochosphere stage) were counted in a drop of liquid after three days settlement. The authors also give a graph showing the relative weight distribution, in one-year old English native oysters.

F. W. James, Dr. J. S. Anderson and Prof. H. V. A. Briscoe find that when complex cobaltammines are dissolved in partially heavy water, complete isotopic interchange takes place, as reported by Erlenmeyer and Gartner, but that it requires some hours. Since the exchange can be stopped by rapidly distilling off the water from the solution or, better, by precipitating the complex, for example, as the mercurichloride, $[Co(NH_3)_6]Cl_3.HgCl_2$, a kinetic analysis of the reaction is possible and is being undertaken.

Mr. W. C. Pei announces that a fifth skull of early man in China has been discovered, and that a preliminary report by Prof. F. Weidenreich will appear shortly on the new material.

A very minute effect has been found by the Michelson-Morley-Miller experiment for determining the absolute velocity of the earth. Prof. W. B. Cartmel states that if one of the arms of the interferometer is inclined at a different angle from the other, a very large fringe shift may be observed even with a small interferometer. The experiment is simple, and can easily be repeated.

An increase in the number of radio atmospherics observed in Paris and also at Tunis and Rabat on December 12, 1936, is attributed by R. Bureau to an improvement in the propagation of the long waves over a great distance. This seems to be due to the ionospheric perturbations following upon the solar hydrogen eruption observed on the same date and at the same time at Greenwich by H. W. Newton.

In answer to Prof. Synge's criticism, Prof. Leigh Page submits an example indicating that his relativistic theory is able to dispense, in certain cases, with both the concept of the rigid measuring rod and that of the isochronous clock.

A method for the measurement under the microscope of fog-, cloud- and rain-droplets is described by N. Fuchs and I. Petrjanoff. The droplets are collected on glass slides coated with a mixture of vaseline and mineral oil, which practically prevents the evaporation of the droplets, without affecting their spherical shape.

The preparation of a highly active apo-dehydrogenase (a non-dialysable and heat-sensitive colloidal carrier, protein in nature) which is an essential component in the fermentation of alcohol, is described by M. Sreenivasaya. The purified preparation is 135-fold more active than the original yeast extract.

The activity of the hormone progesterone in inducing ovulation in the South African clawed frog, *Xenopus lævis*, is described by Dr. H. Zwarenstein. Ovulation was induced not only in adult normal animals but also in a certain proportion of immature normal animals and in others from which the pituitary gland had been removed. The hormone also acts upon ovaries *in vitro*.

In *Pisum sativum* the genes R and A (R/r = round/wrinkled, A/a = coloured/white flowers) have hitherto been found, according to Miss Caroline Pellew, to be independent in the normal structural type The relation of these two genes in the three structural heterozygotes, found by Mrs. Sansome to have one interchanged chromosome, No. 1, in common, show that they are located in this chromosome in the normal structural type.

S. Paramasivan reports that the classical Jain paintings at Sittannavasal in South India have been executed in *fresco-secco* technique. He gives the results of analysis of the plaster and the pigments. Lime, carbon, yellow and red ochres, lapis lazuli and terre verte have been used as pigments.

S. Bhagavantam and Dr. A. Veerabhadra Rao have photographed the Raman spectrum of benzene vapour. While the principal line at 992 shows no shift, the line at 3061 in the liquid shifts to 3069 in the vapour and 3047 has not appeared in the vapour picture. Considerable alterations take place in the structure and intensity of the 'rotation wing' on passing from the liquid to the vapour.

The fact that Cario and Stille could not observe the negative bands of nitrogen and those first-positive bands which originate on vibrational levels higher than $v' = 14$, is due, according to Prof. J. Kaplan, to incomplete purification of the nitrogen in their discharge tubes.

R. N. Rai has calculated the conditions of reflection of radio waves from the ionosphere on the assumption that the group velocity vanishes. In addition to the usual results, a new condition for the extraordinary ray is found according to which the penetration frequency difference is only one fifth the expected results. This is in agreement with the observations made at the Physical Laboratory, University of Allahabad.

Research Items

Jungle Yellow Fever

ONE of the most interesting sections of the annual report for 1935 of the International Health Division of the Rockefeller Foundation deals with the occurrence and ætiology of what is termed "jungle yellow fever". This form of yellow fever is met with in Brazil in districts in or close to uncut forest or jungle, and in which the ordinary and only vector of yellow fever in town or city, the mosquito *Aedes ægypti*, is absent. One large area was discovered in 1934 in which more than sixty fatal cases had occurred, all with one possible exception acquiring their infection in rural areas in which this mosquito did not exist. Accumulated evidence suggests that jungle yellow fever usually occurs in man as an accidental infection secondary to an infection in a lower animal, much as bubonic plague occurs secondary to plague in rats and other animals. Evidence is presented that jungle yellow fever is secondary to the disease in the wild monkeys of the district, with transmission by mosquitoes of the genus *Hæmagogus*, for it was demonstrated that a large proportion of the monkeys of the district had a naturally acquired immunity to yellow fever, and that the infection could be experimentally transmitted by *Hæmagogus* sp. Work upon several other diseases—malaria, hookworm disease, diphtheria, yaws, tuberculosis and others—is surveyed in the report, as well as the aid given by the Foundation in furthering public health education throughout the world.

Genetics and Cytology of Hybrid Ducks

THE intergeneric hybrids between Aylesbury and Muscovy ducks have been studied genetically and cytologically by Prof. F. A. E. Crew and Dr. P. C. Koller (*Proc. Roy. Soc. Edinb.*, 66, pt. 3). Aylesbury ♀ × Muscovy ♂ produces sterile males and grossly abnormal females with rudimentary ovary and no sex behaviour. Both sexes have a crest. In the reciprocal cross, the males are sterile while the females have a normal ovary, lay small eggs and show normal sex behaviour. The females are uncrested. The chromosomes of the parent species show no visible differences, consisting in each of five pairs of long chromosomes and numerous tiny granules, the highest chromosome count obtained being 72. Spermatogenesis shows numerous abnormalities, including short or multipolar spindles, binucleate spermatogonia, chromosome elimination, supernumerary post-meiotic divisions and giant multinucleate cells. One chromosome in the hybrid commonly lagged on the spindle in meiosis, probably because of a short terminal inversion. Since this would be insufficient to account for the phenomena of sterility, and also because the parent species show differences in nuclear and cell size and in rate of embryonic development, it is suggested that the abnormal gametogenesis is due to genetic factors which do not affect chromosome pairing, but which affect the harmonious relationship between chromosomes and spindle. This is conceived to be a result of profound differences in cell metabolism between the parental genera.

Chalcid Wasps of the Genus *Harmolita*

TECHNICAL BULLETIN No. 518 of the U.S. Department of Agriculture (September 1936) is a brochure forming a second revision of the species of the genus *Harmolita* (*Isosoma*) of America north of Mexico. Its author, Mr. W. J. Phillips, was, until lately, entomologist in the U.S. Bureau of Entomology and Plant Quarantine. It is seventeen years since the first revision of the genus was published, and in the present communication some twenty new species are described. The members of the group show a remarkable specificity of their host preferences, and it is only very rarely that a species will develop in more than one species of host. The author adds that he has never known a species of *Harmolita* to oviposit in plants of different genera. The extensive key which accompanies this paper refers to the females only: in half the known species males do not normally occur. The basis of the revision is the author's discovery of a new character in the sculpturing of the ventral aspect of the petiole and of its point of fusion with the ventral sclerite of the abdomen. This character is used with reference to identification of the males, where it appears to be better than other characters, although less valuable than with regard to females. The genus is one of definite economic importance since some of its members attack certain cereals and cultivated grasses.

Japanese Bopyrids

THREE recent papers by Dr. Sueo M. Shiino deal with interesting new Bopyrids ("Bopyrids from Tanabe Bay (3)". *Mem. Coll. Sci.*, Kyôtô Imp. Univ., Ser. B., 11, No. 3; 1936. "Bopyrids from Shimoda and other Districts" and "Bopyrids from Misaki", *Rec. Oceanograph. Works in Japan*, 8, Nos. 1, 2 and 3; 1936). The first is a continuation of his work published in this same journal in 1933 and 1934. Several new forms are described, mostly from crabs or shrimps. The new genus *Cataphryxus* has been created for *C. primus* in a former paper called *Epiphryxus primus*, the generic name *Epiphryxus* having been used by Nierstrasz and Brender à Brandis to describe a phryxid *E. adriaticus*. The second paper also includes new species, the material being collected at Shimoda, Nagasaki and Formosa. The new genus *Heterocepon* is here created for an Ione-like Bopyrid, closely related to *Dactylocepon*, *Metacepon*, *Anacepon* and *Hypocepon*, all having well-developed endopodites in the female and the medio-dorsal process absent. A table shows the differences between these genera. The third paper includes species collected near the Marine Biological Station at Misaki.

Spores of the Mushroom

MISS D. M. CAYLEY has made a detailed study of the spores and spore-germination in wild and cultivated mushrooms (*Trans. Brit. Mycol. Soc.*, 20, Parts 3 and 4, November 1936). It has been stated that the wild mushroom has four basidiospores, and the cultivated form only two; but Miss Cayley has shown that two of the three common varieties in cultivation have a number of spores varying from one to four. The origin of the cultivated mushroom is very obscure, and the present paper does not illuminate this question; but mycologists will be greatly interested in the discussion of circumstantial evidence for heterothallism in the genus *Psalliota*. Spores of wild mushrooms are haploid, and it is suggested that *P. campestris* and *P. arvensis* may be haplodiœcious. The cultivated mushroom is a saprophyte, but there is a certain amount of evidence that the wild form may be a facultative parasite upon the roots of grasses.

Some Diseases of the Potato

MODERN knowledge has not brought a new cure for the fungus causing wart disease of potatoes, but numerous investigations have elucidated the incidence and pathogenic cycle of the disease. The Ministry of Agriculture and Fisheries has provided an admirable summary of modern findings in its new Advisory Leaflet No. 274, "Wart Disease of Potatoes". This replaces the old Leaflet No. 105, and perhaps the most striking addition is a list of solanaceous plants, other than the potato, which have been infected artificially with the causal fungus *Synchitrium endobioticum*. Such hosts do not, however, seem to play any practical part in spreading the disease under natural conditions. The subject matter of all sections of the leaflet has been entirely rewritten, and the list of immune varieties has been brought up to date. Advisory Leaflet No. 278, which replaces Leaflet No. 164, makes a clear presentation of the menace of the virus disease leaf roll to the potato crop. Rogueing diseased plants from isolated crops with very slight incidence of the malady, and fumigation of seed-tuber stores to eradicate transmitting insects, are the control measures recommended.

Glaciation of Bantry Bay District

THE results of a study of the evidences of the latest glaciation in the neighbourhood of Bantry Bay have recently been recorded by A. Farrington (*Sci. Proc. Roy. Dublin Soc.*, 21, No. 37; 1936). The area was invaded by an ice-sheet coming from the north-northwest over the ridge formed by the Caha and Slievemiskish Mountains, which were overwhelmed to a height of about two thousand feet. The Bay was filled with ice which escaped south-westwards along the Bay itself; north-eastwards into the mountain valleys, where fine terminal moraines are found; and south-eastwards as far as Skibbereen. The terminal moraine of this sheet can be traced for about twenty miles from the pass of Keimaneigh to Skibbereen. The press of ice coming down the Glengarriff valley was congested at the head of the Bay, and there is evidence of much differential movement within the ice-mass. Drumlin trains mark the north-east and south-west ice movements, but in the south-east direction they are poorly developed. The occurrence of erratics of typical crinoidal limestones of Lower Carboniferous type on the south shore of the Bay seem to have been derived from a former exposure of Carboniferous limestone which is now covered by the waters of the Bay. Otherwise they must have been carried from the outcrops at Kenmare without leaving a single example on the ranges to the north of the Bay.

Obtaining Upper Air Data

A RECENT report circulated by Science Service of Washington, D.C., deals with a new development of upper air research. The sounding balloon, with recording instruments that are not at once recovered, is not equal to the demands of modern weather forecasters for prompt information about the physical state of the upper air. This failure has led to the construction in various countries of devices carried by balloons which send out automatically, by radio, reports of pressure, temperature and humidity. The latest of these comes from the California Institute of Technology. Carried by a balloon 5 feet in diameter, and emitting on a wave-length of 1·7 metres, it has already yielded a sounding up to 30,000 feet. L. E. Wood, graduate assistant of the Institute, has designed the meteorograph, and has developed for it a 2-volt storage battery that weighs only 4½ gm. Fifty of these batteries are used in series in place of the ordinary dry battery system. The radio transmitting apparatus is the work of Capt. C. O. Maier, of the U.S. Signal Corps. A very small tube emits a constant signal, which is interrupted by a timing device that translates the data for broadcasting. It is a modified watch that develops twenty-five times the power of an ordinary watch. Power for the radio comes from three dry cells, of 135 volts in all, and three small storage batteries. The signals are recorded on an electrically operated tape.

A New Actinometer

As a result of experiments carried out in the laboratory of the Meteorological-Hydrographical Institution at Stockholm, A. Angstrom has produced a new design of actinometer. This is described under the heading "A Simple Actinometer" in paper No. 9 of the Institution reprinted from *Gerlands Beiträge zur Geophysik* (48, 303; 1936). The author suggests that in some ways it would be better to reduce rather than to increase the number of actinometers; but this one was designed and made for the glaciological expedition of Prof. H. Ahlmann to Iceland in the summer of 1936, and worked well, and as it was felt also that a very simple and portable instrument is in demand for meteorological work, it seemed desirable to publish a description of it. The new actinometer consists of a thermometer with blackened spiral bulb the plane of which is perpendicular to the graduated stem. Solar radiation is admitted through an aperture in the lid of a cylinder which surrounds the thermometer. At the bottom end of the cylinder is a Fuess aspirator similar to those used on psychrometers. When the inside of the apparatus has been brought to air temperature, which takes about two minutes, the aspirator is removed and the cylinder is trained on the sun with the aid of a diopter. An exposure of 90 seconds is made, and the rise of temperature is observed. This rise is for a particular instrument nearly proportional to the intensity of the solar radiation. The constant by which the rise must be multiplied to get the radiation intensity is found for each instrument by comparisons made with some standard instrument of more elaborate pattern. Figures are quoted which suggest that the error arising from the use of this simple actinometer will usually be less than three per cent, which for many purposes is quite accurate enough. An observation can clearly be made in a very short time.

Clarification of River Water

IN an account of an extensive series of experiments on the clarification of water from the River Vltava in Czechoslovakia (*Proc. Masaryk Academy of Work*, 10, 233; 1936), Prof. J. Milbauer concludes that crude aluminium sulphate is the most satisfactory clarifying agent for this and other river waters. In his investigations it was found that the addition of 100 mm. of the salt per litre gave the best results. Pure aluminium sulphate was not so satisfactory, probably because the silica and other impurities in the crude salt play an important part in flocculating the aluminium precipitates. The most suitable temperature was 10° C.; below this point flocculation was slow. Clarification was favoured by hydrogen ion concentrations up to pH = 4·2. Beyond this it decreased to a minimum at pH = 5·0. The addition of such substances as calcium hydroxide, ferric sulphate or silica had no perceptible influence, although addition of excess of charcoal was favourable to sedimentation. Cheap natural products like chalk, felspar, clay, dolomite powder, coal dust, peat or infusorial earth had no useful action on the process. Addition of colloids (proteins, saponine, silicic acid, etc.) were definitely detrimental, but kaolin and certain industrial wastes and the ash from a refuse-burning station were beneficial in assisting the flocculation of the precipitates from the addition of aluminium sulphate to the river water. Pre-treatment with ozone, chlorine, carbon dioxide or sulphur dioxide was not advantageous.

Magneto-optic Method of Chemical Analysis

THE work of Allison and others on the magneto-optic apparatus has been called into question by certain observers who have been unable to observe the 'minima' which are claimed to be characteristic of the substances under observation. Gordon Hughes has recently described a photographic method whereby small changes in light intensity have been successfully detected and the reality of minima conclusively demonstrated (*J. Amer. Chem. Soc.*, 1924; 1936). More than 2,300 photographs taken in this investigation show that there is a small effect—the change of light intensity for a minimum being 0·7 per cent—which is characteristic of the substance under test in the apparatus. Water-blanks showed approximately zero percentage change. The presence of foreign materials did not change the magnitude of the intensity change for a minimum. The direction of the effect was found to be dependent on the direction of the magnetic field in the coils, and to reverse with the setting of the Wollaston prism on either side of the critical 45° position. The measured photographic effect was found to occur only at positions of minima which had been previously determined by repeated visual observations It is concluded that the photographed effect is identical with the visual effect and that the latter is real, despite the not unexpected inability of certain workers to observe it

Locomotive Furnace Control

THE principle of furnace control by means of the carbon dioxide concentration in the flue gases is well known in its application to stationary units. In practice, conditions of firing and air supply are regulated, and heat losses in the flue gases (carbon monoxide and hydrogen) are eliminated by maintaining the carbon dioxide at a fixed optimum percentage. Measurement of the carbon dioxide content is frequently carried out by a thermal conductivity method, but unfortunately this is complicated by the fact that both carbon monoxide and hydrogen affect the readings of any thermal conductivity meter. On application of this principle to locomotive furnaces, where conditions of firing and air supply are not so readily controlled as in stationary plants, the presence of carbon monoxide and hydrogen has a very pronounced effect on the carbon dioxide meter reading. V. Binns and S. Bairstow, in a paper read before the Institute of Fuel on November 25, emphasized this factor and outlined investigations which had been made with the view of assessing the accuracy of thermal conductivity methods of gas analysis when applied to locomotive flue gases. Results of such investigations proved that this method can be adopted, providing appropriate corrections are made to meter readings. The method of correction is simple and is well illustrated in the paper by a rapid graphical method.

Strength of Materials

IN a paper entitled "The Relationship between Mechanical Tests of Materials and their Suitability for Specific Working Conditions" read before the North-East Coast Institution of Engineers and Shipbuilders on December 18, Dr. N. P. Inglis dealt with the various stipulations most or all of which are usually included in the specification of an important steel forging; he analysed critically each of these from the point of the useful information it provides and demonstrated, that for service under particularly severe conditions, such as high temperature, mechanical tests require to be supplemented by precise knowledge of chemical composition, method of manufacture, amount of ingot croppage and of hot work, and the nature of the heat treatment given. It was, however, also shown that from the ordinary mechanical tests, by the adoption of suitable procedure, much more than the usual amount of information could be derived and, as an example, the value of the Izod test both as a guide to the correctness or otherwise of heat treatment in certain alloy steels, and also as a means of indicating the presence of laminations or other effects of segregation, was quoted. In this last connexion, the position of the notch must be suitably arranged and, following from his discussion of this point, the author suggested that microscopic examination of Izod test fractures would add materially to the information of the mere figures of the test. Among other matters, the deterioration of mechanical properties under severe service conditions was discussed, and the results of two groups of notched bar tests were cited. The first of these referred to a number of samples of different qualities of steel subjected, during fifteen months' service, to temperatures of 410°–430° C., and it was here shown that while some samples depreciated to Izod values 14–80 per cent of their original figures, in others the initial value was fully maintained. In the second group, similarly varying results, arising from different preparatory treatment, were obtained in samples subjected to subnormal temperatures of − 30° C. while in service.

Mandibles of Peking Man*

THE late Dr. Davidson Black, honorary director of the Cenozoic Research Laboratory of the National Geological Survey of China, at the time of his lamented death was engaged on the study of the mandible of Peking man. Further material discovered since then has necessitated some modifications in the conclusions at which he arrived. This new material has now been incorporated in a study by his successor, Prof. Franz Weidenreich, in which he has been able to include the plates which Dr. Black had prepared.

The number of mandibles, or parts of mandibles, of *Sinanthropus*, which has now been obtained from Choukoutien, is eleven, of which six are juvenile and five are adult. [A further specimen was found in October last.] They are of both sexes. In his prefatory remarks, Prof. Weidenreich points out that the importance of the mandibles of fossil man has always been recognized, and given rise to considerable discussion, since the discovery of the Naulette jaw in 1866; but the jaw of *Sinanthropus* is of special interest. All the known lower jaws of fossil man, with the exception of Heidelberg and Piltdown, form a group which is distinguished from modern man in lacking a chin, in being more massive and bulky and in having the relief of the surface strongly developed. In these respects *Sinanthropus* conforms; but as the teeth constitute the essential factor in its classification, it is of importance to determine how far the lower jaw fits into the framework. Its significance is enhanced by the fact that, unlike the other jaws of fossil man, all the specimens come from one site, though from different levels.

In its bearing on the evolutionary problem, the evidence of *Sinanthropus*, the most primitive and geologically the oldest hominid known, is crucial. It should point the way to the solution of the problem whether the modern jaw is derived from an ape-like ancestral jaw by the retraction of the teeth and the development of the chin, modifying an original prognathism, or from a 'mesogeneiotic' form which develops on one side into the prognathism of the anthropoid, and on the other into the orthognathic form of modern man. The high antiquity of the Heidelberg jaw, combined with its resemblance to Neanderthal man, has been thought to militate against the former alternative, which demands that the earlier the jaw in a chronological sense, the nearer its resemblance should be to the ancestral type. On this question, the position of the Peking mandible should be decisive.

Prof. Weidenreich, after describing in detail the eleven mandibles now available, and recording and discussing their measurements, passes on to consider the peculiar characteristics of *Sinanthropus* and its comparison with other types, as well as the place of Peking man in the evolutionary scale, incidentally recording some interesting conclusions on *Australopithecus* and the Piltdown jaw.

As regards sexual differences, it is evident that two types, a large and a small, are represented in the mandibles. The idea that they belong to different races may be discarded. If the difference is due to sex, as is held, the ratio in size of female to male is much lower than in recent man, and more closely resembles that of the anthropoids. In *Sinanthropus* the ratio of small to large is 85·0 per cent; in modern man (Mongol), of female to male it is 92·4 per cent, in orang, 78 per cent, gorilla, 80 per cent and chimpanzee (approximately) 87 per cent.

As regards the special character of the mandible, the male is much larger, and bulkier than that of modern man; but this does not hold of the female, although the female ramus exceeds in height and breadth that of the Mongol of to-day. In height of body the symphysis height of 40 mm. reaches the upper margin of recent man, though the two measurements do not exactly conform. The *Sinanthropus* jaw has a higher alveolar and lower basal plane than modern man. The bicondylar breadth of 146·4 mm., it is interesting to note, is greater than that of the Eskimo, 140·0 mm., which is exceptionally broad, although the bigonial breadth, 108·6 mm. is below the Eskimo measurement of 130 mm. In both, measurements the female jaw is within the range of modern man. The angle of inclination of the frontal part of the jaw is the lowest known in hominids excepting the Heidelberg jaw, which is the same, namely, 60°. Another striking feature is the parallelism between the alveolar and basal planes, which is present also in orang and gorilla.

The shape of the alveolar arch presents a very characteristic picture in all adult specimens. Compared with recent man, the arcade shows a horseshoe-shaped, long and relatively narrow curve with its frontal part equally rounded in the region of the canines and incisors, and not flattened as in recent man. The free ends of the arches come close to each other.

In regard to the relief of the surfaces, one of the most outstanding features is the absence of chin (*mentum osseum*). In one specimen the area occupied by the roots of the frontal teeth is much larger than has been observed in any other known hominid, including the Heidelberg jaw. This feature, together with the strong inclination of the frontal part, points to a very primitive stage. There is, however, the beginning of a real mental spine, which has never been observed before in any of the Neanderthal mandibles, except La Chapelle-aux-Saints.

The juvenile mandibles exhibit the same qualities as the adult in regard to their bulkiness, even when sexual differences are considered. As to the anterior alveolar arch, it is noted, that in the only one concerned, it is much longer and more widely stretched than in recent man, and essentially longer than in the adult *Sinanthropus*. A distinct shortening takes place during dentition, in which *Sinanthropus* apparently follows modern man and differs fundamentally from the anthropoids.

In comparing *Sinanthropus* with other forms, Prof. Weidenreich records his agreement with Prof. R. Dart and Dr. R. Broom that *Australopithecus* is neither chimpanzee nor gorilla, but comes well within the human line of development. This conclusion he bases on the character of the teeth, which resemble those of *Sinanthropus* (to be dealt with in a later monograph) rather than those of chimpanzee or has already been completed. Now, with the approach of the Third Five-Year Plan, the activities of the Academy in this field are to undergo a decided change. Attention will be concentrated on key positions, and the number of the Academy's branches will be reduced, or handed over to the local authorities. A further function of the Academy is to study the cultural and economic achievements of mankind and to help in their rational application for the building-up of the new society. The main responsibility for this work falls upon the Social Sciences Section.

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* The Mandibles of *Sinanthropus pekinensis*: a Comparative Study. By Franz Weidenreich. (Palæontologia Sinica, Series D, 7, Fasc. 3.) Pp. 162+xv plates. (Nanking and Peiping: National Geological Survey.)

The work of the Academy in the immediate future is to aid the State Planning Commission in the drawing up of the Third Five-Year Plan. The main efforts of the Academy's various institutes will be directed towards the solution of the following ten problems, outlined at a session held last March. (Needless to say, these problems do not comprise the whole work of the Academy and its research workers but, for the moment, they are the leading and dominant ones.)

(1) To develop geological, geochemical and geophysical methods of prospecting for useful minerals, particularly tin, rare metals and oil.

(2) To solve the problem of power by creating a unified electric power system throughout the U.S.S.R., with high-voltage transmission.

(3) To rationalize and extend the use of natural gas and by-product gas from industrial plants.

(4) To find a new type of fuel for internal combustion engines (study of chain reactions and explosion processes, internal combustion motor and electric automobiles).

(5) To rationalize technological processes in chemistry and metallurgy.

(6) To help in raising the grain yield of the country (research in seed selection, soil chemistry, plant biology, fertilizers and the mechanization of agriculture).

(7) To establish scientific bases for the development of animal husbandry and fisheries.

(8) To develop telemechanics (long-distance control of machinery) and to extend automatic processes in industry through application of theoretical physics.

(9) To draw up the balance sheet of the national economy of the U.S.S.R. so as to serve as a scientific basis for the Third Five-Year Plan.

(10) To study the history of the peoples of the U.S.S.R.

Science News a Century Ago

Robert Macnish (1802–37)

DR. ROBERT MACNISH, a brilliant physician and man of letters, who died on January 16, 1837, was born at Glasgow on February 15, 1802, the son and grandson of medical men. He obtained the degree of master of surgery at the early age of eighteen years, and first served as assistant to a general practitioner for eighteen months. He then went to Paris, where he attended the lectures of Broussais and Dupuytren and made the acquaintance of Gall, who pointed out Macnish to his fellow students as presenting a remarkable development of the organ of comparison.

On his return to Glasgow in 1825, Macnish obtained the degree of M.D. with a thesis on "The Anatomy of Drunkenness", which was published in 1827. Enlarged editions afterwards appeared and enjoyed a wide popularity. The work is of some historical value as being the first attempt to study drunkenness in its physiological aspects rather than as a crime. Macnish's next most important medical publication was "The Philosophy of Sleep", and was mainly based on the doctrines of Gall. His interest in phrenology is further shown by the publication in 1836 of an elementary treatise on the subject in the form of question and answer. At about the same time, he brought out a new edition of Amariah Brigham's "Remarks on the Influence of Mental Cultivation and Mental Excitement upon Health", to which he added numerous notes. He also contributed numerous articles to various periodicals, the best known of which, published in *Blackwood's Magazine*, was the tale entitled "Metempsychosis", which he wrote under the *nom de guerre* of "Modern Pythagorean". His collected tales, essays and sketches were afterwards published under this title with an account of his life by his friend Dr. David M. Moir. His premature death was due to an attack of influenza.

Production of Minerals in France

AT a meeting of the Statistical Society held on January 16, 1837, a paper by the chairman, G. R. Porter, was read entitled "A Statistical Account of the Mineral Products obtained in France during the year 1834; taken from official documents". In his opening remarks, the author said, that though in Great Britain no systematic effort had been made to gather statistics on the iron and coal mines, the French Government had recently deputed M. Le Play to ascertain the capability of every iron works and nearly every coal-field in England.

Mr. Porter's review of the mineral resources of France was divided under the following heads: ironworks; fuel; metals; salt, alum and copper ore; quarries, and operations connected with mineral substances. The quantity of iron ore obtained in France in 1834 was 1,551,473 tons, the number of smelting furnaces 374 and the weight of iron produced 221,886 tons. There were in use 97 furnaces for converting ore at once into malleable iron and steel, by a peculiar process used in Corsica, the production being 8,531 tons of iron and 399 tons of steel. There were also 1,230 forges for converting cast into malleable iron, and 1,556 rolling, drawing and slitting machines. The total value of the French iron manufacture was £3,492,519, and the number of men employed 31,704. Five sixths of the fuel used in iron manufacture came from the French forests. During 1834, 140 coal mines were being worked, and the coal produced was 1,550,530 tons.

George Richardson Porter, the author of the paper, was born in 1792 and died in 1852. Failing in business as a sugar-broker, he devoted himself to economics and statistics, and the Statistical Department of the Board of Trade was established mainly under his supervision. Among his writings was "The Progress of the Nation from the Beginning of the Nineteenth Century", the third edition of which appeared in 1851.

Rev. Baden Powell on the Dispersion of Light

AT a meeting of the Royal Society held on January 19, 1837, the Rev. Baden Powell, then Savilian professor of geometry at Oxford, read a paper entitled "Researches towards establishing a Theory of the Dispersion of Light". An abstract of the paper said:

"The author here prosecutes the inquiry on the dispersion of light which was the subject of his former papers published in the Philosophical Transactions for 1835 and 1836, extending it to media of higher dispersive powers, which afford a severer test of the accuracy of M. Cauchy's theory. He explains his method of calculation and the formulæ on which his computations are based. On the whole he concludes that the formula as already deduced from the undulatory theory, applied sufficiently well to the case of media whose dispersion is as high as that of oil of anise-seed: or below it, such as nitric, muriatic and sulphuric acids, and the essential oils of angelica, cinnamon, and sassafras, balsam of Peru and creosote. It also represents, with a certain approximation to the truth, the indices of some more highly dispersive bodies."

Faraday on the Views of Prof. Mossotti

The evening meetings of the Royal Institution, said the *Athenæum*, began on January 20, 1837, when considerable interest was excited by its being known that Faraday was to deliver a lecture on the views of Prof. Mossotti, of Corfu, who has lately promulgated an opinion, that one general law would account for those forces of matter which are exhibited in universal gravitation, cohesion, and electrical attraction and repulsion. Faraday began by observing that the want of such general law had been strongly felt, and had latterly been more than hinted at by Babbage, Roget and other philosophers. He went on to speak of the nature of the forces of gravitation, cohesion and electrical attraction and repulsion, and then, according to the *Athenæum*, said: "Hence there is such an adjustment of these forces, that at certain distances, matter acts inversely as the square of the distance, producing gravitation; but when the particles are nearer to each other, the powers are balanced, producing the state of cohesion; and when they are still nearer, they exert that repulsion, which keeps the particles of every solid and fluid body out of actual contact".

Robert Thornton (1768–1837)

Dr. Robert John Thornton, who was a prolific writer on botany and medicine, was born in 1768 and died on January 21, 1837. He received his medical training at Trinity College, Cambridge, where he attended Prof. Thomas Martyn's lectures, and at Guy's Hospital, where he was a pupil of the eminent surgeon Henry Cline. He qualified in 1793, and after further professional studies in Edinburgh, Dublin and Paris, and also in Holland and Germany, set up in practice in London, where he was for some time physician to the Marylebone Dispensary and lecturer on botany at Guy's Hospital.

At an early stage of his career, Thornton ruined himself by the publication of a magnificent folio in which contemporary artists and poets collaborated entitled "The Temple of Flora or Garden of the Botanist, Poet and Philosopher; with picturesque plates in illustration of the Sexual System of Linnaeus" (1799–1804). He was also the author of "Practical Botany" (1808), "The Philosophy of Botany" (1808), "Outlines of Botany or an Introduction to that Science" (1810), and "A Grammar of Botany" (1811). His medical writings included "The Philosophy of Medicine" (1799–1800), "Vaccinae Vindiciae or a Vindication of the Cow Pock" (1806) and "The Prevention and Cure of the Venereal Disease" (1817).

Societies and Academies

Paris

Academy of Sciences, December 14 (*C.R.*, 203, 1301–1406).

Louis Bouvier: Complementary observations on the claws of decapod crustaceans belonging to the Astacomorph section.

Serge Bernstein: The formula of approximate quadrature of Tchebycheff.

Jean André Ville: The convergence of the median of the *n* first results of an infinite series of independent experiments.

Frédéric Roger: The limits of a function at a point.

Alex. Froda: The properties characterizing the possibility of measuring multiform and uniform functions of real variables.

Bernard Salomon: Certain classes of reducers of oscillations of machine shafts.

Douchan Avsec: The ratio λ/h for vortices in longitudinal bands.

Jean Labat: The importance of Reynolds number in trials on small models. Results of an experimental study, using chronophotographs of particles of aluminium in suspension in water.

Charles Chartier: The structure of the general flow round a helix. Two diagrams based on a study by chronophotography.

L. Cagniard: The propagation of intumescences in directions with or against the current in rivers.

Bernard Lyot: The spectrum of the solar corona in 1936, wave-lengths and the intensities of the emission lines.

Daniel Chalonge and Horia Safir: Study of the variations of γ-Cassiopeia.

Mme. Marie Antoinette Tonnelat-Baudot: Relation between the action function and the force which acts on the electron.

Paul Soleillet: The interpretation of phase in the matrices of quantum mechanics.

Gabriel Duch: The determination of the surface tension of a liquid by the formation of drops at the end of a capillary tube in which the elongation of the meniscus is observed.

James Basset: Thermal exchanges in nitrogen and in hydrogen at ultra-pressures up to 6,000 kgm./cm.^{2}.

Marcel Laporte: The production of white light by the electrical luminescence of gases. The method is based on the production of discharges of very high intensity of very short duration through a gas (xenon), the discharges being repeated with a frequency sufficiently high to make use of the persistence of light impressions. In the arrangement described, the oscillating discharge has a period of 8×10^{-6} sec.

J. J. Placinteanu: The electronic nature of light.

Claude Charmetant: The electrolysis of ferrous chloride, bromide and iodide and of ferric chloride in mixtures of water and ethyl alcohol.

Jean Jaffray: The discharge spectrum in air of high-tension magnetos.

B. Rosen and Mlle. Nina Morguleff: Spectroscopic study of the constitution of sulphur vapour. Additional proofs of the existence between 3600 A. and 6000 A. of two absorption systems of sulphur vapour, one of which forms part of the principal system of S_2.

François Grisel: The flow of water, under constant pressure, through a mass of concrete. The volume of water passing through is a linear function of the logarithm of the time; hence the permeability of a specimen of concrete, under constant pressure, can be determined by measuring the volume passing during a relatively short time.

Gabriel Valensi: The kinetics of the oxidation of copper at a high temperature.

Jacques Bénard: Study of the stability of solid solutions between the lower oxides of iron and cobalt.

Maurice Dodé: Remarks on the conditions of possibility of heterogeneous reaction with a gaseous phase, in the case of miscibility of condensed phases.

Jean Cournot and Marc Baudrand: The corrosion of joints. Details of results obtained with riveted joints. For light alloys, cadmium-plated rivets give the best results. For joining steels, light alloy rivets without cadmium give the best autoprotection.

Etienne Vassy: The variation of the absorption coefficients of ozone and the temperature of the upper atmosphere.

Emmanuel Voyatzakis: The compounds of nitroprussides and hexamethylenetetramine.

Mlle. Alice Lacourt: Application on the microanalytical scale of the methods of quantitative organic analysis by hydrogenation.

Maxence Meyer: The synthesis of $\alpha\alpha'$-diethoxy-acids with straight chains.

Antoine Willemart: Researches on the dissociable anthracene oxides: the photoxides of 9-phenyl-10-methylanthracene and of 9-phenyl-10-ethylanthracene.

Georges Darzens: A new general method for the condensation of dichloracetic ester with ketones and aldehydes by the use of very dilute metallic amalgams. A general method for preparing compounds of the types $RR'.C(OH).CHCl.CO_2C_2H_5$ and $R.CH(OH)CHCl.CO_2C_2H_5$. The yields are high.

Léon Palfray, Sébastien Sabetay and Jean Kandel: The catalytic hydrogenation of α-ionone, ionol, dihydroionol, tetrahydroionol, dihydroionone, tetrahydroionone.

Henri Lefebvre and Georges Le Clerc: The thermomagnetic study of the iron catalysts utilized in the synthesis of hydrocarbons by the Fischer method.

Pierre Chouard: Building up the stem in the Monocotyledons.

Raymond-Hamet: A new alkaloid, formosanine, extracted from *Ourouparia formosana*.

Georges Fron: The fight against tracheomycoses in plants. An account of the beneficial effects of the neutral sulphate of *o*-oxyquinoline by increasing growth and combating attacks by fungi.

Albert Peyron, Jean Verge, Louis Blanchard and Pierre Goret: The genesis of interstitial cells at the expense of seminiferous tissue, in the embryonic testicle and in the seminome.

Georges Bourguignon and René Humbert: Double contraction and double chronaxy of normal striated muscle of man and mammals. Analysis by progressive currents.

Philippe L'Héritier: The appearance of differences of pigmentation between various strains of *Drosophila melanogaster*, wild type, as the result of a larval intoxication.

Mme. Véra Dantchakoff: The effects of a permanent treatment with folliculine on the male organism.

Mme. Paulette Chaix: The mechanism of the action on substances containing sulphur in glucose by *Propionibacterium pentosaceum*.

Mlle. Camille Chatagnon: The gastric secretion of bromine in the course of bromide therapeutics.

Gustave Guittonneau and René Chevalier: The sensibility of the *Azobacter* of the soil to the molecular structure of the monoxybenzoic acids. For the strains of *Azobacter* studied, none of the isomeric sodium hydroxybenzoates was toxic, but their food value depended markedly on the position of the hydroxyl group.

André Boivin and Mme. Lydia Mesrobeanu: Bacterial variations and complete *O* somatic antigen.

Fernand Arloing, Albert Morel, André Josserand and Louis Perrot: The stereochemical configuration of the organic basis and the antitumoral activity of the metallo-ascorbic complex compounds.

Melbourne

Royal Society of Victoria, November 12.

Elizabeth A. Ripper: Stromatoporoids of the Lilydale limestone. (2) Species of *Syringostroma, Stromatopora, Stromatoporella* and *Idiostroma* are described. A review of the whole fauna indicates that a high proportion of the species can be identified with forms occurring elsewhere in the Middle Devonian; three occur in the Helderbergian (Lower and lower part of the Middle Devonian) of North America, while only two are typical of the Wenlock limestone of Great Britain and the Niagaran of North America. The Lilydale stromatoporoid fauna has very little in common with that of the British Wenlock with which the Lilydale limestone has generally been compared, and should rather be correlated with European and North American Devonian faunas.

Kathleen M. Crooks: Studies on Australian aquatic Phycomycetes. An account of the systematic and physiological characteristics of twenty species of aquatic fungi collected in the vicinity of Melbourne.

Isobel Cookson: On *Saprolegnia terrestris* n.sp., with some preliminary observations on Victorian soil Saprolegniales. The forms identified from Victorian soils include—*Saprolegnia terrestris* n.sp., *S. megasperma* Coker, *S. anisospora* de Bary, *Isoachlya unispora* Coker and Couch, *Achlya apiculata* de Bary, *A. racemosa* Hilderbrand, *A. caroliniana* Coker, *Thraustotheca clavata* (de Bary) Humphrey.

R. T. Patton: Ecological studies in Victoria (4). Red box – red stringybark association.

Vienna

Academy of Sciences, October 22.

A. Sommerfeld: Klein's parameters α, β, γ, δ and their importance to the Dirac theory.

Josef A. Priebsch and W. Baldauf: Temperature effect with cosmic rays (from three years records of the ionization on the Hafelekar, 2,300 m. above sea-level).

Marietta Blau and Herta Wambacher: Distribution of α-tracks of the radium series.

E. Moles and T. Toral: The molecular groups $CO_2:O_2$ and $N_2O:O_2$.

G. Jantsch and E. Schuster: Determination of the solubility of mercurous oxalate.

Hans Strouhal: The terrestrial Isopoda collected by Dr. Franz Werner in Greece and the Ægean Isles.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, January 18

Royal Geographical Society, at 5.—Prof. David Brunt: "Climatic Cycles".

King's College, London, at 5.30.—Prof. J. G. Semple: "Projective and Abstract Algebraic Geometry" (succeeding lectures on January 25, and February 1, 8, 15 and 22).*

Royal Society of Arts, at 8.—Prof. P. M. S. Blackett, F.R.S.: "Cosmic Rays" (Cantor Lectures. Succeeding lectures on January 25 and February 1).

Tuesday, January 19

University College, London, at 5.—Prof. J. C. Drummond: "Problems of Nutrition" (succeeding lectures on January 26 and February 2, 9, 16 and 23).*

Eugenics Society, at 5.15—(at the Linnean Society, Burlington House, Piccadilly, W.1).—Dr. David Forsyth: "Heredity versus Environment—a False Issue".*

Royal Statistical Society, at 5.15—(at the Royal Society of Arts).—Major P. Granville Edge: "The Demography of British Colonial Possessions".

Engineers' Study Group on Economics, at 8—(at 23, Grosvenor Place, London, S.W.1).—Major L. Urwick: "The Contribution of Scientific Management to the Solution of Present Economic Difficulties".

Wednesday, January 20

Bedford College for Women, at 5.15.—Prof. R. G. Stapledon: "The Utilization of the Hill Lands of Great Britain to the Best National Advantage" (succeeding lectures on January 21 and 22).*

Royal Microscopical Society, at 5.30.—Annual Meeting.

Dr. R. S. Clay: "The Mechanical Development of the Microscope".

Institution of Chemical Engineers, at 6—(at the Chemical Society, Burlington House, Piccadilly, London, W.1).—Symposium on "Superphosphate—its History and Manufacture".*

Royal Entomological Society of London, at 8.—Annual Meeting.

Dr. A. D. Imms, F.R.S.: "Some Reflections on Recent Developments in Entomology" (Presidential Address).

Royal Society of Arts, at 8.—J. de la Valette: "The Study of Colonial Culture in Holland and France".

Institute of Chemistry (London Section), at 7.30.—Dr. C. Ainsworth Mitchell: "Some Recent Advances in the Scientific Examination of Documents".

Friday, January 22

Royal Institution, at 9.—Gerald Seligman: "The Nature of Snow".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Junior Investigator for Corrosion Research in the British Non-Ferrous Metals Research Association—The Secretary, B.N.F.M.R.A., Regnart Buildings, Euston Street, N.W.1 (January 20).

Civilian Education Officer (Grade III, physics or engineering) in the Royal Air Force Educational Service—The Secretary, Air Ministry (E.S.1), Adastral House, Kingsway, London, W.C.2 (January 20).

Two Senior Scientific Officers in the Explosives Directorate, Research Department, Woolwich, S.E.18—The Chief Superintendent (January 23).

Technical Officers (electrical engineering) in a War Department establishment at Woolwich—The Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, N.W.1, (January 29).

Assistant Director of Horticultural Education to the Norfolk County Council—The Director of Agricultural Education, Agricultural Station Offices, Sprowston, Norwich (January 30).

Assistant Botanist in the Plant Breeding Institute, School Agriculture, Cambridge (January 30).

Director of the All-India Institute of Hygiene and Publi Health, Calcutta—The High Commissioner for India, General Depar ment, India House, Aldwych, London, W.C.2 (January 30).

Director of Pottery Research in the proposed Pottery Researc Association at Stoke-on-Trent—Sidney H. Dodd, Piccadilly, Tunstal Stoke-on-Trent (February 1).

Instructor Lieutenants (mathematics, physics, chemistry engineering) in the Royal Navy—The Director, Education Department, Admiralty, 5 Millbank, London, S.W.1 (February 8).

Assistant Meteorologists (Grades II and III in the Meteorological Office—The Secretary (S.2.E.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (March 1).

Nuffield Professor of Clinical Medicine in the University of Oxford—The Registrar (April 17).

Assistant Surveyor of Lands in the Civil Engineer-in-Chief's Department, Admiralty, London, S.W.1 (mark envelope "A.S.L.").

Lecturer in Domestic Science in the Huguenot University College, Wellington, South Africa—The Office of the High Commissioner for South Africa, South Africa House, Trafalgar Square, London, W.C.2.

Official Publications Received

Great Britain and Ireland

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge during the Academical Year 1935–1936. Pp. 123. (Cambridge: Printed at the University Press.) [2412

Air Ministry: Meteorological Office, London. Southport Auxiliary Observatory (The Fernley Observatory of the Corporation of Southport). Annual Report, and Results of Meteorological Observations, for the Year 1935. By Joseph Baxendell. Pp. 32. (Southport: Fernley Observatory; London: Meteorological Office.) [2912

The Royal Botanic Gardens, Kew. Illustrated Guide, 1936. Pp. 64. (London: H.M. Stationery Office.) 1*s*. net. [41

Ministry of Agriculture and Fisheries: Fisheries—England and Wales. Salmon and Freshwater Fisheries: Report for the Year 1935. Pp. 41+2 plates. (London: H.M. Stationery Office.) 9*d*. net. [41

Other Countries

New Zealand: Department of Lands and Survey. Discharged Soldiers Settlement: Report for the Year ended 31st March 1936. Pp. 12. (Wellington: Government Printer.) 6*d*. [2912

The Institute for Science of Labour, Kurasiki, Japan. Annual Report of the Institute for Science of Labour for 1935. Pp. ii+35. (Tokyo: Institute for Science of Labour.) 70 sen. [2912

Government of Madras. Livestock of Southern India. By Capt. R. N. Littlewood. Pp. x+239. (Madras: Government Press.) 4.2 rupees. [2912

The National Geological Survey of China. Palaeontologia Sinica. Series D, Vol. 7, Fasc. 3: The Mandibles of *Sinanthropus pekinensis*; a Comparative Study. By Franz Weidenreich. Pp. 162+15 plates. (Nanking and Peiping: National Geological Survey.) [2912

Osmania University, Hyderabad. Publications of the Nizamiah Observatory. Astrographic Catalogue, 1900·0, Hyderabad Section (Part 3), Dec. + 35° to + 40°, from Photographs taken and measured at the Nizamiah Observatory, Hyderabad, under the direction of T. P. Bhaskaran. Vol. 10: Measures of Rectangular Co-Ordinates and Diameters of 64,791 Star-Images on Plates with Centres in Dec. + 38°. Pp. xxv+236. (Begumpet: Nizamiah Observatory.) 15 rupees; 20*s*. net. [2912

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok 15, 1933. iv: Meteorologiska iakttagelser i Sverige, Band 75. Pp. x+107. 7.00 kr. vii: Meteorologiska iakttagelser i Riksgränsen. Pp. ii+48. 4.00 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [2912

Kungl. Sjokarteverket, Stockholm. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovo (Stockholm) im Jahre 1932. Pp. 103. (Stockholm: Kungl. Sjokarteverket). [41

Sudan Government. Annual Report of the Agricultural Research Service for the Year ended 31st December 1935 (being Part 2 of the Annual Report of the Department of Agriculture and Forests) relating to Experimental Results obtained in the Season 1934–35. Pp. v+xi+183+14 plates. (Wad Medani: Agricultural Research Service.) [41

India Meteorological Department. Scientific Notes, Vol. 7, No. 70: A Study of Correlation Coefficients of Mean Maximum Temperatures, between Successive Months, at a few Selected Stations in India. By Dr. R. J. Kalamkar. Pp. 15–20+3 plates. (Delhi: Manager of Publications.) 5 annas; 6*d*. [41

U.S. Department of Agriculture. Circular No. 412: Groups of Plants valuable for Wildlife Utilization and Erosion Control. By W. L. McAtee. Pp. 12+7 plates. (Washington, D.C.: Government Printing Office.) 5 cents. [41

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Electrical Supply in Great Britain

THE sixteenth report of the Electricity Commissioners which has just been issued[*] shows that the use of electrical energy in Great Britain is expanding very rapidly. Between April 1, 1935 and March 31, 1936, the consumption of electrical energy increased by 16 per cent as compared with the same period in 1934–35. Compared with the corresponding period in 1933–34, the increase is 47 per cent. A survey has been made from which it appears that at the end of 1934 the areas of supply of the 625 electrical undertakings contained more than 12 million premises, of which 53 per cent were connected to the public supply systems. Of the total number, 85 per cent were domestic premises, and 52 per cent of them were connected with supply systems. With regard to electricity charges, two-part tariffs for domestic supplies were being offered by 81 per cent of the supply companies. The fixed or service charge of the tariffs was based on a variety of principles, the most common being the rateable value of the premises (217) and, next to this, 161 undertakings based their charge on the size of the premises. Of the supply systems, 398 offered a two-part domestic service with a running charge of 1*d.* or less per unit, and in 105 of them the running charge was ½*d.* per unit or less. In addition, statistics are given of the undertakings which offer 'assisted wiring schemes' and of those which provide showrooms or make arrangements for 'house to house' canvassing.

While the survey reflects the great progress made in the development of the public supply of electricity since the end of 1934, it also discloses the great potentialities still before the supply industry. There are still nearly six million unconnected premises, of which 87 per cent are domestic, and there are also great possibilities of a much-extended consumption for existing and additional purposes in the premises already connected. The existence of the Grid makes it possible to supply on much more uniform terms and in particular to offer a two-part domestic tariff with a low unit charge.

A recent event of particular interest to the electricity supply industry was the appointment by the Government, in July 1935, of a committee to consider and report upon the organization for the distribution of electricity in Great Britain. Its report was published in June last[*] ; the committee is usually referred to as the McGowan Committee.

Another report, published quite independently by Political and Economic Planning[†] (P E P), is of interest and value. The individuals who form the group P E P prefer to remain anonymous. They are a non-party group, who are by vocation industrialists, officers of central and local government boards, university professors, etc. The group has already issued nearly ninety broadsheets, to many of which reference has been made in our columns, as well as long reports on coal-mining, the cotton and iron and steel industries. The present report extends to 70,000 words and contains 40 tables of statistics. The instructions to the group of experts who wrote it were that they should present the facts about the electric supply industry of Great Britain, including the Grid, and prepare constructive proposals for making electricity more widely and cheaply available. The report does not conflict seriously with that of the McGowan committee.

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[*] Electricity (Supply) Acts, 1882 to 1936. Sixteenth Annual Report of the Electricity Commissioners, 1st April 1935 to 31st March 1936. Pp. 195. (London : H.M. Stationery Office, 1936.) 3*s.* net.

[*] Ministry of Transport. Report of the Committee on Electricity Distribution. (London . H.M. Stationery Office, 1936.) 2*s.* net.

[†] P E P (Political and Economic Planning). Report on the Supply of Electricity in Great Britain . a Survey of Present-day Problems of the Industry with Proposals for Reorganisation of Electricity Distribution. Pp. vi+171. (London : P E P, 16 Queen Anne's Gate, S.W.1 (1936).) 6*s.* net.

From the consumer's point of view, there must be in the first place a supply readily available at cheap rates. There must be the necessary service and credit facilities, so that the cost of wiring, of appliances and of maintenance is not a heavy burden on the consumer. There must also be a method of charging which is reasonably simple to understand and which, so far as possible, follows the same lines all over the country. Finally, a standard voltage and frequency must enable appliances to be interchangeable, so that the consumer is not stranded with useless apparatus and the manufacturer loaded with inflated costs owing to having to supply an unnecessarily wide range of appliances for different voltages or frequencies or both.

Looking back over the last fifty years, it is seen that as the result of falling costs, cheap electricity plays a part in the life of a nation entirely different from that played by expensive electricity. The difference is one of kind and not one of degree. "As yet the limits of future development are not only not in sight but are beyond conjecture."

The Electricity Commission's major function is that of granting powers under statute to supply electricity. Local authorities must obtain the consent of the Commissioners, if they want to borrow money for electricity purposes, such as building new generating stations or extending existing ones. This led to the formation under the Act of 1926 of the Central Electricity Board, which performs for the whole country the coordination of generation and high-tension transmission which had been intended by the Act of 1919 to be done on a regional basis. The Board has no financial control over authorized undertakings, but it can force owners to form part of the national supply scheme. In the event of refusal, the station can be compulsorily acquired. Generation and distribution have been dealt with in this way. Schemes for more 'regions' have been carried into effect, and trading has begun in most of them. Electricity supply is available in bulk at tariffs of uniform type in all these regions, but the activities of the Board do not extend beyond the ends of the transmission lines.

The PEP report points out that on the distributive side the prospect is less reassuring. The areas served by the hundreds of undertakings selling electricity to the public range from less than one square mile to 5,000 square miles, with widely different densities of population. Areas also vary widely in their wealth, their rates and many other factors. These numerous authorities record a considerable range of prices and methods of charging. There are several undertakings with a badly designed and inefficient system of supply (in one or two cases the units sold are only about 50 per cent of the units generated or purchased !). Credit facilities for the hire and hire-purchase of wiring and appliances seem abundant, and no efficient company should have any difficulty in finding the money to provide consumers with such facilities.

One of the fundamental problems for the supply industry is the price to charge the consumer. Should the best policy be to make each class of consumer equally profitable, in proportion to his consumption, to the undertaking, or should (as the railwaymen say) "the fat traffic pay for the lean" ? Should rural consumers be helped by urban consumers ? The PEP report offers no solution to this problem.

The all-in 1*d*. a unit with a slot-meter used in certain working-class housing schemes is mentioned. It is successful in the East End of London, but future development of such a simple tariff demands close study. The report says that many supply undertakers are backward in their attitude to fundamental marketing studies ; economic investigation would help them to provide a sound basis for long-period planning. Rural area supply is handicapped by the absence of trained specialist salesmen. Melton Mowbray is quoted as an example of excessive rating. In this town, local rates exceed in amount the whole cost of the electricity purchased from the Central Board together with the cost of the coal required for local generation.

The final chapter in the PEP report deals with the re-organization of electricity distribution, and is of real value. The recommendations are brief and overlap largely those of the McGowan Committee. Five proposals for legislation are suggested. First, that the Government should in consultation with the Electricity Commissioners appoint a committee of investigation. Six problems are stated in the terms of reference, agreed solutions of which would be a great help. Secondly, that an electrical development authority should be appointed with a constitution similar to that of the Central Electricity Board. The main functions of this body would be development and research, transfer and administration of purchase rights, publicity, statistics and design. This authority should have the power to finance practical experiments in the application of electricity to agricultural, industrial and commercial uses. It is also suggested that it should have the power to set up a central institution for the testing of consumers' appliances and equipment. Thirdly, the powers of the Electricity Commission should be increased. Fourthly, existing legislation on electric lighting should be co-ordinated and simplified; and lastly, certain anomalies and restrictions should be removed.

To a large extent, as we have said above, the conclusions and proposals of the P E P report coincide with those of the McGowan Committee. Both reject nationalization—at least at the present stage of evolution of the electrical supply industry. Both bodies prefer to proceed by the method of overhaul and consolidation and more efficient grouping of existing undertakings on a regional basis. The P E P proposal to set up an investigating committee is similar to the proposal of the McGowan Committee to set up district commissioners. The latter committee accepts as a guiding principle that larger undertakings are the remedy for present distribution difficulties, and contemplates schemes of amalgamation. The former committee sees some disadvantages in this. The P E P committee concludes by saying that "The public expects that the supply industry should hasten towards a future in which the maximum amenities will be available for the residential consumer, farmer and industrialist through the fullest freedom to use electricity".

Civilizing Science

(1) A Hundred Years of Medicine
By Wyndham E. B. Lloyd. (The Hundred Years Series.) Pp. 344. (London: Gerald Duckworth and Co., Ltd., 1936.) 15*s*. net.

(2) The Next Hundred Years:
the Unfinished Business of Science. By Prof. C. C. Furnas. Pp. xx + 366. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1936.) 8*s*. 6*d*. net.

(3) A Short History of the Future
By John Langdon-Davies. Pp. xxi + 272. (London: George Routledge and Sons, Ltd., 1936.) 10*s*. 6*d*. net.

THESE three books have two things in common. All of them attempt to link the present with the immediate past or the immediate future, by way either of historical summary or extrapolative prediction. All of them, almost inevitably, are largely devoted to considering scientific or technological development; to call this development progress would be to beg the question raised continually by two of them.

(1) Prof. Lloyd's book is the most specialized and the staidest of the three. How much so may, perhaps, be illustrated by quoting the second sentence of his final chapter, "Epilogue". He writes: "Any attempt to predict the purely medical developments of the future would be extremely rash". But the author's caution does allow him to go so far as to say "that we are not using to the full even the knowledge that we have". His short expansion of this statement, though guarded to the point of indiscretion and including an unpleasant and snobbish reference to "the masses", again links his book thematically with the other two. In any event, it may be fairly said that books like this contribute much of the raw material out of which books like those of Prof. Furnas and Mr. Langdon-Davies are built.

The introductory part of the book makes a rapid survey from "The Origins of Medicine" through the eighteenth century to the nineteenth. Chapters are included on surgery, the hospitals, the sanitary condition and health of the people, some common infectious diseases, the organization of the medical profession and "The Sources of Modern Scientific Medicine". In Part 2 the author gets down to his central subject matter, and ranges over the whole of medical development in "the last hundred years". The new pathology, based on the cell theory; newer methods of diagnosis; anæsthetics; nutritional studies; the 'germ theory', antisepsis and vaccine therapy; hormones, vitamins and radiological methods; such is the wide field surveyed in some 140 pages. In Part 3 the author writes of "Health Organization", both hospital systems and State medicine being examined, and so to the "Epilogue", to which reference has already been made.

The accuracy of Prof. Lloyd's statements of fact could only be judged adequately by a board —and obviously a very large board—of specialists ; the simple reviewer must analyse by sample. For example, it is entirely incorrect to imply that synthetic adrenalin still consists of an optically active mixture of isomers ; see the 1932 British Pharmacopœia. The account of liver treatment for pernicious anæmia, on the other hand, though brief, is unexceptionable, as is most of what he has to write about the vitamins. But in a book published in 1936, there seems little justification for closing the vitamin C story with Szent-Györgyi's brilliant isolation of ascorbic acid, and making no reference to the equally sensational simultaneous syntheses by Haworth and Rechstein in 1933. However, for the student of medicine, in the widest sense, as well as for the medical student, this book, in spite of the absence of any strikingly original concepts and in spite of the slight austerity of the author's approach and style, should prove thoroughly informative and useful, and it makes an excellent addition to Duckworth's "The Hundred Years Series", of which it is the fourth in five.

(2) Prof. Furnas's exasperating, stimulating, indignant, encyclopædic, wrong-headed, fervid, naive volume is altogether another pair of sleeves. Paradoxical in the extreme is the effect made by his attempt to show what tremendous distances science has to travel, for he could only do this by making abundantly clear how astonishingly long is the road already travelled, and at how breakneck a speed. The author works steadily through the sciences, or the main groups of sciences—biology, chemistry, physics and engineering—and concludes with three chapters on "Social Consequences" and a rather piquant "reading list" that ranges from Paul de Kruif to the U.S. Census, from the *Journal of Biological Chemistry* to *Time*, and from Wells, Huxley and Wells to Andrade.

The method of sampling applied to this book does not inspire over-confidence in the author's meticulous accuracy, as witness the statements about thyroxine that "Kendall and many helpers worked upon its exact molecular structure. An Englishman, Harrington, was also extremely active. These two . . . finally came to agreement". Truly, some of the worst examples of insularity come from people who live on the largest continents ! The trans-Atlantic origin of this book—Prof. Furnas occupies a chair of chemical engineering at Yale—is shown not only by the innumerable American examples used to illustrate the arguments, but also by the characteristic tang of the writing (possibly originating in part from the author's *Time* studies) and his inability to resist the epigrammatic 'wise crack', at whatever stretching of scientific accuracy. His advocacy of Epsom salts for preventing milk-fever in cows is scarcely in accord with the most scientific veterinary practice, and his declaration that vitamin C is "practically non-existent in animal tissues" is unnecessarily contemptuous of the adrenal cortex and many other tissues ; nor ought he to be puzzled about the source of vitamin D for tropical peoples who live mainly on vegetable food. On the other hand, his attack on the stream-lining of low-powered automobiles appeals to the commonsense of the user, if not to the pockets of the maker, but it is rather a schoolboyish jest to say of the second law of thermodynamics that "There is no danger of that law being repealed".

In spite of Prof. Furnas's attention to social phenomena, and his obvious concern with their bearing on scientific progress, he shows a curious blindness to the *reciprocal* effects of the two sets of forces—man's action on his environment conditioning the environmental forces that in turn act on man. While admitting up to a point this reciprocity in the world of machinery, he does not seem to have realized its far wider social implications, nor to conceive it possible that the complete change in social organization, which he somewhat reluctantly admits to be ethically and scientifically necessary, may be unexpectedly accelerated by changes in man himself, brought about largely by those very technological advances Prof. Furnas considers at present so incomplete as to be merely embryonic.

(3) Mr. Langdon-Davies, by profession an anthropologist, makes no such mistake ; he errs on the other side It is not in the least that he is unaware of actual or potential progress in applied science. For some years now he has been one of our leading popularizers of science ; his own training has given him the necessarily objective and experimental outlook, while his education in the humanities has given him a directness, accuracy and flexibility of style that should be the envy of all purely scientific writers and most other popularizers. As an example of irony in the tradition of Swift and Samuel Butler, the reader should study Mr. Langdon-Davies's examination of the Government's proposals for safeguarding the civilian population from gas attacks.

In his book, Mr. Langdon-Davies presents us with a plethora of alternatives. Peace or war ; Fascism or Communism ; free-will or determinism ; monogamy or polymorphism. He appears to see human evolution as a struggle between man's instrument of reason and the "social habit". His personification of this habit strikes me, at any rate, as curiously anthropomorphic. Mr. Langdon-Davies, I submit, has taken far too little into account the effect on that social habit both of man's reason directly and, much more important, of the environment created by man's reason.

However that may be, and whatever relative emphasis we place on the forces so differently emphasized by Prof. Furnas and Mr. Langdon-Davies, both books are thoroughly well worth reading. "The Next Hundred Years" is chiefly commendable for its survey of the vast field of man's technical adventures already achieved, and only incidentally for its author's views about present or future. "A Short History of the Future" also fails to convince in its prophetic vein, but is of great value in its ruthless analysis of the world to-day around us, a world that is in grave danger of passing out of the control of forces that alone could ensure peace and prosperity for the whole of mankind. As controlling influences, democracy and science have hitherto played unequal and unco-ordinated parts, but only those two forces, and only those two forces acting together in every department of man's social activity, can avoid the catastrophe the coming of which Prof. Furnas dimly and shrinkingly senses. Mr. Langdon-Davies, on the other hand, fully realizes the danger and faces it with pointed irony and a quite brutal bluntness; scarcely anyone could read his book without being healthily shocked.

A. L. BACHARACH.

The Mind of a Medieval Cleric

Opicinus de Canistris:
Weltbild und Bekenntnisse eines Avignonesischen Klerikers des 14 Jahrhunderts. Von Richard Salomon. Mit Beiträgen von A. Heimann und R. Krautheimer. (Studies of the Warburg Institute, edited by Fritz Saxl, Vols. 1A, 1B.) Textband. Pp. viii+348. Tafelband. Pp. v+45 plates. (London: Cassell and Co., Ltd., 1936.) Paper, 50*s*. net; cloth, 57*s*. 6*d*. net.

A CURSORY glance at the volume of plates, reproducing for the first time a Vatican MS. of the early fourteenth century (*Cod. Pal. Lat.* 1993), might lead one to dismiss it as a mere curiosity, so strange is the jumble of fact and fancy displayed by the drawings. But this would be a mistake, for, as is clearly shown in the learned commentary which accompanies it, the work throws many interesting side-lights on the life and ideas of the late Middle Ages.

The MS. was virtually unknown until a few years ago, when attention was directed to it by the distinguished Vatican Librarian, Cardinal Ehrle. Independently of each other, two scholars have since examined it in detail, and one of them, Dr. F. Gianani of Pavia, published his results in 1927. He concerned himself chiefly with another MS. of Opicinus—his panegyric upon Pavia, his early home—an anonymous work to the authorship of which the present MS. has first given the clue. It does him credit by its intimate knowledge of Pavia under all aspects, as well as by its judicious tone, in which it differs markedly from his other known writings. The present study is of wider interest, and Dr. Gianani's previous work in no way renders it superfluous.

Without the autobiography, the proper understanding of the Vatican MS. would have been still more difficult than it is. In his youth, the author's circumstances were far from easy and his education was somewhat fragmentary. After trying various occupations, he eventually became a cleric, but never advanced to any of the higher offices of the Church. Pavia was then distracted by the struggle between Guelfs and Ghibellines, and his advocacy of the Papal side forced him into exile, whereupon he betook himself to Avignon, and obtained a post as scrivener in the entourage of the Pope. There, in 1335, he began the present MS., and it could scarcely fail to be influenced by its *milieu*—a focus of the most varied currents of medieval life.

The parchment sheets offer a bewildering mixture of drawings and notes scattered over the whole surface, sometimes with no obvious connexion, and it needed the most persevering study to decipher and explain the whole. In this Herr Salomon has been singularly successful, and has wisely recorded the results in full detail, for few readers would have the knowledge or patience to unravel the puzzle for themselves. A recurring feature in the drawings is the map of the world, and the relative accuracy of its outlines shows at once that Opicinus deserves the credit of having followed the best models then available. It was just the time when the better knowledge previously confined chiefly to sailors was becoming more widely diffused, thanks largely to the cartographical work of Petrus Vesconti, one of whose maps may well have been known to the author. But whereas such maps did little for the interior of the lands, Opicinus shows a better knowledge in this respect than most of his contemporaries

Characteristic of the Portolan type of map is the close network of direction lines, in the careful drawing of which Opicinus seems to have taken a special pleasure. The strange thing is the way in which he used this correct knowledge as a starting point for wild flights of fancy, converting the outlines of land and sea into allegorical figures, and adding others to give a general picture of the religious side of life. The world-map seems to typify sin, as when it overlies the picture of Lazarus bound in grave-clothes, while the cure of sin is represented in another sheet by the healing streams typified by the system of the Po, *superimposed*, on a larger scale, on the general map. Quotations from Scripture abound, and here and there Old Testament curses are launched against the rival political party in Lombardy. Besides the maps, geometrical figures, especially circles, are freely used, and various sheets give attention to the calendar and astrological subjects, with the signs of the Zodiac and other associated symbols. In all this, Opicinus shows no decided break-away from current ideas, his originality consisting in the way in which he represents them graphically.

The drawings show no definite order and were composed at different dates. Much that is abnormal may be explained by a serious illness mentioned in the autobiography—of the nature, it would seem, of a paralytic stroke. The author is morbidly self-centred, obsessed with a consciousness of personal sin, though at times he goes to the other extreme and claims to be an inspired teacher. Students of mental pathology might find an interest in the work from their own point of view, while the drawings are not without value for the history of art and architecture, as is shown in two appendixes contributed by other hands.

The Warburg Institute deserves great credit for undertaking this publication. E. H.

The Study of Bird-Song

Songs of Wild Birds
By E. M. Nicholson and Ludwig Koch. (Bird-Lovers' Manuals.) Pp. xxxi+216+18 plates. (London: H. F. and G. Witherby, 1936.) With 2 gramophone records, 15*s*. net.

MR. NICHOLSON has given us a book which, although in the form of a popular manual, is much more than a presentation of established facts. It indeed makes a real contribution to a neglected subject, giving the results of original observation and usefully indicating lines of further research. It has additional novelty, through the enterprise of Messrs. Witherby, in being a 'sound-book'—illustrated by gramophone records as well as by pictures. To these remarkable records of birds singing in the wild state reference has already been made (NATURE, Oct. 10, p. 610): the text now before us includes a chapter by Mr. Koch telling how they were obtained, and an appendix giving a detailed key to their contents.

Biological interest centres on the part which song plays in the life of the bird, a matter which is still very little understood. From a functional point of view, Mr. Nicholson tentatively distinguishes four different levels. At the simplest of these, song seems to serve no very definite purpose beyond possibly expressing a feeling of well-being: at this level, song is very near the 'sub-song' which more accomplished species exhibit in addition to their louder and more definite music. At the next level a sexual factor is added, in that song is used as a stimulus in courtship. Still higher, there is also an element of advertisement, in announcing the presence of an adult male in breeding condition. In the extreme case there is a definite association with territory, and the song assumes the character of a challenge in addition to its other functions. In the British Isles at least, the species which utter typical loud song are all holders of individual territory, and the song is used by the male mainly in relation thereto.

The evolution of song presents a problem with several aspects. It is only the most highly developed birds, the passerines, that possess the anatomical apparatus necessary for producing the best type of song. On the other hand, among the species with this equipment, there is great inequality in the extent to which command over the voice has been achieved. Thirdly, Mr. Nicholson points out, even when both conditions are fulfilled, there must also be an adequate incentive among the conditions of life of the particular species, especially as regards its territorial and sexual behaviour. "A bird such as the starling has the equipment and the skill of a first-rate songster, but he is not one, presumably because song has not assumed an important enough function in his life to make him sing for all he is worth."

Apart from their function, songs are provisionally classified by Mr. Nicholson in four groups according to their structure. There are highly developed songs such as the music of the blackbird; finished song-patterns such as that of the chaffinch; and more primitive types, including rambling or indistinct utterances of low carrying power such as the twittering of the swallow. Finally, there are many breeding notes and song substitutes, such as the call of the cuckoo: and here also may perhaps be included some non-vocal sounds such as the 'bleating' of the snipe.

About half of the book is occupied by a useful account of the songs of different British species. Mr. Nicholson recognizes that musical notation is of little service in transcribing sounds which lie largely outside the range of the instruments of human art; and that attempts at phonetic representation in words or syllables have at most a mnemonic value. He therefore rightly aims at a more objective method of description, and in this he makes full use of exact timing of the length of the song, or of particular portions of it, and of the customary interval between each repetition. It is only in this way that accurate study can be made of such questions as local variations in the song of a species. Cases of regional 'dialects' are already known, and further study is desirable.

The book is full of welcome information and stimulating suggestion. With its accompanying records, it will surely be a source of both interest and pleasure to many. A. L. T.

Elementary Mineralogy

(1) Mineralogy:
an Introduction to the Study of Minerals and Crystals. By Prof. E. H. Kraus, Prof. W. F. Hunt and Prof. L. S. Ramsdell. Third edition. Pp. ix + 638. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 30s.

(2) Mineralogie
Von Prof Dr. R. Brauns. (Sammlung Göschen, Band 29.) Siebente, verbesserte Auflage. Pp. 146. (Berlin und Leipzig: Walter de Gruyter und Co., 1936.) 1.62 gold marks

(1) THE popularity of "Kraus and Hunt", first published in 1920, has led to the appearance of a third edition and the enrolment of a third author. Some sixty further illustrations have been added to an already lavishly illustrated book, and there is additional material on physical properties, the polarizing microscope, crystal structure and X-ray analysis, and the formation and occurrence of minerals.

The first 226 pages are devoted to crystallography and the physical and chemical properties of minerals; the next (and briefest) section contains descriptions of 150 of the commoner species, while the remainder of the book, printed on paper of a different tint, contains determinative tables based principally on the characters of lustre, hardness and streak. The illustrations, which form so attractive a feature, include photographs of wooden crystal models, well-known mineralogists and mineral specimens. The latter are notoriously difficult to produce successfully, and there are many here which are of doubtful value as an aid to identification. Interesting information on the commercial uses of minerals is given in a special chapter, and a brief chapter on gem-stones is designed to introduce the student to an attractive branch of mineralogy in which the senior author is a specialist. In another chapter, the fundamentals of X-ray crystal analysis are clearly explained and a valuable note on the structure of the silicates, as recently determined by X-ray methods, serves to clarify the complexity of this important class of minerals. Chemical (blowpipe) methods for identification are given in unusual detail.

There are some unexpected omissions. Goniometric methods are not even mentioned (the word 'goniometer' is not to be found in the index), and, while values for $2V$ are usually given for each species, interfacial angles are not so given. The hydrostatic and heavy-liquid methods for determining specific gravity are not described, as the authors consider that "these methods are very accurate but time consuming. They are generally employed in mineralogical research and but rarely by students of elementary mineralogy". It is strange that the use of heavy liquids, by which more rapidly than in any other way the density of a small fragment of mineral can be determined, should be dismissed as "time consuming", when a description of the far more time consuming pycnometer method has been included.

In the descriptive portion, the specific gravities accorded to each species represent the extreme range, with no indication of the normal value for reasonably pure specimens of the mineral in question. Refractive indices, however, are usually given to three places of decimals as though constant for the species, no variation being indicated.

The book is chiefly to be recommended for its clear and attractive presentation of the subject: only in the literal sense of the term (it weighs three pounds) can it be said to make heavy reading.

(2) Into this miniature text-book, which would not seriously embarrass a jacket pocket, Dr. Brauns compresses a description of some 120 minerals, preceded by introductory pages dealing with crystallography and such easily determined properties as streak, hardness and specific gravity. The optical properties of minerals, except dichroism, are not mentioned. B. W. A.

British Rainfall, 1935:

the Seventy-fifth Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1935 as recorded by over 5,500 Observers in Great Britain and Ireland. (Air Ministry: Meteorological Office. M.O. 395.) Pp. xvi+285. (London: H.M. Stationery Office, 1936.) 15*s*. net.

THIS detailed account of the rainfall of 1935, based on returns from more than 5,500 co-operating observers, is the seventy-fifth annual issue of the series begun in 1861 by G. J. Symons, founder of the British Rainfall Organization. Like its predecessors in the series, the present volume includes maps, tables and descriptive matter dealing with the distribution of the rainfall each month and for the whole year, studies of heavy falls on individual days of particular interest and data in regard to rainfall duration, evaporation and spells of dry or wet weather.

The statistics show that the year's rainfall was about normal in Ireland; in other regions there was an excess averaging thirteen per cent over England and Wales, eight per cent over Scotland and nine per cent over the British Isles as a whole. During October, 22·92 inches fell at Inverary Castle, Argyllshire, and on February 15 a fall of 6·16 inches was measured at New Dungeon Ghyll Hotel, Westmorland. On the other hand, both March and July gave exceptionally low totals in certain areas.

The issue contains two special articles; one of these gives details of the remarkable hail-storm which occurred in the early morning hours of September 22 over Northamptonshire, probably the most destructive hail-storm that has occurred for many years in the British Isles. The other article, by the Superintendent, deals with the frequency of occurrence of heavy falls in short periods. An analysis of ten years autographic records leads to a new empirical formula connecting the rainfall amount, the time of fall and the frequency. On the basis of this formula, the curves used for defining "noteworthy", "remarkable" and "very rare" falls have been drastically revised. It is also suggested that data computed from the formula should form the basis of sewer and drainage works design.

Tools of To-morrow

By J. N Leonard. Pp. vii+303. (London: George Routledge and Sons, Ltd., 1935.) Cheap edition, 5*s*. net.

IT is a truism that military leadership has seldom foreseen the conditions under which the next war would be fought, and has tended rather to plan its strategy and tactics in accordance with the experience of previous decades. The rate of impact of science on society is now increasing, or rather the period of industrial gestation is decreasing so rapidly that over whole spheres of our industrial and social life a like condition tends to prevail. Mr. Leonard could well have anticipated for this book the title of Sir Josiah Stamp's presidential address at Blackpool to the British Association. He is concerned with the impact of science upon society and with the means of adaptation and change which science has put into our hands. The book, which is admirably written, can be commended to all who seek to form an intelligent opinion on social and technical change and the numerous grave problems arising out of them. While avoiding the sensationalism of many journalistic efforts in this field, it is lucid and always stimulating and well deserves a wide circle of readers. It is unfortunate, however, that Mr. Leonard should give fresh circulation to the mistaken belief that war stimulates development, more particularly as in one of the examples cited by him, namely, aviation, war needs have been the main factor responsible for warping its whole development.

Electrical Laboratory Experiments—Theory and Practice:

being an Abridgement of "Experimental Electrical Engineering". By Prof. Vladimir Karapetoff. Arranged and Revised by Prof. Boyd C. Dennison. Pp. xii+487. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 20*s*. net.

KARAPETOFF's text on experimental electrical engineering had become so comprehensive that it became desirable for the production of the present abridgement for undergraduate purposes, but even so the number of experiments described—and these cover the 'heavy' or machine side only—are so varied and numerous that a normal undergraduate could expect to cover a fraction only. After all, it cannot be necessary that a student be taken through all the experiences possible; apart from training his hands, the purpose of laboratory work should be to give him faith in the theory that he obtains from books and lectures, supplemented by exercises, and he should be taught to depend on what he learns. Nevertheless, the present text would be invaluable in designing or improving laboratory courses. L. E. C. H.

Magic Squares of $(2n + 1)^2$ Cells

Avec sommaire: Les carrés magiques impairs. By M.-J. van Driel. Pp. 90. (London: Rider and Co., 1936.) 10*s*. 6*d*. net.

THE author of this volume has evidently devoted much research to the interesting study of magic squares, and though many results of his work were published in Amsterdam in 1931, it is pointed out that this book is not a mere translation of that work. New methods of composing magic squares of order 5 are given and, by a development of the uniform step method, constructions for squares of an order greater than 5 are deduced. Original practical rules are then enunciated for simple and pandiagonal squares of order $2n + 1$. Symmetrical and bordered squares are also considered.

The text is not easy to follow, although it contains much valuable information based upon sound mathematical principles and substantiated by many references to original work on the subject. The book concludes with a summary which is written in French.

The Flora of Krakatau

THE eruption of Krakatau, from May 20 to the end of August 1883, which killed the vegetation of the three islands of the Krakatau group and destroyed some two thirds of the island of Krakatau itself, was perhaps the most important volcanic outburst, from the point of view of the biologist, that has occurred in historic times. Its biological importance is, of course, due to the fact that Krakatau is now one of a group of four (formerly three) islands in the middle of the Sunda Strait, Krakatau itself being 40 km. distant from the nearest point of west Java, and the same distance from the nearest point, Varkenshoek, of south-eastern Sumatra. The nearest island to the group is the volcanic Sebesy Island, some 13 km. to the north, where the vegetation was not wholly destroyed. If, as has generally been accepted, the whole of the vegetation of the Krakatau islands was destroyed, then the study of the gradual recolonization recently published by Dr. W. M. Docters van Leeuwen is of unique interest and importance. Krakatau's historic eruption, however, is only one of a series each of which, could it have been studied, would have afforded invaluable information as to methods of plant distribution. From the geological evidence, there was originally a single volcanic island in the Straits about 2,000 m. high. This was destroyed, and the three main remaining portions are represented by Krakatau, Verlaten and Lang Islands, surrounding a deep circular sea basin. This eruption was followed by another violent one, and later, by the fusion of the two volcanoes Perbuatan and Danan, the historic island of Rakata or Krakatau, 9 km. long and 5 km. broad, was formed, two thirds of which were erupted and dispersed in 1883. Recently Anak Krakatau has been erupted.

Prof. Treub of Buitenzorg, it will be remembered, was the first botanist to visit Krakatau after the eruption in 1883. The earliest visitors to the island were Verbeek, two months, and Cotteau, the Frenchman, nine months after the eruption. Neither record the presence of any living plants, and Cotteau expressly states that he could not discern any vegetation on the island. It was the classic visit of Treub, nearly three years after the eruption, which focused attention on the problem of its recolonization, when he pointed out that the first colonizers of the volcanic ash and cinders were the blue-green Algæ, which formed a hygroscopic layer in which fern spores could germinate, and that under the conditions obtaining in a volcanic island such as Krakatau, ferns would necessarily precede the phanerogams. Of the plants recorded by Treub in 1886, eleven were ferns, eleven dicotyledons and four monocotyledons. He also found a few mosses; the fifteen flowering plants were mainly those which are usually found on sea-beaches.

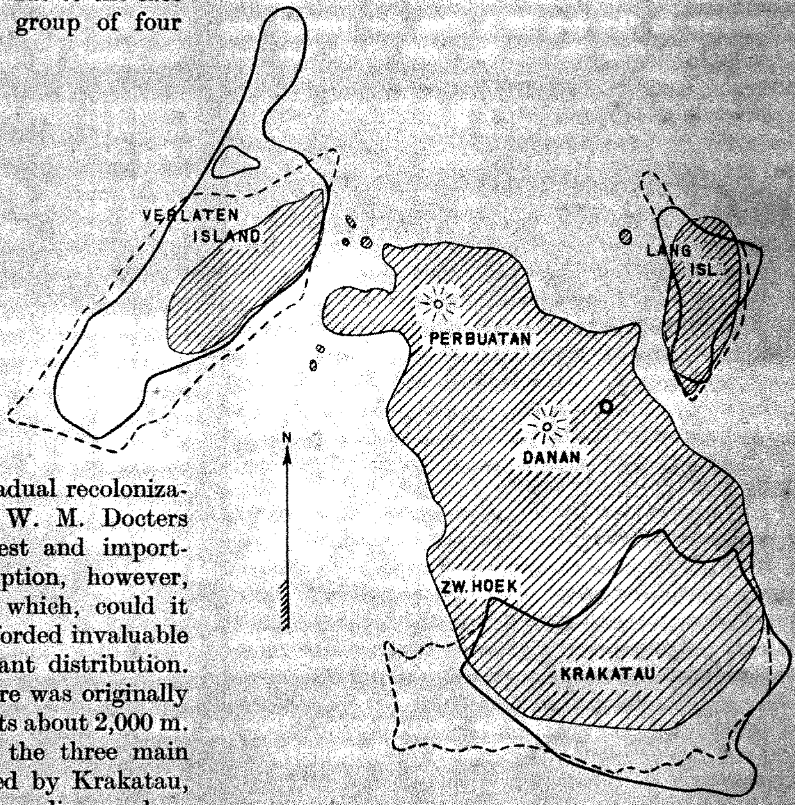

Fig. 1.
CHANGES IN FORMATION OF THE KRAKATAU GROUP.

Were these twenty-six plants found by Treub immigrants from land across the Straits, or were some of them survivors from buried seeds or from trunks or rhizomes, not wholly killed, which were exposed by the tropical rains washing away the overlying mass of ash and pumice thrown up by the eruption?

Thanks to the exhaustive labours of Dr. Docters van Leeuwen, we are now in a position to give a definite answer to this all-important question. In his masterly treatise on the island now before us, he has marshalled all the facts and discussed fully the evidence which has been produced for and against the total destruction of the vegetation of Krakatau by the eruption of 1883 with judicial fairness*.

The circumstances, unfortunately, do not permit of an *absolute* 'yes' or 'no', since three years elapsed before the fairly full investigation of the island by Treub was made, and even then owing to the extreme difficulties in getting up the deep fissures and among the waste of volcanic ejecta, it was possible to examine only a relatively small portion of the island. Verbeek's statement, however (see p. 18), with reference to his visit to Krakatau in October 1883, that the ground was then so hot that the coolies with their bare feet could not stand still and that steam was issuing from the bottom of the gaps cut out by the rain, makes it seem highly probable that all plant life, even that of seeds buried under the hot ashes and pumice, must have been destroyed. Verbeek concludes his letter to Docters van Leeuwen with praiseworthy caution: "I believe," he writes, "that this question can never be settled with absolute certainty, though I, myself, am inclined to assume that everything was dead".

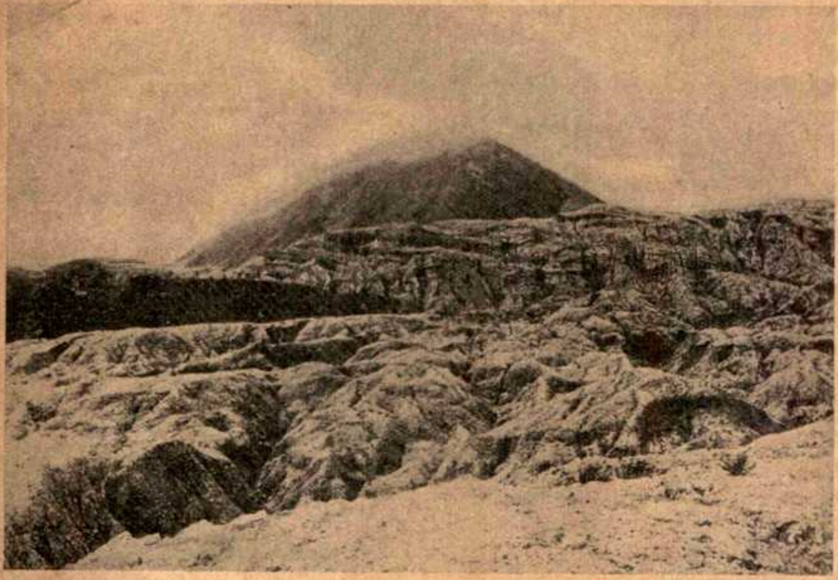

Fig. 2.
WEST SIDE OF ZWARTE HOEK, JUNE 20, 1886.
Photo by H. Busenbender.

Before the eruption, the islands were covered with dense tropical vegetation up to the top of Mount Rakata on Krakatau, and after the eruption there was nothing living to be seen, owing to the thick covering of ashes and pumice and the destructive effect of the hot gases, steam, etc. From the charred wood exposed by the washing away of the thick ash deposits, it seems clear that nothing in the way of stems or rhizomes could have survived. Buried seeds might have escaped destruction, had they been quickly exposed again by landslides or erosion, but the evidence for survival is very slight.

After all, Treub found only fifteen species of flowering plants three years after the eruption, and even if a few of these had grown from seeds which survived the eruption, their number is negligible compared with the 219 species which were recorded in 1934, all of which must have been brought to the islands by ocean currents, winds, birds or man.

Until the year 1908, no one appears to have questioned Treub's presumption of the complete sterilization of Krakatau. Penzig, who visited the island in 1897, Ernst in 1906 and Backer (on his first visit) in 1908, were all equally convinced.

The late Dr. J. P. Lotsy, writing in 1908, appears to have been the first to question the total destruction of the vegetation, on account of the finding of a large plant of *Cycas Rumphii* by Valeton in 1905, twenty-two years after the eruption! Based on the analogy of the growth of cycads in general, the objection might be a weighty one, but Dr. Docters van Leeuwen, on p. 346 in his detailed account of this plant, records how rapid is the growth of this species when young, and has shown by his own experiments that a plant of this *Cycas* can grow from seed to a height of more than 1 metre in the space of five years.

Other dissentient views are fully discussed and as fully rejected; it was not until the year 1929 that any serious challenge to the generally accepted opinion was brought forward. We have therefore to thank Mr. Backer (whose work was reviewed in NATURE, 125, 627; 1930), since it is not only owing to his expressed disbelief in the sterilization of Krakatau, but also on account of the aspersions he has cast on the work of Treub and the veracity and competence of previous investigators, including particularly Dr. Docters van Leeuwen, that we owe this volume, which will be the classic work of reference on the subject for all time and a vindication of Treub's fine pioneer investigations.

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* Krakatau, 1883–1933. By W. M. Docters van Leeuwen. A: Botany. (Annales du Jardin Botanique de Buitenzorg, Vol. 46–47.) Pp. xii+506+37 plates. (Leiden: E. J. Brill, 1936.) By the courtesy of the publishers, several of the illustrations are here reproduced.

It is unnecessary here to go over again the various points raised by Backer, but it is good reading to follow Dr. Docters van Leeuwen's judicious handling of Backer's assumptions, some of which would have been quite reasonable had they had a shadow of evidence for their support.

Dr. Docters van Leeuwen has devoted a chapter (iv) of thirty pages to a review of the recolonization of other territories all over the world, and it seems clear that had any seeds remained viable after the eruption, such as those of *Ficus fistulosa*, *F. hispida*, *F. toxicaria*, *Macaranga Tanarius*, or even of *Cycas Rumphii*—the two *Ficus* first recorded in 1897, the rest in 1905—the seedlings would have been so tall in 1886 (several metres in the case of the first four, judging by observations made on their growth in Sumatra) that Treub could not have failed to have noticed them!

I fully agree therefore with Dr. Docters van Leeuwen, after carefully reading his able review of all the evidence, that not a single valid argument has been given that any part of the original vegetation of Krakatau was saved, and that the present plant covering of the islands must consist wholly of immigrants.

The author devotes eight extensive chapters to the visits of the various botanists to the islands between 1884 and 1932, one being concerned with the stay of J. Händl on Krakatau, from 1916 until 1921, and the fate of any plants he and his workpeople may have introduced. He then gives a complete list of the flora of the island and records the different dates when the various species—now numbering 271—were first observed. These are all dealt with in detail in the final chapters, which occupy 175 pages replete with valuable information. Chapter xvi deals with the means of transport by which the plants must have reached Krakatau—wind, sea, animals and man. Only the conclusions can be given here, but the discussion should be read in detail. Dr. Docters van Leeuwen feels justified in assuming that about 41 per cent of the plants now found in Krakatau (not counting the lower cryptogams), were transported by wind, 28 per cent were introduced by ocean currents, 25 per cent by animals, while not more than ten or fifteen plants, if as many, which may have been introduced by man, have survived.

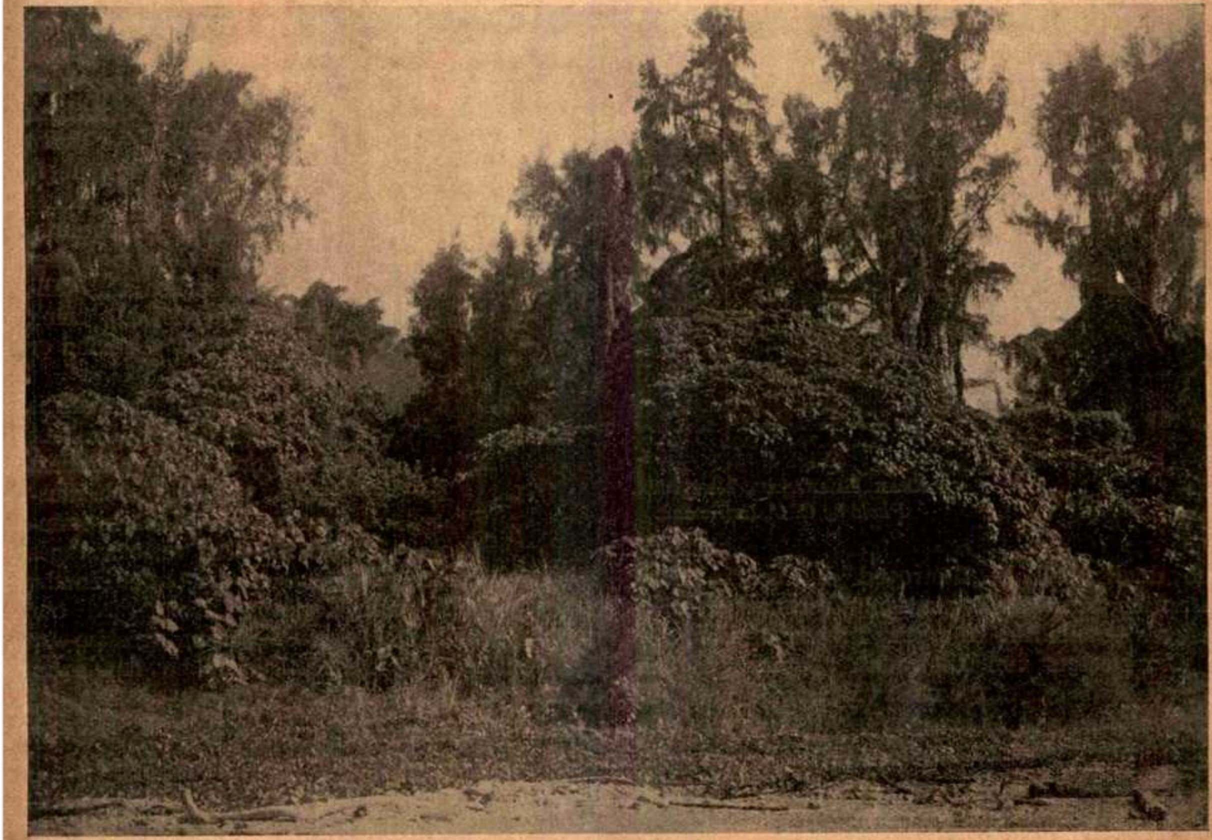

Fig. 3.
KRAKATAU, SOUTH-EAST SIDE, MAY 1928.

An interesting chapter (xviii) is devoted to the recently erupted island of Anak Krakatau, which first emerged above sea-level on January 26, 1928, and a list of the seeds and plants found on this 'baby' island by the author includes many coconuts, forty-one of which had germinated. These no doubt will be destroyed during the next eruption, but the colonization of this new creation affords possibilities of a very interesting study.

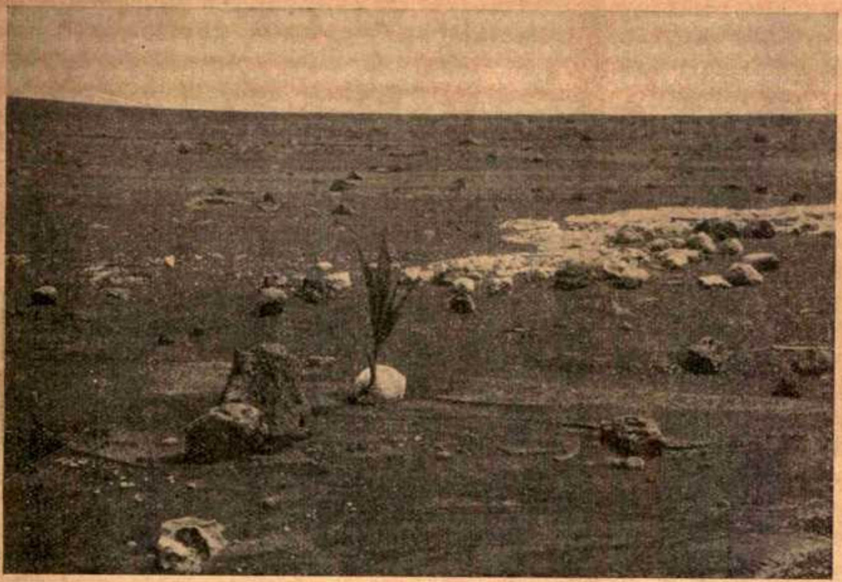

Fig. 4.
ANAK KRAKATAU, MAY 1932.
Photo by C. C. Reijnvaan.

Dr. Docters van Leeuwen's chapter (xxi) on *Zoocecidia* is one of the most valuable in the book, not only because he is a leading authority on the group, but also because these short-lived gall-producing insects and mites must have been destroyed by the eruption, so that all those now present on the island can only be immigrants.

No galls were found on the plants collected by Treub, though this does not prove that none had then arrived, but it is of interest that very few galls are known on the plants found by Treub on Krakatau in 1886. Dr. Docters van Leeuwen has collected no less than sixty galls on forty-four different plants on the islands. Since, then, it is inconceivable that these delicate insects can have survived the eruption, it is clear that the plants were the first immigrants, and when they had become established the gall-producers followed, being transported by the wind or ocean currents.

The value of the work is completed by the excellent bibliography and full index, and by the admirable illustrations, sixty-one in number, showing various stages in the development of the vegetation on the islands.

Dr. Docters van Leeuwen has earned our grateful thanks for this convincing treatise—so well written in English—which he has most fittingly dedicated to the memory of Melchior Treub.

ARTHUR W. HILL.

Prevention of Smoke and Dust Emission from Chimneys

THE weight of coal consumed annually in Great Britain is approximately 165 million tons, and of this only a small proportion is burned without smoke or grit being discharged into the atmosphere. It is, however, not possible to make even an approximate estimate of the extent to which the use of coal is responsible for atmospheric pollution and its attendant evils, on account of the wide differences which occur in the nature and quantity of smoke or grit produced by the combustion of unit weight of fuel. Both depend upon the type of coal used, the purpose for which it is burned and the skill employed in burning it, all of which vary from case to case.

When coal is burned on a domestic grate—and some 35 million tons are used annually for household purposes—the smoke produced consists of partially cracked tarry vapours formed by the distillation of a portion of the volatile matter in the coal. The quantity depends, of course, upon the type of grate and the nature of the fuel used. To burn soft bituminous coal smokelessly in an open fireplace is extremely difficult, but endeavours are being made to devise a suitable grate. Should they not be successful, it will be necessary, if smoke is to be avoided, either to abandon the open fireplace altogether, or to increase still further the use of smokeless fuel, such as low temperature coke, and gas or electricity.

The same type of smoke as that produced from domestic fireplaces may also be emitted from small industrial furnaces. In this case, however, there is no real difficulty in avoiding incomplete combustion. Its cause is usually either incorrect operation or the fact that the furnaces are being forced beyond their capacity. Reservations must be made in favour of certain metallurgical and ceramic processes requiring a reducing atmosphere, but even in these, improvements in the design of the furnace, care in the selection of the fuel, and scientific operation can often mitigate the nuisance. Generally speaking, therefore, the excessive emission of tarry vapours or soot from an industrial furnace is inexcusable. Nevertheless, many industrial furnaces are sources of a form of atmospheric pollution far more difficult to prevent than that due to incomplete combustion, namely, the dust and grit carried through the furnace by the draught.

In order to obtain sufficiently high rates of heat liberation in the space available, the air supplied for combustion may pass through the fuel bed at such a velocity that it will carry with it small solid particles of ash and unburnt or partially burnt fuel, as distinct from smoke. These may be relatively large, up to say ⅛ in. in diameter, and as, for economic reasons, the fuel used may be small in size and contain a considerable percentage of ash, the weight of solid material carried over may be high. In the case of large boilers, such as those found in power stations, the combustion chambers are so designed that the weight of carbon discharged in the flue gases is relatively small, but a large proportion of the ash in the coal is inevitably carried through the boiler. As the fuel often contains 10 per cent or more of ash, the weight of dust and grits discharged daily from a boiler burning several tons of coal per hour is appreciable.

During the last few years, an increasing number of the furnaces used in boilers and for metallurgical purposes have been fired with powdered coal. With this fuel most of the ash particles are less than 10 microns in diameter, with the result that, unless some form of dust-arresting apparatus is employed, most of the ash in the fuel will find its way up the chimney. This, more than any other isolated fact, has probably been the origin of the present increased interest in the prevention of dust emission.

The most obvious way of reducing the amount of dust leaving a furnace is to reduce the amount of ash supplied to it, that is, to use cleaned coal. It is gradually becoming realized that dirty coal is not necessarily cheap coal, and the use of cleaned coal is rapidly increasing. Nevertheless, it is not possible to clean boiler coal so as to reduce its ash content below a certain figure, say between 3 and 5 per cent on the average, so this method can provide only a partial cure.

A second method is to retain the ash in the furnace, and this is done to some extent in stoker-fired furnaces in which a large proportion of the ash fuses on the grate and is removed in lumps as clinker. The same method has been tried in certain pulverized fuel furnaces known as 'slag tap' furnaces, in which conditions are so arranged that the ash particles are caused to fuse into a pool at the base of the furnace, from which molten slag is run off at intervals. The arrangement is, however, not popular in Great Britain.

The remaining method, and the most generally used, is to remove as much dust as possible from the flue gases during their passage from the boiler to the chimney. For this purpose various types of dust extraction plant have been evolved, but their use is not so general as might be desired, mainly on account of expense.

In a few industrial processes the dust discharged has a commercial value and pays for its collection, but in most plants, including boiler furnaces, the dust produced is worthless and the cost of its collection is a complete loss, entailing not only capital, power and maintenance charges, but also the cost of disposing of the material caught.

Commercial dust extraction plants may be divided into two main groups, namely, dry and wet. The dry types include (*a*) those making use of gravity alone, (*b*) those using centrifugal force and (*c*) the electrostatic type; in these the collected material is removed in the form of a dry powder. In the wet types the dust is brought into contact with water sprays or films and is removed from the plant as a 'slurry'.

The simplest form of dry dust collector is a large empty chamber in which the solid particles settle out of the flue gases under the action of gravity. For such a chamber to be effective, a particle must be able to fall through the height of the chamber in less time than it takes the gas to travel through it. Now the rate of fall is proportional to the square of the radius of the particle, and the volume of flue gas leaving a boiler of only moderate size is very large; hence, in practice, an efficient settling chamber of reasonable dimensions is possible only with small boilers emitting large grits. Against this, the simple settling chamber has the great advantages that it requires no special fans or machinery and that no additional power costs are involved.

Many methods of reducing the size of settling chambers have been employed with varying success. Of these the most effective is the use of baffles or other devices which assist dust separation by causing the flue gases to undergo sudden changes of velocity and direction. The application of such devices is, however, limited by the fact that they increase the small pressure drop in the flue gases which constitutes the main advantage of the settling chamber. If fan power becomes necessary, more efficient forms of collector are available.

When a pressure drop of the order of about 2 in. water gauge or more is permissible, it is possible to use a form of separator in which gravity is replaced by centrifugal force. The simplest device of this type is the well-known cyclone, in which the flue gases enter a short cylinder tangentially and leave through a central axial opening. The dust is thrown out by centrifugal force and is collected in an inverted cone below the cylinder, being finally withdrawn through a suitable valve at the base.

The common cyclone has been subject to many modifications with the object of increasing its efficiency and decreasing the capital and power costs involved in its use. In addition, a great variety of other centrifugal devices have been evolved, for some of which high efficiencies are claimed, even with pulverized fuel dust. All these apparatus have the advantage of comparative low cost and simplicity, but all are subject to certain inherent limitations: they are more effective with large than with small particles, and their efficiency depends upon the flue gases being constrained to flow at a high velocity in a circle of small radius. As a result of these limitations, centrifugal separators may in practice be regarded as eminently suitable for arresting the relatively large grits associated with hand and mechanical stoker firing, but distinctly less satisfactory for dealing with the very fine dust from powdered fuel furnaces.

During recent years, particularly as a result of the growing use of powdered fuel, increasing attention has been given to a form of dry dust extractor which, although more costly than the types already mentioned, has the great advantage of being able to deal with very fine dust as well as with grits, namely, the electrostatic precipitator. In this device the dust-laden flue gases are caused to flow between two electrodes, one of which is charged to a high negative potential and the other earthed. As a result of ionic discharge between the electrodes, the dust particles become negatively charged and move towards the earthed electrodes to which they give up their charge, and upon which they are collected. They are then caused to fall into some form of hopper from which they are removed from the system.

The method has the advantages of low pressure drop, low maintenance charges, low power costs and, above all, its ability to give very high efficiencies with really fine dust particles. Against these there are the large space occupied by the plant and the use of high voltages. Its main drawback, however, is high capital cost.

All dry methods of cleaning flue gases have one fundamental disadvantage which is of major importance in the case of urban power stations, namely, the fact that no dry method of dust removal will also remove sulphur.

Before the problems associated with the contamination of the atmosphere by sulphur compounds reached their present importance, it was common practice to attempt to increase the efficiency of settling chambers and certain centrifugal separators by using sprays to wet the dust particles and so to increase their settling rate. The disadvantage of the method is that water does not readily adhere to fine dust, and in consequence the quantity of water required is very large indeed, involving not only the cost of providing and 'atomizing' the water but also the disposal of the 'slurry' leaving the plant—a task comparable in magnitude with that of the initial removal of the dust from the flue gases.

In spite of this, spray chambers are now being used on a very large scale, primarily to obtain sulphur removal and incidentally for dust removal. Thus in one large power station in Great Britain, one and a half million cubic feet of flue gases are scrubbed per minute in a system through which they take 30 seconds to pass, and 20 tons of water are pumped through sprays for every ton of coal burned. The slurry is dealt with partly by settling and partly by filtration through sand and rotary filters. The advantage of the system is that high efficiencies can be obtained with regard to both dust and sulphur removal, but against this must be balanced the high cost, the space and plant required and the necessity for large water supplies.

In some plants sprays are replaced wholly or in part by films of water in contact with metal surfaces, a system which still involves the use of large volumes of water and slurry treatment.

During the past few years, a new wet system has been evolved for the removal of dust and sulphur in places where large water supplies are not available. In this 'non-effluent' system, the gases are scrubbed by contact with special arrangements of wooden plates and grids, which are kept wetted by alkaline liquor continuously circulated through the plant. As with other wet systems, the solid matter suspended in the liquor has to be disposed of by settling and filtration, but the main problem, ingeniously overcome, is the prevention of scale formation in the scrubbing towers.

From this brief review it will be seen that adequate means are available for the prevention of excessive emission of dust and grit into the atmosphere. In the case of very large installations, public opinion has already compelled the use of admittedly expensive methods of dust removal, and there are signs that in the near future, whatever the cost, the demand made upon smaller plants will be more exacting than in the past. There are, however, also indications, both in patent specifications and in the technical press, that increased public interest in atmospheric pollution has given rise to increased experimental work upon its prevention, and it is reasonable to hope that by the time a more rigorous standard is adopted, its cost will not be too heavy a burden upon industry.

Obituary Notices

Mr. Thomas Crook, O.B.E.

A LIFE of strenuous and useful work with ripe experience terminated on January 6 when Thomas Crook, principal of the Mineral Resources Department of the Imperial Institute, London, died after an abdominal operation, at the early age of sixty years.

Crook was born at Burnley, in Lancashire, on January 12, 1876. On the examination results of the old Science and Art Department he gained in 1898 a Royal Exhibition to the Royal College of Science for Ireland, where he took the associateship (A.R.C.Sc.I.) in natural science in 1901. He then became assistant in geology to the late Prof. Grenville A. J. Cole. In 1905 he joined the Scientific Department of the Imperial Institute, and for six years (1919–25) he was chief of the Intelligence and Publications Section of the new Imperial Mineral Resources Bureau, which afterwards was incorporated with the Imperial Institute.

Thomas Crook, with his keenness for work and his balanced judgment, early gave promise of being a prominent scientific investigator; but in course of time, his energies became more and more devoted to economic problems in connexion with developing the mineral resources of the Empire. While in Dublin, he described with Grenville Cole rocks dredged from the Atlantic, and devised a method for the mechanical analysis of soils with the well-known Crook's elutriator. In London, under Sir Wyndham Dunstan, excellent mineralogical work was done, and papers were published on geikielite, carnotite, strüverite, ankerite and magnesite, on the electrostatic and electromagnetic separation of minerals, and on some curious optical properties of certain minerals. A paper with a philosophical bearing was "The Genetic Classification of Rocks and Ore Deposits", which several years later he expanded to form a book, "History of the Theory of Ore Deposits" (1933). Another excellent and useful book is his "Economic Mineralogy" (1921).

This promising scientific work gradually became eclipsed by a vast number of well-written abstracts and articles on the occurrence and possible uses of a great variety of mineral products, which appeared mostly in the *Bulletin of the Imperial Institute*, but without being keyed to an author's name (with the result that they were not always entered in bibliographies, and not easily quoted). With the foundation in 1919 of the Imperial Mineral Resources Bureau, a still more intensive period followed. Then were issued long series of useful pamphlets and books dealing with some fifty different minerals and ores, each complete in itself, and with several editions bringing the statistics up to date. Authoritative statistical volumes of the world's mineral production were also issued annually. Another useful volume, "Minerals of the Empire", was issued for the Wembley Exhibition in 1924. This good work was continued on Crook's return to the Imperial Institute in 1925. All these publications bear evidence of his influence.

Content in his work, Crook did not strive for honours; but some did come at the end of the chapter. He was made O.B.E. in 1936. In November last he was elected a vice-president of the Mineralogical Society; and in December the honorary degree of B.Sc. was conferred on him by the National University of Ireland.

L. J. S.

Dr. E. E. Prince

DR. EDWARD ERNEST PRINCE died at his residence in Ottawa, Canada, on October 10, at the age of seventy-eight years. A native of Leeds, he graduated from the University of St. Andrews, and taught in the University of Edinburgh and (as professor of biology) at the Royal College of Medicine, Glasgow. He was one of the group studying the development of fishes under Prof. W. C. McIntosh at the St. Andrews Marine Laboratory. His publications in this field gave him recognition as a fishery specialist, and as such he investigated the fisheries on the east coast of England and the west coast of Ireland.

In 1892 Dr. Prince was appointed commissioner of fisheries for Canada, which position he held until his retirement from active life in 1925. Being responsible for the application of science to fishery problems, he urged in 1894 the establishment in Canada of a marine scientific station, and the support of the Royal Society of Canada and of the British Association at its Toronto meeting in 1896 led to the Canadian Parliament voting the necessary funds in 1898. He was made director of the new station, which operated with a board of university men to manage it and was located on the Atlantic coast. When a Great Lakes station and a Pacific station were afterwards developed, he continued to guide the work as chairman of the modified Board (incorporated in 1912 as the Biological Board of Canada), retaining this position until 1921 and remaining a member of the Board until his death.

Dr. Prince played a leading part on various fishery commissions in Canada, and with Dr. D. Starr Jordan formed the International Fishery Commission, established by treaty in 1908, which prepared common regulations for the fisheries in waters contiguous to Canada and the United States.

Dr. Prince was a keen naturalist and intensely interested in people. By charm of manner and breadth of interests he exercised a wide influence in a multiplicity of personal contacts throughout Canada and elsewhere. He was the author of more than fifty papers, nearly all on fishery subjects, and initiated or stimulated a large part of the investigations of Canadian waters, effectively applying to the first stage of fisheries research in Canada the knowledge and experience he had developed in Great Britain.

A. G. H.

Mr. G. P. V. Aylmer

We regret to record the death of Mr. Gerald Percy Vivian Aylmer, African traveller and explorer, which took place on December 20 at Newcastle-on-Tyne in his eightieth year.

Mr. Percy Aylmer, as he was generally known, was born in 1857 and educated at Eton and Trinity College, Cambridge. Notwithstanding the fact that as a result of a fall in the hunting field at Cambridge one leg was permanently deformed, Mr. Aylmer on leaving the University entered on a life of travel and strenuous adventure. In 1881, after taking a course of study in astronomy, he went to the Sudan with F. L. and William D. James and E. Lort-Phillips. The party entered the then unknown Basé country and mapped this region for the first time. Until then, it is said, no white man who had attempted to enter this country had ever returned. In 1884 the same party succeeded, where Burton, Speke and others had failed, in crossing the Horn of Africa and reaching the Webbe Sinbeli River. Here again uncharted lands were traversed; parts of Somaliland, including Wal-Wal, were then mapped for the first time. Observations on the natural history and natives of the country were noted in Aylmer's diaries, it is stated by Sir Alfred Pease in a communication to *The Times* of January 1; but unfortunately these have never been published.

We regret to announce the following deaths:

Prof. J. A. MacWilliam, F.R.S., emeritus professor of physiology in the University of Aberdeen, on January 13, aged seventy-nine years.

Dr. R. J. Tillyard, F.R.S., formerly chief Commonwealth entomologist in Australia, on January 13, aged fifty-five years.

Dr. T. B. Wagner, consulting chemist on foods and chemical engineer, president of the American Institute of Chemical Engineers in 1913, and vice-president of the Society of Chemical Industry (London) in 1908, on November 12, aged sixty-seven years.

Dr. Theodor Wiegand, president of the Archæological Institute of Berlin and director of excavations at Pergamon, aged seventy-two years.

News and Views

International Congress of Genetics and the U.S.S.R.

The next International Congress of Genetics was to have been held at Moscow in August next, the preparations for it being in the hands of Russian geneticists. A wireless message from Moscow to the *New York Times*, which was published in *Science* of December 18, stated that the Congress had been cancelled by the Soviet Government; that genetics had been attacked as of no practical value by T. D. Lysenko, who is known for his work in the vernalization of wheat and other crops; that Prof. N. I. Vavilov, the distinguished head of the plant-breeding services in the U.S.S.R., had been arrested; and that Prof. S. G. Levit, who is director of the Maxim Gorky Medico-Genetical Institute and was general secretary of the Organization Committee for the International Congress of Genetics, had been heavily attacked in the Communist party press for allowing a member of his staff to publish a paper in which it is concluded that the Buryats of Siberia have a mental age of twelve years. Prof. Vavilov has since sent to the *New York Times* a message, a copy of which has been sent to us by the Soviet Union Year Book Press Service, denying the story of his arrest and pointing out the large growth which has taken place in the Institute of Plant Breeding under his direction during the Soviet regime. According to a report circulated by Science Service, of Washington, D.C., Prof. H. B. Ward, permanent secretary of the American Association, has received a message from the U.S.S.R. indicating that the Congress of Genetics has been postponed but not cancelled. As the titles of papers for the Congress were to have been sent in soon, it is clear that a more definite announcement regarding the postponement is desirable, since many geneticists were already making arrangements to attend. These Congresses have been held every five years, the last being at Ithaca, New York, in 1932 No adequate grounds for a postponement have yet appeared.

Prof. N. I. Vavilov

PROF. N. I. VAVILOV, whose work is mentioned above, was a pupil of Bateson at the John Innes Horticultural Institution, London, in 1913 and 1914. Profiting by the unexampled opportunities afforded by the Soviet Government, he began in 1919 to study the natural variation of the ancestral species of cultivated plants. His special method was to use the geographical distribution of particular gene variations in determining the centre of their diversity, which he presumed to be the site of their origin. He applied this method to all the principal crop plants, leading expeditions to all parts of the world. This enabled him to infer the centres of origin of these plants. The most interesting example of this method concerns the wheats. The cultivated forms were already known to fall into two inter-sterile groups, the tetraploids like *T. durum*, *T. turgidum*, *T. polonicum*, and the hexaploids like *T. vulgare* and *T. compactum* Vavilov found that the hexaploids had arisen from a Central Asiatic centre, while the tetraploids had arisen from an entirely different centre in North Africa, hence the association of the two groups of wheat with different lines of human cultural development.

THE precise value of Prof. Vavilov's methods and the importance of his "Law of Homologous Series in Variation", and his principles of regional selection, are only beginning to be appreciated, but his published work undoubtedly represents the most important systematic attempt to study natural variation in plants since De Candolle and Darwin. Since 1921, Vavilov has been director of the Institute of Plant Industry. Under his control, this organization has come to embrace stations distributed all over the Soviet Union. Vavilov has used his centralized authority to secure a co-ordination of genetics, cytology, physiology and taxonomy, in which more than two thousand trained workers are engaged in problems of the efficient utilization of plants in the national economy. The work of acclimatization and hybridization carried out by the Institute bears witness to the success of his work, a success which is due to the combination of an enlightened method of inquiry with an industry, enthusiasm and organizing capacity suited to the heavy responsibilities given him by the Soviet Government.

International Geological Congress, 1937

IN spite of the difficulties which the International Congress of Genetics appears to be meeting, Soviet geologists are busy preparing for the eighteenth International Geological Congress, of which the opening plenary meeting will be held in Moscow on July 21. The session will close on July 29. Excursions, both prior to and following the Congress, are being arranged for delegates and their families. Pre-Congress tours, beginning on July 1, include the following: (*A* 1) Karelia and the Kola Peninsula: Pre-Cambrian; igneous complexes; ore deposits; (*A* 2) Ukraine and Crimea: Pre-Cambrian; Donets Coal Basin; Crimean stratigraphy and tectonics; (*A* 3) Volga: stratigraphy of the East European U.S.S.R.; Caspian depression; salt domes; engineering problems; (*A* 4) Caucasus: stratigraphy; tectonics; igneous activity and ore deposits; (*A* 5) South Urals, Kazan and Donets Basin: stratigraphy and palæontology of the western slope of the Urals. The longer August excursions, the first two of which will occupy forty days, are as follows: (*C* 1) Urals, Caspian, Caucasus: the principal oil deposits of the U.S.S.R.; (*C* 2) Siberia: Caledonian, Variscan and Alpine tectonics; Palæozoic and Mesozoic stratigraphy and associated coal and iron deposits; (*C* 3) Novaya Zemblya: stratigraphy and tectonics; Caledonian granites and mineralization; (*C* 4) Urals: gabbro-peridotite and alkali complexes; mineral deposits of great variety. Full details and conditions of membership are given in the Third Circular, issued by the Organization Committee, copies of which may be obtained from the General Secretary, Moscow 17, Bolshaya Ordynka, 32. All arrangements for travelling, hotel accommodation, etc., are in the hands of Intourist, Ltd., Bush House, Aldwych, London, W.C.2.

Races in the British Isles

IT is generally considered more or less a fixed point in discussion of the racial history of the British Isles that a fundamental element in the population, which appears at least as early as the long barrow, is of Mediterranean origin. It will, therefore, come as a surprise to many to find that arguments subversive of this view have been put forward recently by Dr. G. B. Morant (*J. Roy. Anthrop. Inst.*, **66**, Pt. 1) in an analysis of the material upon which Dr. Cecil P. Martin based his study of the racial composition of the Irish people in "Prehistoric Man in Ireland" (London: Macmillan and Co., Ltd., 1935). Dr. Martin's conclusions pointed to a virtual identity of racial history in Ireland and Britain up to the intrusion of the Romans and Saxons in Britain. Ireland, however, on the whole was said to have a larger Iberian element and a smaller Nordic element than Britain. Dr. Morant, after a statistical analysis of the modern Irish material, has arrived at the conclusion that the modern Irish and the British Iron Age population are so similar that they might be samples from the same material, while the latter bear the same relation to the population of the Whitechapel plague pit of the seventeenth century. The Anglo-Saxon is slightly removed; but the modern English and the modern Irish might well be considered variants of one race.

ON this argument, it would, therefore, appear that the Iron Age population absorbed the Anglo-Saxon type. Further, this race, with which Dr. Morant would class the British Neolithic, on comparison with Continental types, emerges as essentially Nordic. It is comparable with the prehistoric Scandinavian, the Reihengraber people, the Merovingians of northern France, and the Belgian Franks—all Nordics. Dr. Morant justifies the inclusion of the British Neolithic in this group on the evidence of stature and head-measurement, pointing out that the extreme length characteristic of the Nordic skull, in which it exceeds any of the dolichocephalic Mediterranean skulls, is also a character of the British neolithic skull. He argues, therefore, that there is no evidence in skeletal remains for the early presence of a Mediterranean element in Neolithic Britain, but that this has been inferred on cultural evidence only. It will be noted that the important character of pigmentation does not enter into the argument; but as has been pointed out on more than one occasion, the argument from pigmentation in the classification of the prehistoric races of Europe rests solely on inference from modern distributions, until in the historic succession we come to the evidence reported in the classical writers.

Colonial Medical Reports

MAJOR P. GRANVILLE EDGE read a paper before the Royal Statistical Society on January 19 entitled "The Demography of British Colonial Possessions", in which some of the outstanding details to be found in Colonial medical reports were summarized. It was pointed out that the British Colonies comprise upwards of fifty distinct Governments, with territories exceeding an area of two million square miles, of which more than nine-tenths lies wholly within the tropics, inhabited by a bewildering medley of races, religions, languages and customs. The bulk of the people of British tropical Africa are native-born Africans, but in British Malaya the Chinese outnumber the indigenous Malays, and in the British West Indies no traces of the original Carib inhabitants survive, the present population being composed of descendants of African slaves, East Indians, Europeans and other inter-racial mixtures. The Colonial medical reports contain records of population, births, and deaths, so far as these are known, and in addition survey the records of sickness in the Colonies with the view of discovering and removing the predisposing causes of various diseases. The incidence in different parts of the world of such diseases as malaria, helminthiasis, venereal affections, dysentery, sleeping sickness and tuberculosis were discussed by Major Granville, and the difficulties connected therewith commented upon. The public health services, wherever located, may be regarded as fighting organizations engaged in combating insanitary conditions, in raising defences against the invasions of disease, and in attempting to stave off the approaches of death. Without these services detailed sanitary knowledge cannot be acquired, and without such knowledge commercial and other development of the Colonial Empire must be precarious and costly in the face of unrealized menaces to life and health.

Magnesium Alloys for Aircraft

As the standards of aircraft performance are raised, possible saving of weight is becoming of ever greater importance, so that more and more interest is being taken by aircraft constructors in metals lighter than aluminium. On January 14, Dr. C. H. Desch, superintendent of the Metallurgical Department of the National Physical Laboratory, discussed, before the Royal Aeronautical Society, recent work on magnesium and other light alloys, much of which has been carried out at the National Physical Laboratory. Magnesium is too weak a metal to be used in the unalloyed state, and the metals which may be added to it to produce strong alloys are limited in number. In fact, taking all the factors into account, only aluminium and cadmium are suitable for alloying in comparatively large quantities, although calcium, cerium, nickel, cobalt and manganese have proved useful in small quantities. To those who have only known magnesium in the form of ribbon or powder for use in flashlights, it is rather surprising to find that magnesium alloys are remarkably easy to cast. This comes about, Dr. Desch said, from the fact that molten magnesium has very little power of dissolving gases, so that magnesium alloys do not suffer from porosity caused by the liberation of gases at the moment of freezing. It is necessary to use a suitable flux and a protective atmosphere during pouring. These conditions are now well understood, and no difficulties are experienced in the foundry. In annealing processes similar protection is necessary, and the special technique adopted has resulted in making a magnesium alloy foundry a remarkably clean and inoffensive place. Exhaustive search at the National Physical Laboratory for magnesium alloys capable of age-hardening has suggested that those containing silver are the most promising. The fact that silver is relatively costly is of little importance, since in the articles of the type produced the cost of manufacture is much greater than that of the material used.

Afforestation in the Lake District

AN interesting pamphlet has been issued by the Forestry Commissioners entitled "Afforestation in the Lake District" (London: H.M. Stationery Office, 1936). The pamphlet embodies the report by the Joint Informal Committee of the Forestry Commission and the Council for the Preservation of Rural England which was set up early in 1935. The Committee commenced its task with the recognition that large-scale afforestation and the preservation of areas of typical natural beauty are both necessary on national grounds, and that the land available for both purposes is limited. This does not entirely represent the actual position of affairs. For the public in some cases in the past have not only been against new afforestation work, but also have declaimed at old woods, such as are to be found in some of the enclosures in the New Forest, for example, being touched; in spite of the fact that it is evident that the old trees cannot last for ever. Towards the end of 1935, the Commissioners acquired an estate of 7,000 acres in the valley of the River Esk and the adjacent valley of Duddon, and prepared to plant. Objections were made by the public to the planting of conifers in the two valleys, especially in Upper Eskdale. It was agreed that some 440 acres of plantation land in Upper Eskdale should be omitted from the planting scheme, the Commissioners undertaking to pay special attention to amenity in afforesting the remainder of the plantable ground. The total area of the estate which will be ultimately planted is less than 2,000 acres of the 7,000 acres purchased. It has become evident that afforestation in the Lake District offers considerable difficulties, as a countryside can be completely changed by stretches of woods, and especially coniferous woods. With this object in view, the Joint Committee has recommended that a central block of some three hundred square miles in extent should be excluded from afforestation work.

British Films and the Cinema

THE Committee appointed by the Board of Trade to consider the position of British films in view of the approaching expiry of the Cinematograph Films Act, 1927, has now issued its report (Cmd. 5320 London: H.M. Stationery Office. 9*d*. net) It finds that in some important respects the situation is still the same as in 1926. The much greater home market available for United States films, which is represented by some 11,500 picture-houses and a seating capacity of about 10,000,000, as against 4,300 cinemas in Britain and a seating capacity, including that of the Dominions, of less than 6,000,000, offers a security encouraging a flow of capital to the American industry which finds no parallel here. The United States accordingly occupies a commanding position, contributing all but 25 per cent of the films shown in Great Britain, and the Committee was unanimous in its decision that the quota system should be continued and the quotas, under certain conditions, increased. The detailed proposals of the report are accordingly designed to deal with admitted flaws in the present system rather than to modify its principles. A quality test is proposed to restrict the deplorable output of bad films made simply to satisfy quota requirements An increase in the penalty for blind booking, which is to apply to renters and not to exhibitors, removal of restrictions on advance booking but prohibition of block booking, and the application of the quota system to short as well as to long films are among other recommendations of the Committee It is suggested that long and short films should be judged by different standards, and stress is laid upon the value of the short film as an opportunity of experimenting with new ideas within reasonably safe financial limits. The ultimate aim of the measures proposed is to reach a quota of fifty per cent in the next ten years, and to give effect to its recommendations and administer the provisions of the new legislation required, the report recommends the constitution of a Film Commission of members entirely independent of any professional or financial interest in the industry.

Architectural Lighting

A PAPER by R. O. Sutherland published in *Light and Lighting* of December gives a history of the progress made in architectural lighting during the last ten years. He states that this kind of lighting received great inspiration from the French Colonial Exhibition in 1925. As a result of the illumination shown at this festival, ornamental features in the form of tiles and richly decorated panels in moulded glass were popularized in buildings, especially those used for catering and entertainment purposes. The floral character of this lighting soon gave way to a more restrained treatment. Plain sheet opal glazing was largely substituted for moulded glass. This made it economical to have large areas of lighted panels. Once the idea of converting an architectural element into a lighting feature was established, it rapidly became a typical method of architectural lighting technique. A photograph of the lighting of the Egyptian Hall in the London Mansion House, and of the lighting in the library of the University of Cambridge, show how the architectural treatment is emphasized in a simple and dignified way by the illumination. To Londoners and visitors to London the lighting of some of the escalators on the underground railways is of interest. The barrel ceiling is lighted from standards placed at 8-foot intervals, each containing a 100-watt lamp in a suitable reflector. The illumination is ample for the needs of the traveller, and is sufficient for the vault sides to be used as advertisement space. In the lighting of the gallery of the Shakespeare Theatre at Stratford-on-Avon, the acoustic panels at the back of the auditorium are also utilized as light reflectors.

Timber for Wood-Turning

AN interesting, and, from the point of view of encouraging small local industries in the countryside, practical report has been issued by the Forestry Commission (H.M. Stationery Office, 1936), entitled "On the Demand for Timber in Wood-Turning in Great Britain". The investigation was carried out in 1935, when 438 firms were visited, all but 14·8 per cent being wood-turners. The information upon which the report is based comes therefore from 373 firms ranging from single-handed turners who have one room or a small shed fitted up as a workshop, to mass-production factories with a hundred or more automatic or semi-automatic machines. Some of these latter specialize in the production of a single commodity, such as heels for shoes, legs for chairs, bobbins for textile mills, rollers for mangles, the manufacture of tool handles, or bungs for beer-casks; others are general turners, fabricating a wide variety of products. The majority of the firms are turners only The last census returned 56,930 persons, including pattern makers (the latter being chiefly of wood), as employed in the United Kingdom in wood-turning It is difficult to obtain figures of the actual consumption of wood in this industry; but, from information supplied, approximately two hundred firms are using 6,000,000 cubic feet of timber in wood-turning annually, of which about 53 per cent is home-grown and 47 per cent imported.

Agricultural Meteorology

MR. J. W. HOPKINS has recently published a paper, entitled "Agricultural Meteorology: Some

Characteristics of Precipitation in Saskatchewan and Alberta", in which it is apparent that the author's investigations and their results may have a wider application than the merely agricultural (*Canadian J. Res.*, 14, No. 9, Sept. 1936). In previous agricultural meteorological investigations, Mr. Hopkins demonstrated statistically significant correlations between annual variations in rainfall and temperature, and the yield and nitrogen content of wheat crops grown in central and southern Saskatchewan and Alberta. In the present paper, the author gives the results of a study complementary to the previous one, dealing with some average characteristics of the seasonal precipitation in these districts, and also analysing the fluctuations which past experience has shown to occur from year to year in the precipitation at a given place, and from place to place in the same district during a given year. The investigations appear to be based on observations carried on between 1898 and 1934, the stations being Edmonton, Calgary, Battleford and Swift Current. "In spite of irregularities, to be expected in the limited sample of years available," says the author, "the frequency of distribution of seasonal precipitation at the stations showed no gross asymmetry, seasons with precipitation in the vicinity of the average being on the whole more numerous." The average (1916–32) percentage of days on which rain fell showed a distinct seasonal trend during spring and summer, being lowest in April and highest in June. Similar variation was noted in the average amount of rain per rainy day, which was lowest in April and highest in June and July. It would be of interest if in future observations some data could be collected on the subject of the possible influence of the forests on the atmospherical moisture content in these regions.

Plant Pathology in Devon and Cornwall

THE twelfth annual report of the Department of Plant Pathology at the Seale-Hayne Agricultural College, Newton Abbott, Devon, considers the pests and diseases of plants from an essentially local aspect, which should be much appreciated by growers in Devon and Cornwall. Mr. L. N. Staniland, the advisory entomologist, contributes a general section upon the more common pests of farm and garden. He has made a special study of eelworm troubles. Methods of combating this pest are discussed at considerable length, and a thorough revaluation of the usual hot-water treatment has been made. It has been found that although eelworms are killed by seventeen minutes exposure to a temperature of 110° F., the technique of commercial treatment varies greatly. The usual period of three hours heating is shown to be inadequate in some cases, and various recommendations as to improved methods are made. Mr. A. Beaumont, the advisory mycologist, has made a further detailed study of the relation of potato blight to the weather of Devon, and has separate articles on "Tulip Fire and the Weather", "Snapdragon Rust; Trials of Resistant Varieties", and "Apple and Pear Fruit-rotting Fungi".

Vital Statistics for England and Wales for 1934

THE text volume of the Registrar-General's Statistical Review of England and Wales for 1934, recently issued, contains the official commentary on the two volumes of vital statistics already published (London: H.M. Stationery Office. 3*s*. 6*d*. net). The report deals with the statistics of births, deaths and marriages registered in 1934, estimates of population, and other matters. The estimated population of England and Wales in the middle of 1934 was 40,467,000 persons, of whom 19,412,000 were males and 21,055,000 females. The total is 117,000, or 0·29 per cent greater than the estimate for the previous year, and 515,000 or 1·3 per cent greater than the population at the census of 1931. The average ages of the estimated population, which are gradually increasing, are 32·4 years for males and 34·2 for females. In addition to reviewing the mortality from various causes, the report also contains several studies of mortality. One of these deals with the handicaps suffered by the winter-born compared with the summer-born child, and another with the mortality rate from pregnancy and child-bearing for the wives of men in various social groups.

Fall in French Birth-Rate

THE annual number of births in France reached its maximum towards the end of the Second Empire, when it was so high as 1,034,000 in 1868. In 1934 it had fallen to 677,000 and in 1935 to about 650,000, of which nearly 50,000 were the children of foreigners. The birth-rate has therefore diminished by 384,000 or nearly a third, although the population has increased since 1868 by three million immigrants or naturalized persons, which has resulted in increasing the population from 38 to 48 million inhabitants. During the period 1900–35, the birth-rate has decreased by nearly 100,000. The number of births per marriage has decreased even more rapidly. In 1800 the average number of births in France was 4·5 per marriage, at the end of last century it was 3, and to-day only 2·2, or a diminution of about fifty per cent.

The Value of Experiments on Animals

THE autumn issue of the *Fight against Disease* (24, No. 4), the quarterly journal of the Research Defence Society, contains extracts from the evidence given by Lord Justice Fletcher Moulton before the Royal Commission on Vivisection, 1906–8. The considered opinion of Lord Moulton, whose scientific knowledge and clarity of thought must have materially assisted the Commission in forming an opinion upon the anti-vivisection controversy, should help those who have to address meetings on the question, or have to deal with anti-vivisection propaganda.

Physics in Industry

AT the meeting at the end of October commemorating the fifth anniversary of the founding of the American Institute of Physics, the replies of fifty leading industrial physicists to the question: what training is best for the scientific worker who wishes to enter industry, were summarized by Dr. Oplin, director of research at Kendall Mills, Boston. His summary has been taken up by Science Service, Washington, D C., and circulated His principal conclusions are: "Industries need physicists trained in the fields of optics, magnetism and acoustics", and "too little emphasis is placed on these fields in academic training" as "the best known scientists are working on the problems of cosmic rays, atomic disintegration and transmutation" and "students naturally look up to them for guidance". "Some training in engineering courses is advocated for future industrial physicists. Industry finds it better and easier to use a student trained adequately in physics and have him in the plant attain his additional engineering knowledge than to try to give the engineering student the additional knowledge of physics".

R.R.S. *Discovery II* Survey Party

CONSIDERABLE concern was caused by the announcement on January 18 from the commanding officer of the R.R.S *Discovery II*, that a survey party which had been landed on King George Island, South Shetlands, was missing Early on the following day, however, the reassuring message was received that the party had been located and had returned to the ship The Discovery Committee states that the party consisted of: Lieut. R. Walker, R N.R., chief officer; Dr J. R. Strong, ship's surgeon; Dr F. D. Ommanney, scientific officer; Mr. R. G. Gourlay, third engineer; Mr J. Matheson, boatswain's mate, and Mr J. Dobson, A B.

Bureau of Human Heredity

ONE activity contemplated in setting up the Bureau for Human Heredity is the organization of information service for research workers in the subject The value of such a plan has been demonstrated in the information service already established for workers on *Drosophila*, etc. Workers are requested to address to the Bureau a short paragraph describing the work on which they are engaged These notices will be multiplied and circulated to all those co-operating In the first instance, this bulletin will be issued every twelve months. Later supplementary bulletins will be issued more frequently. Those using this service are asked to subscribe 5*s*. Communications should be addressed to the Hon. General Secretary, Bureau of Human Heredity, 115 Gower Street, London, W.C 1

Federal Council on Scientific Management

AN important step forward in the co-ordination of the varied activities of the many societies connected in some way or other with the several phases of scientific management was taken on January 12, when a British Management Council was formed. After the highly successful sixth International Congress for Scientific Management, held in London during July 1935, a committee was set up under the chairmanship of Dr E. F Armstrong both to take all necessary action to ensure the proper representation of Great Britain at the next Congress, to take place in the United States in 1938, and to examine the factors involved in the formation of a national scientific management organization A scheme of federation has been produced by this committee, and after discussion has met with provisional acceptance from the greater number of the associations concerned, numbering some thirty in all. The objects of the new Federal Council are: "To ascertain and represent both nationally and internationally the views of those bodies concerned in Management in Great Britain, and in particular as its immediate object to enter into relations and to co-operate with similar bodies in other countries, and to act as the representative of its Constituent Members in International Congresses and other activities concerned with Management." Lord Leverhulme has been elected as its first chairman, Dr E F Armstrong as vice-chairman, Mr. G. R. Freeman as treasurer, and Mr. U. Baliol Scott as secretary. The new body is assured of the support and co-operation of the Federation of British Industries. It has an important function to fill and may be expected in time to exert a pronounced influence on the development of the functional management movement in Great Britain.

Botanical Society of America

AT its thirty-first annual meeting at Atlantic City, New Jersey on December 20–31, the Botanical Society of America elected the following botanists to be corresponding members: Dr. N. I Vavilov, director of the State Institute for Experimental Agronomy, Leningrad; Dr. Agnes Arber, sometime fellow of Newnham College, Cambridge; and Dr. Lorenzo R. Parodi, professor of botany in the University of Buenos Aires The following officers of the Society for 1937 were also elected: *President*, Prof Edmund W. Sinnott, Barnard College, Columbia University, New York City; *Vice-President*, Prof. Loren C Petry, Cornell University, Ithaca, N.Y.; *Secretary*, Prof George S. Avery, jun., Connecticut College, New London, Conn: *Treasurer*, Dr. F E. Denny, Boyce Thompson Institute for Plant Research, Yonkers, N.Y. A new Section for Paleobotany was also organized with the following officers: *Chairman*, Prof. A C. Noé, University of Chicago; *Secretary*, W. C. Darrah, Harvard University

International Congress of Agriculture

THE seventeenth International Congress of Agriculture will be held at The Hague on June 16–23, 1937, under the patronage of the Queen of the Netherlands. The work of the Congress is divided among eight sections. Three are economic in character, and at The Hague will discuss the means which have been taken to deal with the depression in the agriculture of the Netherlands, the organization of the world butter market, the provision of credit to agriculture, the relation between State planning and agricultural co-operation, the effect on agriculture of the development of artificial wools, cottons and other products. Sections dealing with the technical and scientific aspects of agriculture will discuss the vernalization of crops, a limitation in the varieties of plants in cultivation and the protection of producers of selected seeds, artificial fertilization in the improvement of livestock, animal nutrition and other subjects. Social and educational questions will include the teaching of agricultural economics, broadcasting in the service of agriculture and health and hygiene in the rural home, a subject to which the National Federation of Women's Institutes (England) will make the principal contribution. Further particulars may be obtained from the Secretary, British Corresponding Committee, International Congress of Agriculture, 10 Doughty Street, London, W.C.1.

An International Exhibition of Photography

UNDER the chairmanship of Gustave Fassin, of the Bausch and Lomb Scientific Bureau, Rochester, New York, a committee has been appointed to secure and arrange exhibits for the International Exhibition of Applied and Scientific Photography to be held in the Rundell Memorial Building at Rochester, New York, in March, under the auspices of the local section of the Photographic Society of America. This new and beautiful civic building has exceptional facilities for showing both pictures and apparatus. Men of science working in any of the following fields are invited to send exhibits to the Secretary, Mr. C. B. Neblette, Rochester Athenæum and Mechanics Institute, Rochester, New York: astronomy, meteorology, light-sensitive substances; photomicrography, microphotography, metallography; X-ray spectrography; cosmic ray photography and theoretical physics; press photography; high-speed photography; technique of colour photography; photography by invisible radiation; aerial photography.

Awards of the Geological Society

THE Geological Society has made the following awards: Wollaston Medal to Prof. Waldemar Lindgren of the Massachusetts Institute of Technology, for his researches concerning the mineral structure of the earth, and especially concerning the problems of mesasomatism, contact ore deposits and the application of physical chemistry to ore deposition; Murchison Medal to Dr. L. J. Spencer, in recognition of the value of his original contributions to mineralogical science and of his services to the publication of mineralogical literature; Lyell Medal to Mr. L. Richardson, for his contributions to the geology of the Jurassic rocks of Great Britain; Bigsby Medal to Prof. C. E. Tilley, in recognition of the value of his researches in petrological science, especially in the petrology of the metamorphic rocks; Wollaston Fund to Dr. D. Parkinson; Murchison Fund to Mr. S. H. Straw; a moiety of the Lyell Fund to Mr. J. F. Jackson; another moiety of the Lyell Fund to Miss M. E. Tomlinson.

Announcements

DR. E. J. BUTLER, secretary of the Agricultural Research Council; Dr. J. B. Conant, president of Harvard University; and Lord Hailey, director of the African Research Survey, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

MR. J. RAMSBOTTOM, keeper of botany at the British Museum (Natural History), and a secretary to the Linnean Society of London, who is known for his mycological researches, has been elected an honorary member of the Quekett Microscopical Club.

MR. RICHMOND T. ZOCK, of the U.S. Weather Bureau, has been elected a foreign member of the Royal Meteorological Society.

THE annual general meeting of the Association of Technical Institutions will be held in the Carpenters' Hall, Throgmorton Avenue, London, E.C.2, on February 26–27. On February 26, at 10.45 a.m., the incoming president, the Right Hon. Lord Kennet, will deliver the presidential address. Further information can be obtained from Dr. H. Schofield, Loughborough College, Loughborough, Leicestershire.

THE fourth International Grassland Congress will be held in Great Britain under the presidency of Prof. R. G. Stapledon on July 8–23. The Congress will meet first at Oxford and will then proceed to various places of topical interest including Leicester, Birmingham, Cirencester, Hereford, Aberystwyth, Newcastle and Edinburgh. Further information can be obtained from the Joint Secretaries, Agricultural Buildings, Aberystwyth.

THE Associated Grocery Manufacturers Association of America at the annual banquet on December 1 presented Dr. George R. Minot of Boston with the annual award for research in the field of health leading to the prevention of disease and the advancement of health. The presentation address was made by Dr. Morris Fishbein, editor of the *Journal of the American Medical Association*.

DR. JOHN HOWARD NORTHROP, of the Rockefeller Institute for Medical Research, Princeton, N.J., has been awarded the Charles Frederick Chandler Medal of Columbia University in recognition of his fundamental discoveries concerning bacteria, the constitution of protein and the chemistry of digestion. The medal was founded in 1910 in honour of Prof. Chandler, who taught at Columbia University and was a pioneer in industrial chemistry.

DR. DAVIDE GIORDANO, president of the Italian Society of the History of Medicine and Natural Sciences; Dr. Bernhard Peyer, professor of palæontology at Zurich; and Dr. Brouwer, professor of neuropathology at Amsterdam, have been elected members of the Leopold Caroline German Academy of Natural Philosophy at Halle.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 157.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Exchange of Phosphorus Atoms in Plants and Seeds

IN a letter to NATURE[1] we communicated the results of experiments carried out on maize plants using radioactive phosphorus as an indicator of the behaviour of the phosphorus atoms. The results obtained showed unambiguously that the greater part of the phosphorus atoms present in the leaves and in the roots of the plants investigated is not permanently in one place, but migrates from leaf to leaf. We extended the experiments described above and investigated the behaviour of phosphorus in the sunflower.

The plant was first grown in an ordinary nutritive solution until a set of leaves, which we will call 'lower leaves', appeared. We then placed the plant in a second nutritive solution in which the phosphorus atoms were replaced by 'labelled' phosphorus atoms (mixed with radioactive phosphorus atoms). The second set of leaves, which we will denote as 'upper leaves', were grown in this solution and contained accordingly labelled ('radioactive') phosphorus atoms. For the sake of simplicity we will assume that the 'lower' leaves did not grow further in the second solution but retained their original size; then we must distinguish between two extreme cases: (*a*) the phosphorus atoms do not migrate; (*b*) the phosphorus atoms migrate. In case (*a*) labelled phosphorus atoms should only be found in the upper leaves; in case (*b*) the labelled phosphorus atoms should be equally distributed between the upper and lower leaves.

TABLE 1.

Time in days	Part of the plant	Total P (mgm.)	Labelled P (per cent)	Unlabelled P (mgm.)
0	Lower leaf Upper leaf Stem	0·980	0	0·980
4	Lower leaf	0·848	43·6	0·478
	Upper leaf	0·840	51·5	0·407
	Stem	0·361	63·7	0·131
9	Lower leaf	0·742	66·9	0·246
	Upper leaf	2·838	65·6	0·976
	Stem	0·844	85·6	0·122

As is seen from Table 1, the lower leaves contain an appreciable amount of labelled phosphorus atoms, clearly showing that in the case of the sunflower, just as in that of the maize plant, a very considerable migration of the phosphorus atoms takes place, and the probability of a labelled phosphorus atom being found in a preformed leaf is not very different from the probability of its being found in a leaf grown in a labelled solution. In comparing the figure obtained for the lower and upper leaves, we have to take into account the fact that the lower leaves increase in size to some extent while the plant is in the labelled solution; however, this increase was found to be very slight, as to be seen from the third vertical column of Table 1 and also from Fig. 1, which illustrates the plant at the three different stages of its growth.

From the above, it follows that the greater part of the phosphorus atoms are not fixed in position in the leaves but can migrate. The bulk of the phosphorus atoms found in plants are presumably present as inorganic phosphate, and carried about with the circulation stream in the plant. To what extent the phosphorus atoms present in organic combination are permanently localized is under investigation.

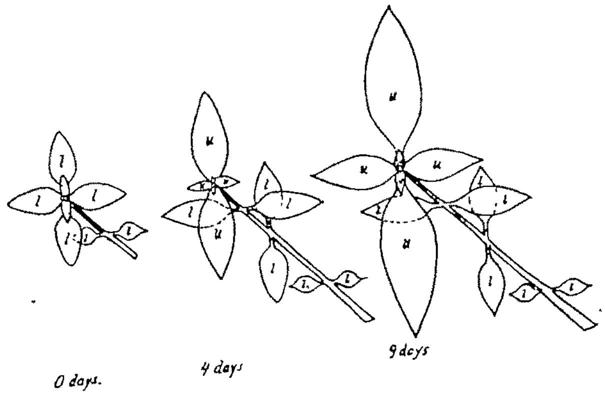

Fig. 1

In connexion with the experiments discussed above, we tried to ascertain if any exchange of phosphorus atoms takes place between an isolated leaf and a nutritive solution. These experiments were carried out with the leaves of a sunflower grown in labelled nutritive solutions. Some of the leaves were ignited and analysed at once after separating them from the stem, while other leaves were placed for 48 hours in a nutritive solution containing unlabelled phosphorus to give a chance for exchange to occur between the labelled phosphorus in the leaf and the normal phosphorus in the solution. No labelled phosphorus could, however, be found in the nutritive solution.

In another set of experiments we placed cut leaves of sunflowers, grown in a normal nutritive solution, in labelled solution for 48 hours; in all the cases investigated an uptake of a few per cent of the labelled phosphorus atoms into the cut leaf was found. As was to be expected, a cut leaf takes up not only the solvent but also the solute from the solution in which it has been immersed.

Finally, we would like to mention some experiments carried out with seeds. Two different series of experiments were carried out, one with maize seeds, the other with those of the pea. In both cases the seeds were germinated until rootlets 2–3 cm. long were formed. Then the seeds were placed in small flasks with the rootlets dipping into a nutritive solution containing labelled phosphorus. In the case of the maize seeds (Table 2) the germ and endosperm were removed after the lapse of 4–14 days and analysed separately. While the germ was found to contain an appreciable amount of labelled phosphorus taken up from the nutritive solution, the endosperm did not contain the slightest trace; this shows that no exchange takes place between the phosphorus atoms of the germ and the endosperm. In the case of the pea, there is no such marked distinction between germ and endosperm, the cotyledons occupying most of the space inside the seed, so that the labelled phosphorus atoms are taken up by the different parts of the seed. The concentration of the labelled phosphorus in the leaves and rootlets was here considerably higher than in the rest of the seed (cotyledons), as is seen from Table 3.

TABLE 2. MAIZE.

No. of days	Part of the plant	Total P (mgm.)	Labelled P (mgm.)
8·9	Rootlet + leaf + scutellum	0·511	0·0134
	Endosperm	0·098	0·0001
7·0	Rootlet + leaf + scutellum	0·778	0·0275
	Endosperm	0·068	0
13·8	Rootlet + leaf + scutellum	1·008	0·0576
	Endosperm	0·016	0

TABLE 3. PEA.

No. of days	Part of the plant	Total P (mgm.)	Labelled P (mgm.)
3·9	Rootlet + leaf	0·167	0·0118
	Cotyledon	0·281	0·0013
7·0	Rootlet + leaf	0·445	0·0411
	Cotyledon	0·314	0·0033
18·8	Rootlet + leaf	0·481	0·0508
	Cotyledon	0·151	0·0050

We wish to express our thanks to Prof. Niels Bohr and Prof. S. P. L. Sørensen for the kind interest taken in this work, and to Miss Hilde Levi for her assistance in the counting experiments.

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K. LINDERSTRØM-LANG.
C. OLSEN.

Institute of Theoretical
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Nov. 24

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[1] NATURE, 137, 66 (1936).

Organic and Inorganic Chemistry of Iodine Oxides

IN comparing multivalent iodine with multivalent nitrogen, I was led in 1933 to try the action of iodic acid upon aromatic compounds; an unexpected result was found, namely, the copious formation of iodonium salts. The existing knowledge of these proving to be inadequate, a long digression was necessary in which we were able to clear up the main chemistry of iodoxy-compounds and to discover (*inter alia*) that iodine can form compounds in which it recalls 'quinquevalent' arsenic as this is seen in arsinic and arsonic acids; some of the ways in which iodonium salts are derived from iodoxy- and iodoso-compounds were elucidated[1]. Mr. Race and I then reverted to the initial reaction, which takes place in sulphuric acid media of hydration less than $H_2SO_4.H_2O$; from iodic acid and chlorobenzene, for example, one obtains in a single operation an 80 per cent yield of the *para*-iodonium derivative. Benzene similarly yields diphenyl-iodonium salts, and its derivatives with *o*- *p*-directing substituents (provided that these are not too highly activating) react in the same way; while *meta*-directing substituents like the nitro-group prevent the reaction. Particulars of this work will be published.

It appeared, however, that despite the high yields, the action of iodic acid was a secondary one, and that it ensued upon a prior reduction of the iodic acid at the expense of some of the organic reagent. In following this up, I find that if one starts with iodine sesquioxide (in the form of Chrétien's sulphate $I_2O_3.SO_3.\frac{1}{2}H_2O$) instead of iodic acid, in a suitable sulphuric acid medium, the yields of iodonium salts from chlorobenzene become quantitative; and the reaction is very smooth. Further, iodine sesquioxide turns out to be an interesting reagent for effecting, very easily, two new aromatic substitutions. With benzene and its *o*- *p*-directing derivatives, one gets *para*-iodonium salts; with the other type, such as nitrobenzene or benzene sulphonic acid, one gets a direct introduction of the iodoso-group. The orientation of this is *meta*. Thus, for convenience regarding the inorganic reagent as virtually the hydrogen sulphate of trivalent iodine:

(*a*) $RH + HSO_4.I(HSO_4)_2 \rightarrow H_2SO_4 + RI(HSO_4)_2 \rightarrow RIO$;

or, with the less inactive aromatic reagents,

(*b*) $2RH + (HSO_4)_2.I(HSO_4) \rightarrow 2H_2SO_4 + R_2I^{\cdot}.HSO'_4$.

The need to prepare iodine sesquioxide (as its sulphate) has caused me to study anew the inorganic chemistry of the lower oxides of iodine; for the method hitherto used, ultimately derived from Millon, is confused in theory and inconvenient in practice. It consists of heating iodic acid in strong sulphuric acid until iodine boils off along with oxygen, and then awaiting the very slow deposition of a small yield of the desired solid. Some of the main facts disclosed by the present experiments may be presented.

The reaction

$$2I_2 + 3I_2O_5 = 5I_2O_3$$

is a reversible equilibrium; it is displaced towards the left by heat, and wholly (but not instantly) to the left by water, as this converts I_2O_3 into the stable iodate anion; it is displaced to the right by an acid strong enough to convert I_2O_3 into a salt (the cationic nature of trivalent iodine has been plainly indicated by Fichter[2] and others). Thus the sulphate can be got in quantitative yield from iodine and its pentoxide by merely shaking these in cold concentrated sulphuric acid in the proportions stated in the equation. This synthesis goes through an interesting stage; the two reagents, neither of them significantly soluble alone, rapidly dissolve in forming a very deep brown solute which is not iodine but is a compound of a suboxide; the present evidence suggests that it is the sulphate of a radical I_3^+. This then slowly attacks more dissolved pentoxide, the action being slightly reversible but driven towards completion by the insolubility of the product, the pure yellow sulphate of I_2O_3. The dark solute is still being studied, since if the difficulties in the way of its identification can be overcome, it raises interesting points in the electronic behaviour of the iodine atom. It would clearly be related to I_3OH, the brown solute discovered in 1862 by Lenssen and Lowenthal and later examined by Skrabal[3], which is hypoiodous acid co-ordinated with a molecule of iodine.

The thermal dissociations

$$I_2O_5 \rightarrow O_2 + I_2O_3 \rightarrow I_2 + 2\tfrac{1}{2}O_2$$

can be exactly arrested at the middle stage if one heats iodine pentoxide in fuming (instead of concentrated) sulphuric acid, such acid being strong enough to stabilize trivalent cationic iodine as a soluble sulphate even at 220°. It may also be mentioned that fuming sulphuric acid oxidizes elementary iodine, even without heating, forming intense manganate-green or very deep blue solutions, like that of sulphur sesquioxide, and liberating sulphur dioxide.

As to the other intermediate oxides of iodine, IO_2 and I_4O_9, there is good reason to agree with Fichter that they are iodous iodates, and their compositions can be generalized as $I_2O_3 . nI_2O_5$

IRVINE MASSON.

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University, Durham.
Dec. 24.

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[1] Masson, Race and Pounder, *J. Chem. Soc.*, 1669 (1935).

[2] For example, Fichter and Kappeler, *Z. anorg. Chem.*, 91, 134 (1915).

[3] Skrabal and Buchta, *Chem. Z.*, 33, 1184, 1193 (1909).

Bromination of Halogenobenzenes in the Gaseous Phase; Influence of Temperature and Catalysts on the Substitution Type

IN continuation of preliminary experiments[1], we have studied the monobromination of bromobenzene, chlorobenzene and fluorobenzene in the gaseous phase at several temperatures between 380° and 500° C., in the presence of artificial graphite as a contact substance, under well-defined conditions of temperature and rate of gas flow. A few typical results are given in Table 1.

TABLE 1

Temperature	Bromobenzene 380°	440°	480°	530°	Chlorobenzene 375°	475°	Fluorobenzene 360°	500°
Percentage *ortho*	23	26·0	25	18·9	28	20	Not determined	
Percentage *meta*	25	47·2	51	59·0	20	53		
Percentage *para*	52	26·8	24	21·2	52	27	71	24

In these circumstances, the bromination of the halogenobenzenes belongs to the *ortho-para* type (according to the definition of A. F. Holleman[2]) at temperatures below 400°, but to the *meta* type at temperatures above 450°. These results are in disagreement with current theories on benzene substitution.

However, quite different results are obtained when the bromination is carried out with ferric bromide as a catalyst. Within the range 200°–450°, no change of substitution type is observed, but only a gradual change in the relative amounts of isomerides, as is shown in Table 2 for the bromination of bromobenzene:

TABLE 2.

Temperature	Percentage *ortho* Found	Percentage *ortho* Calc.	Percentage *meta* Found	Percentage *meta* Calc.	Percentage *para* Found	Percentage *para* Calc.
200°	16·6	17·3	8·0	7·0	75·4	75·7
250°	20·6	20·1	9·6	8·8	69·8	71·1
300°	23·4	22·4	9·8	10·6	66·8	67·0
350°	23·9	24·4	12·3	12·3	63·8	63·3
400°	25·9	26·2	13·4	13·8	60·7	60·0
450°	27·8	27·6	14·2	15·3	57·8	57·1

The theoretical aspect of the influence of the temperature on substitution reactions in the benzene nucleus has been treated by Scheffer[3]. Using his formula, we were able to calculate the relative proportions of isomerides formed: the agreement between calculated and observed figures is excellent.

It follows from our experiments that in the case of typical *ortho-para* directing substituents like fluorine, chlorine and bromine atoms, the nature of the substituent is not the only determining factor for the substitution type; but that the substitution reaction, in this case a bromination, may belong to the *ortho-para* type or to the *meta* type, depending on the temperature at which the reaction is carried out and on the nature of the catalyst. These new facts should be taken into account in any theory on benzene substitution.

Full experimental details will be published in the *Recueil des travaux chimiques des Pays-Bas*.

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[1] Wibaut, Van de Lande, and Wallagh, *Rec. trav. chim.*, 52, 795 (1933).

[2] Holleman, *Rec. trav. chim.*, 42, 355 (1923).

[3] Scheffer, F., and Kohnstamm, *Proc. Acad. Sci. Amsterdam*, 13, 789 (1911); Scheffer, F., *ibid.*, 15, 1109, 1118 (1913).

Degree of Dissociation of Bi-bivalent Salts in very Dilute Aqueous Solution

THE measurements carried out by Shedlovsky[1] of the equivalent conductivities of solutions of uni-univalent salts in aqueous solution are in good agreement at high dilution with the theoretical equation developed by Onsager[2], but such measurements of conductivities of bi-bivalent salts as are available indicate deviations from theory beyond the magnitude of possible errors of experiment. The equivalent conductivity in this case diminishes far more rapidly with rise of concentration than is predicted by Onsager's equation. Attention has been directed to this point by Davies[3], who calculates dissociation constants for this class of electrolyte. On the other hand, La Mer and collaborators[4] take the view that bi-bivalent electrolytes are completely dissociated in dilute aqueous solution, and support their contention by measurements of activity coefficients of zinc sulphate and cadmium sulphate.

The theory of Onsager has been extended to mixtures of electrolytes by Onsager and Fuoss[5]. According to this treatment of the problem, the mobilities of the cations in a mixed solution, for example, of potassium chloride and hydrochloric acid, are not the same as in solutions containing either of these substances at the same total concentration; and the effect of each cation on the mobility of the other has been calculated. The results have been applied to interpret experimental data for mixed partially dissociated electrolytes in non-aqueous solution by

Mead, Fuoss and Kraus[6]. In a mixed aqueous solution of two completely dissociated electrolytes containing two cations of practically equal mobility and a common anion, this effect should be negligible, and the conductivity of such a mixture should depend only on the mobilities of the ions and on the total concentration. In other words, if the equivalent conductivities of the two electrolytes separately are known over the appropriate range of low concentrations, it should be possible to calculate the conductivity of any mixture of the two, assuming that the conductivities are additive and depend only on the total concentration.

To test this point, I have measured the conductivities at 25° C. of very dilute aqueous solutions over the range 0·00005–0·001 equivalent of calcium and strontium dithionates and the corresponding sulphates, and of their mixtures in which dithionate and sulphate respectively are the common negative ions. The following results appear: (1) The corresponding calcium and strontium salts have almost the same equivalent conductivity throughout the range of concentrations examined. (2) The graph of the equivalent conductivity plotted against the square root of the equivalent concentration deviates sensibly from a straight line only at the highest concentrations examined (3) The slope of this line is in all cases much greater than that predicted by Onsager's equation, using values for equivalent conductivity at infinite dilution obtained by linear extrapolation over a range of a few units. (4) For calcium and strontium dithionates the observed slope is 506, the calculated slope 366 and the equivalent conductivity at infinite dilution 152; the corresponding figures for the two sulphates are 646, 354 and 142 respectively. (5) The salts with the higher equivalent conductivity at infinite dilution give the smaller slope, a result at variance with Onsager's equation. (6) The conductivities of all mixtures examined are additive, usually within the probable limits of experimental error, indicating complete dissociation.

It is intended to extend this work as opportunity offers to the selenates of calcium and strontium and to other bi-bivalent salts. The determination of activity coefficients in dilute mixed solutions, if practicable, should yield results interesting in this connexion.

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Brisbane. Nov. 10.

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[1] *J Amer. Chem. Soc*, **54**, 1411 (1932).

[2] *Phys. Z.*, **28**, 277 (1927).

[3] *Trans. Faraday Soc*, **23**, 351 (1927).

[4] *J. Amer. Chem. Soc*, **53**, 2040 and 4333 (1931).

[5] *J. Phys Chem*, **36**, 2689 (1932).

[6] *Trans. Faraday Soc.*, **32**, 594 (1936)

Surface Temperature of Rubbing Solids and the Formation of the Beilby Layer

RECENT letters[1] have discussed the structure of the Beilby layer, and it may be of interest to describe experiments which throw some light on the mechanism of its formation. Macaulay[2] has suggested that polishing is due to a melting of the surface, but the majority of investigators, Newton[3], Rayleigh[4], Herschel[5], French[6], Adam[7], Hamburger[8], considered that the process is essentially one of abrasion. French embedded a thermometer in the polisher, and concluded that the rise in temperature of the surfaces was negligibly small.

If the sliding contact of two different metals is used as a thermo-couple, the surface temperature can be measured. Experiments show that the local temperatures at the points of contact may be very high; under many conditions of sliding, sufficiently high to cause a real melting of the metal[9]. Even if the surfaces are well lubricated or flooded with water, these local high temperatures still occur. In the case of non-metals of low thermal conductivity such as glass, silk, alumina, etc., the surface temperatures will be very much higher. This localized frictional heating should play a large part in the process of wear, surface flow and polishing of solids. If this view is correct, we should expect the process to be greatly influenced by the *relative melting point* of the polisher and solid. If the polisher melts or softens at a *lower* temperature than the solid, it will melt and flow first, and will have comparatively little effect on the solid. Experiment has shown this to be the case. Surface flow, polish and the formation of the Beilby layer readily occurred on metals, crystals and glasses, provided the melting point of the polisher was higher than that of the solid. The *relative hardness* as normally measured at room temperature was comparatively unimportant.

For example, *camphor* (m.p. 178° C.) readily polished Wood's alloy (m.p. 69° C.) which melts below it, but would not polish higher melting metals such as tin (m.p. 232° C.). *Oxamide* (m.p. 417° C.) polished tin, type metal, etc. and all solids melting below 417° C., but had no effect on speculum metal (m.p. 745° C.). *Lead oxide* (m.p. 888° C.) polished speculum metal, but had no effect on nickel (m.p. 1452° C.) and molybdenum (m.p. 2470° C.). Similar results were obtained for numerous glasses and crystals. Calcite, for example, which melts at 1333° C., was readily polished by *zinc oxide* (m.p. about 1800°) but not by *cuprous oxide* (m.p. 1235° C.) or *oxamide* (m.p. 417° C.). The mechanical strength of many solids falls to a low value at temperatures well below the melting point, so that appreciable surface flow can occur at these lower temperatures. This has been observed in many cases.

The process of polishing is a complicated one, and will be discussed more fully elsewhere. These experiments indicate, however, that an important part of the process is an intense local heating at the points of contact. The melted or softened solid flows, or is smeared, over the surface, and very quickly solidifies to form the characteristic Beilby layer. The extent to which this layer is microcrystalline or 'amorphous' will naturally depend upon the conditions of polishing, rate of cooling, etc., and upon the physical properties of the solid. If oxidizable solids are polished in air, we should expect this local heating to cause rapid surface oxidation. Electron diffraction experiments[10] have shown that the polished layer on copper and aluminium is, in reality, metallic oxide.

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[1] Finch, NATURE, **138**, 1010; **137**, 516 (1936).

[2] NATURE, **118**, 339 (1926).

[3] "Opticks" (Book II), 68 (1704).

[4] "Coll. Works", **4**, 452.

[5] "Encyclopedia Metropolitana", Optics, 447 (1830).

[6] NATURE, **119**, 527 (1926).

[7] NATURE, **119**, 162, 279 (1926).

[8] NATURE, **130**, 435 (1932).

[9] Bowden and Ridler, *Proc. Roy Soc.*, A, **154**, 640 (1936).

[10] Dobrinski, NATURE, **138**, 31 (1936). Preston and Bircumshaw, *Phil. Mag*, **148**, 654 (1936)

Are Viruses Organisms or Autocatalysts?

(1) THE absence of a limiting surface between the material of a virus and its host; (2) the high speed of the transmission of its characteristic symptoms (10–30 cm. per hour) in the tissues of the host; (3) its rapid increase; (4) the vanishingly small quantities needed for inoculation, made me many years ago form the opinion that viruses are more properly regarded as autocatalytic substances than as specific organisms From 1922 on, I have mentioned the idea in my lectures.

This view is now strikingly supported by Stanley's separation from a virus-infected plant of a crystallizable protein, which, when inoculated into a healthy one, produces the symptoms of the virus disease[1]. From the work of Bawden, Pirie, Bernal and Fankuchen[2], it further appears that the molecules of this protein are rod-shaped and are built up of sub-units of the same character.

The facts recently emphasized in Dr. John Caldwell's article[3], namely, that viruses spread most rapidly from growing tissues, where presumably the sub-units of the protoplasmic proteins are in great abundance, and that they travel from cell to cell by way of the plasmodesmata, accord well with the autocatalytic theory. Furthermore, they cannot penetrate through a barrier of dead cells, or through unperforated cell-walls.

No doubt the present workers will test, or have already experimentally tested, the ability of Stanley's protein to catalyse its own production in the extracts from otherwise uninfected cells. It must be remembered that Olitsky has already reported that he has been able to cultivate tobacco mosaic in a simple medium presumably free from cells[4].

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[1] *Phytopathology*, 26, 305 (1936)

[2] NATURE, 138, 1051 (Dec. 19, 1936)

[3] NATURE, 138, 1005 (Dec 19, 1936)

[4] *Science*, 60, 593 (1924)

Spontaneous Chromosome Changes in Pollen Grains

IN preparations showing the first post-meiotic mitosis in pollen grains of two genera, *Tradescantia* and *Hyacinthus*, I find evidence of spontaneous structural changes in the chromosomes occurring with a high frequency. Some of these changes are of the kind that can be produced artificially by the action of X-rays on the post-meiotic resting stage. They depend on breaks and rejoins between chromosomes or chromatids, according to whether the changes occur before or after the chromosomes have split (Riley[1]. Mather unpub.). These breaks and rejoins lead to the formation of dicentric chromatids and acentric fragments (those having two or no centromeres or spindle attachment chromomeres respectively[2]). At anaphase and telophase the dicentric chromatids form bridges connecting the two daughter nuclei, while the fragments lie passively on the equator.

I have found bridges of this kind in *T. virginiana* ($2n = 18 = 3x$) (Fig. 1*a*). One or more bridges may be present together with a corresponding number of fragments, although these are occasionally not visible. The free arms of the bridges may be equal (Fig. 1*a*) or unequal, showing that at least in some cases non-homologous chromatids have joined up. The difference of size between the chromosomes in this species, however, is slight, so that they are not individually recognizable Cells containing these bridges often occur in groups of two or three, although the aggregate number of changes observed is only of the order of ten or twelve in each flower. The original frequency of change must be greater than this, since the results can be readily detected only at anaphase, and a small proportion of nuclei only are undergoing mitosis at any one time.

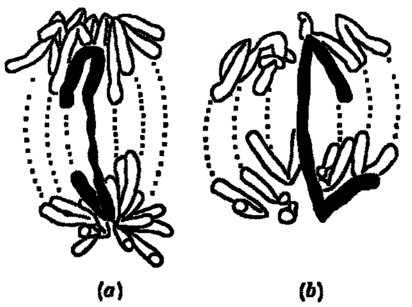

Fig. 1

ANAPHASE OF POLLEN GRAIN DIVISION IN UNTREATED MATERIAL OF (*a*) *Tradescantia virginiana* ($3x = 18$) AND (*b*) *Hyacinthus orientalis* VAR. "WILLIAM MANSFIELD" ($2x = 16$). EACH CELL CONTAINS A DICENTRIC CHROMATID FORMING A BRIDGE. NO FRAGMENT IS VISIBLE. × 1600.

In *Hyacinthus orientalis* variety "William Mansfield" ($2n = 16 = 2x$) (Fig. 1*b*), similar bridges occur with a somewhat lower frequency, but acentric fragments have not usually been seen with them. The bridge is always formed from one of the long chromosomes, and its free arms are always equal. The separation of the remaining chromosomes is normal and there is no evidence of non-disjunction. In such cases, therefore, one of the chromatids of the bridge chromosome must have joined up with its sister, as may also happen with induced changes (Husted[3]). Since fragments are rarely seen, and since the bridge appears to be approximately equal in length to the sum of the free arms (all the long chromosomes have median centromeres), it is presumably the ends that have joined. This conflicts with previous inferences of the inability of chromosome ends to fuse[2].

These structures cannot be the result of crossing-over in inversions at meiosis, since one and not two sister chromatids form the bridge, and further, in the case of the diploid, the normal complement of chromosomes excludes the possibility of non-disjunction. They are therefore the result of spontaneous changes, and changes which differ in both character and frequency from those hitherto inferred.

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Dec. 17.

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[1] Riley, H P., *Cytologia*, 7, 131 (1936)

[2] Darlington, C. D, "Recent Advances in Cytology" (2nd ed., London, 1937).

[3] Husted, L., *Genetics*, 21, 537 (1936).

The Hexlet

DR. FRANK MORLEY has given in NATURE of January 9, p. 72, a very elegant proof of my hexlet theorem which incidentally has enabled me to solve, almost at sight, a further problem on which I had been spending fruitless months. He derives the hexlet with its attendant trio in general from a very simple assemblage, by inversion, namely, from a central sphere surrounded by a ring of six equal spheres between two parallel planes, or spheres of zero bend. The latter invert into two of the spheres of the trio, the central sphere being the third.

To the engineering type of mind at any rate, if not the mathematical, it would be a help to the better understanding of the hexlet if there were some fixed point that could be regarded as the centre and which could be taken as the origin of co-ordinates. I have known for long that the points of serial contact of the infinite necklace of serially touching circles, all in contact with a pair of circles which touch each other, lie on a circle the bend of which is half the difference of the bends of the pair. I therefore expected that the six serial contacts of the hexlet would lie on the surface of a sphere, the centre of which would form the natural fixed point desired.

It is obvious from Dr. Morley's originating assemblage that this is true. The plane midway between the two parallel planes, which contains the six serial contacts and the six contacts of the individual beads of the hexlet with *one* of the trio, also inverts into a sphere the surface of which cuts all the twelve contacts enumerated orthogonally and passes between the other two members of the trio at their point of contact tangentially. Its radius and centre must therefore be those of the 'circle of contacts' of the plane figure, when the assemblage is sectioned through the plane containing the centres of the trio. That is, the centre of this 'sphere of contacts' lies on the line through the centres of the two of the trio between which it passes tangentially, and its bend is half the difference between the bends of these two. I have established this *ab initio*.

The beauty of these propositions, concerning four mutually touching circles and five mutually touching spheres which underlie these assemblages, is that there is absolutely no distinction mathematically between the four circles or five spheres, respectively. It follows that there are, centred in the plane containing the centres of the trio, three different 'spheres of contacts' to each hexlet, intersecting each other, all of which contain the six points of serial contact of the hexlet, and each of which in addition contains the six points of contact of the individual beads of the hexlet with one of the trio, and the point of contact of the other two. This obscured the problem until Dr. Morley's letter furnished the clue. I had actually obtained the correct solution, but since only two of the trio were involved had rejected it as impossible!

Since the line of intersection of spheres is a plane circle, and the six serial contacts of the hexlet lie on the intersection of three spheres, the latter must intersect in the same circle, so that their centres must be in line. I am indebted to Mr. Hodgkinson here for identifying this line for me as one of the axes of similitude of the trio (see Casey's "Sequel to Euclid", 2nd ed., p. 84). It follows that the centres of the six spheres of the hexlet and the six serial contacts lie in a plane. This much simplifies the nature of the assemblage.

The bend, $\varkappa$, of the circle of six serial contacts of the hexlet is given by

$$3\varkappa^2=\alpha^2+\beta^2+\gamma^2-(\alpha\beta+\alpha\gamma+\beta\gamma)$$

or

$$3\varkappa^2=\alpha^2+\beta^2+\gamma^2-\rho^2,$$

where α, β, γ and ρ are the bends of the trio and of the circle inscribed in the triangle joining their centres, respectively. The second form is applicable without ambiguity only when all the bends are positive. By similar reasoning, the contacts of the six beads of the hexlet with each of the trio, respectively, must also lie on a plane circle.

Any hexlet may be fixed and the individual bends of the trio varied, so long as both the sum, and the sum of the squares, of the three bends remain unchanged. So long as the bends of any hexlet associated with a given trio are all positive, one of the bends of the trio may be made zero without changing the hexlet. Thus every such hexlet may be touched by two planes on either side of and equally inclined to the plane of its centres (since it is symmetrical with respect to this plane). This interesting property was discovered experimentally for some of the hexlets of the model illustrated in NATURE (Jan. 9, 1937, p. 78) by Mr. F. March, the mechanic of the Old Chemistry Department, who constructed it. In the limiting case where the bend of one of the beads of the hexlet at its minimum becomes zero, the two planes converge into one normal to the central plane of the hexlet.

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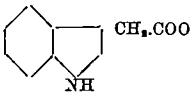
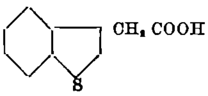
Synthetic Plant Growth Hormones

INDOLE-β-acetic acid or heteroauxine (I) is a product found in normal urine and is well known to have great growth-promoting action on plants, as shown by both the bending of the decapitated oat (*Avena*) and the pea curvature tests.


(I)


(II)

Thionaphthene-β-acetic acid (II) has been synthesized as follows: Thionaphthene → β-bromothionaphthene → thionaphthene-β-carboxylic acid chloride → β-thionaphthene acetic acid, using the reaction of F. Arndt and B. Eisert[1]. The compound melts at 109°, and has a much smaller growth activity than might be expected from its similarity with (I). The oat and pea tests are given by concentrations greater than 1 in 70,000 and 1 in 100,000 respectively, whilst (I) gives a response in dilutions about thirty times greater. It is interesting that an isomeric thionaphthene acetic acid, m.p. 141°, in which the position of the acetic acid group is not yet known, has about the same activity towards peas as (II), but is without effect on oats. A positive response by one method of testing and a lack of response by another method is not unknown; K. V. Thimann[2] shows that coumaryl-*l*-acetic acid gives a positive pea test but no activity in the oat bending test. This and other evidence indicates that the two tests are not necessarily strictly comparable.

Naphthalene-α-acetic acid is several times more powerful than (II), as shown by both oat bending and pea tests. As these two compounds and (I) have many close chemical analogues, it is evident that the biological response is sensitive to very minute changes in the structure, or perhaps diffusibility, of the substances applied.

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[1] *Ber.*, 68, 200 (1935)

[2] *Proc Acad. Sci. Amsterdam*, 38, 896 (1935). Read in *Chemical Abstracts*, 30, 2600 (1936)

Carotene Therapy of Retinitis Pigmentosa

THE loss of dark adaptation and night blindness which characterizes the earliest stages of retinitis pigmentosa suggested to us the possibility that one of the fundamental features of the pathological physiology of the disease is failure of utilization of carotene and vitamin A.

Feeding of these substances by mouth in large doses was found to have no effect upon the course of the disease or upon the symptoms in question. We thereupon administered carotene in oil intramuscularly in a series of cases, and were gratified to find a rapid and prompt response and relief of the night blindness. We administered carotene in doses of 30,000–60,000 New U.S.P. units intramuscularly, one to three times a week in our cases. In all the early cases of retinitis pigmentosa, improvement began to be noticeable within one week after institution of therapy; and dark adaptation became comparable to normal, and in some cases, normal within one to four months, with a corresponding improvement in the night blindness. In the more advanced cases with extensive chorio-retinal atrophy, no improvement has yet been noticed.

Our findings indicate that in retinitis pigmentosa there is a failure of assimilation of vitamin A and its precursors. We are planning a study of this phase of the subject. Another finding of interest is that, judging by the response of the cerebral circulation to bilateral carotid pressure—epileptiform convulsions and more or less prolonged loss of consciousness or coma—the arterial circulation of the brain of these cases is as much impaired as is that of the eye.

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Diphenyl Compounds and Mammary Growth

DODDS and Lawson[1] have found that it is possible to obtain the œstrus response in castrated animals with substances which do not contain the phenanthrene nucleus. Various dihydroxydiphenyl compounds were tested and found to be active if the two hydroxyl groups were in the *para* position. Certain other compounds, for example, diphenyl-α-naphthyl carbinol, were also found to be active.

Since these substances have œstrogenic properties, it might be expected that they would also function as initiators of mammary growth. Three compounds have been investigated for this effect, *p*-*p*′-dihydroxy diphenyl, 4-4′-dihydroxy-3-3′-dimethyl diphenyl, and diphenyl-α-naphthyl carbinol. The compounds, suspended in sesame oil, were injected subcutaneously into young adult male guinea pigs, 100 mgm. being given once a week for three weeks.

With the diphenyl-α-naphthyl carbinol, nipple growth commenced in a few days, and at the end of the three weeks the nipples had reached a size comparable to that at the end of the first pregnancy in the adult female. Histological examination revealed a limited duct growth, and several fairly extensive lobules of acinar tissue were present. Since the testicles were enlarged, and in some cases protruded through the abdominal wall, it is possible that the compound produced its effect through the endocrine system, and that the mammary response is perhaps due to increased secretion of testosterone. Collip, McEuen, and Selye[2] have found that testosterone can cause the development of acinar tissue in the mammary glands of male animals, though Turner and Gomez[3] state that œstrogenic hormones cannot cause growth of mammary parenchyma in completely hypophysectomized animals, the only effect observed being an extensive growth of the nipple. The answer to the question whether diphenyl-α-naphthyl carbinol acts directly or indirectly in promoting mammary growth must therefore await the results of experiments with castrated and hypophysectomized animals.

In the doses given, the *p*-*p*′-dihydroxy diphenyl caused a slight but definite response, while the 4-4′-dihydroxy-3-3′-dimethyl diphenyl was inactive.

These observations were made during the progress of some experiments designed primarily to investigate the possible effect of the above compounds on lactose synthesis in the mammary gland.

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[1] Dodds and Lawson, NATURE, 137, 996 (1936).

[2] Collip, McEuen and Selye, *Amer J. Physiol.*, 116, *Proc*, 29 (1936) *Proc. Soc. Exp Biol*, *N.Y.*, 34, 201 (1936).

[3] Gomez and Turner, *Proc. Soc. Exp. Biol N.Y*, 34, 320 (1936).

Temperature Variation of the Abnormal Unidirectional Diamagnetism of Graphite Crystals

As is well-known, graphite crystal exhibits some remarkable magnetic properties. The susceptibility along the hexagonal axis of the crystal, $\chi_{\parallel}$, is about -22×10^{-6} per gm., at room temperature, while that along directions in the basal plane, $\chi_{\perp}$, is $-0{\cdot}5 \times 10^{-6}$ only[1]—the latter value being nearly the same as that of diamond. The abnormal diamagnetism of graphite is thus more or less confined to one direction. Further, this abnormal diamagnetism is very sensitive to any chemical treatment of the crystal. For example, on treating the crystal with a mixture of strong nitric and sulphuric acids, when it swells up to 'blue graphite', $\chi_{\parallel}$ diminishes numerically from -22×10^{-6} to less than -2×10^{-6}, whereas $\chi_{\perp}$ remains practically unchanged. Also an indefinite diminution in the size of the crystal appears to have the same effect.

We have recently studied the temperature variation of the principal susceptibilities of graphite, and the results may be of some interest in connexion with recent discussions on the contribution of 'free' electrons to diamagnetic susceptibility and its dependence on temperature[2]. The results are represented graphically in Fig. 1. As will be seen from the curves, the magnetic anisotropy of the crystal, namely, $\chi_{\parallel} - \chi_{\perp}$, which was measured directly, diminishes numerically from about -28×10^{-6} at 140° K., to about $-7 \cdot 8 \times 10^{-6}$ at 1,270° K., whereas the corresponding variation of $\chi_{\perp}$ is from about $-1 \cdot 4 \times 10^{-6}$ at 100° K., to $-0 \cdot 5 \times 10^{-6}$ at room temperature, and to $-0 \cdot 4 \times 10^{-6}$ at 940° K.

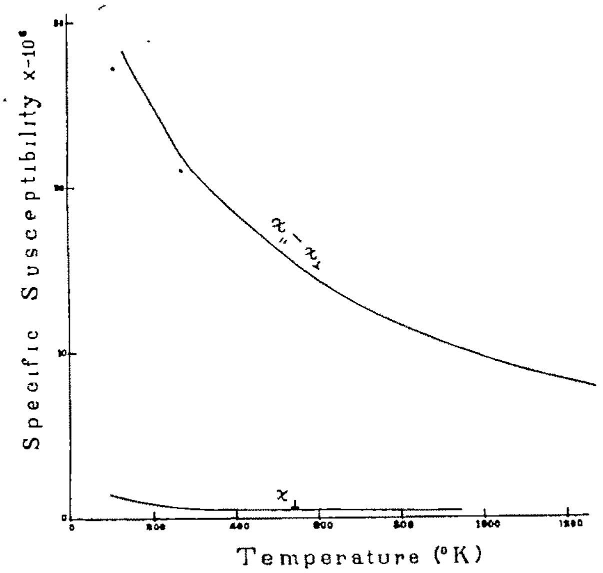

Fig. 1.

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Dec. 3.

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[1] NATURE, 133, 174 (1934); *Ind. J. Phys.*, 8, 345 (1934); *Current Science*, 3, 472 (1935), *Phil. Mag.*, 21, 355 (1936).

[2] See Shoenberg and Zaki Uddin, *Proc Roy. Soc.*, A, 156, 687 (1936); and Stoner, *Proc. Roy. Soc.*, A, 152, 672 (1935)

Examination of Passive Iron by Electron Diffraction

BY Dr. U. R. Evans's method[1] of electrolysis, almost transparent thin films were detached from the surface of electrolytic iron made passive by immersion in potassium chromate solution. These films were examined by means of a cathode ray of about 50 kilovolts. Spacings of the diffracting substance were calculated from the diameters of several diffraction rings and it was found, as the accompanying table shows, that the films are composed of γ-Fe_2O_3 or Fe_3O_4.

Rings	Indices of planes	Spacings (A.)	Side of unit cube (A.)
1	(200)	4·22	8·44
2	(220)	2·95	8·34
3	(311)	2 51	8·32
4	(400)	2 07	8·29
5	(422)	1·68	8·24
6	(440)	1·48	8·38
7	(600)	1·39	8·34

mean a_0 = 8·34 A.
a_0 for Fe_3O_4 (X-ray) = 8·37 A
a_0 for γ-Fe_2O_3 (X-ray) = 8 4 A.; 8·30 A.

As γ-Fe_2O_3 and Fe_3O_4 have almost the same spacings, it is impossible to distinguish between the two oxides. From chemical tests, however, we believe this oxide to be γ-Fe_2O_3. The films are ferro-magnetic and it is certain that they are not α-Fe_2O_3, contradicting the views of many previous workers. Good films are difficult to detach from the surface of iron (not passive) polished in air; but a few samples, fortunately obtained after considerable efforts, proved to be also γ-Fe_2O_3. The conclusion is that passive iron is a state of iron the surface of which is covered in a perfectly compact manner by a thin film of γ-Fe_2O_3. No clear diffraction pattern was obtainable by the reflection method, but three spacings (4·22 A., 2·51 A. and 1·48 A.) were calculated from the vague rings. No rings were observed by the reflection method from iron made passive in concentrated nitric acid, and no film was detached from it.

Details will be reported in the Scientific Papers of this Institute.

ICHIRÔ IITAKA.
SHIZUO MIYAKE.
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Institute of Physical and
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Tokyo.
Dec. 10.

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[1] Evans, U. R., *J. Chem. Soc.*, 127, 1020 (1927).

Geodesics within Matter

THE difficulties regarding the physical interpretation of null-geodesics and time-like geodesics inside matter, discussed in a recent letter by Dr. Silberstein[1], may be met by recourse to a process analogous to that employed in the classical theory of attractions. Thus, to measure intensity of force at a point in a medium, we carve out a small cavity and measure the force (or acceleration of a free particle) in the cavity.

There does not appear to be any difficulty in accepting Einstein's postulates that null-geodesics give the histories of light-pulses and time-like geodesics the histories of free particles, provided that in the application of these principles inside a continuous medium we understand that a thin tunnel in space-time is hollowed out to allow the light-pulse or particle to travel freely *in vacuo*. On that understanding, the Newtonian acceleration inside a small cavity in a liquid sphere agrees with the Einstein acceleration, as expressed in Dr. Silberstein's letter.

J. L. SYNGE.

Department of Applied Mathematics,
University of Toronto.
Dec. 23.

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[1] NATURE, 138, 1012 (1936).

Feeding Habits of Stick Insects

IN reference to the communication from Mr. Sidney T. E. Dark[1], and the observations from the Notre Dame Training College, Glasgow[2], relating to the eating of dead cellulose by *Carausius*, it may be of interest to record that these insects will occasionally eat paper.

When, some years ago, living stick insects were placed on exhibition in this Museum, temporary labels were suspended inside the cages. The labels were of two kinds, some of common white card resembling Bristol board, but not so tough, and others of thin strawboard faced with white paper. Some of the adult insects used to feed on the edges of these labels—arranging themselves astride the labels in the same attitude as when they fed on the fresh privet leaves with which they were provided. In the course of two or three days, the labels—particularly those of strawboard—were so mutilated and diminished in size as to be useless, and they had to be removed and replaced by others protected by glass The insects were not observed to eat their sloughs; the nibbling of the antennæ of individuals in an akinetic condition seems to be a common habit of those in captivity.

H J SARGENT

The Museum,
Bexhill
Dec. 30.

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[1] NATURE, 138, 1058 (1936)
[2] NATURE, 138, 886 (1936)

Adjustable Resonators and Orchestration

THE major difficulty in adopting Prof. Osborne's idea[1] of adjustable resonators in orchestral instruments is that it is not easy to make a change of pitch in an instrument without a change of quality. The same is true, to a less extent, of the voice. The wood-wind have resonators the length of which is adjusted to vary the pitch, but there is a consequent difference in timbre between the upper and lower notes of their registers, notably in the clarinet. To preserve the same quality while the pitch varies would involve a complicated system of levers to alter the bore of the—presumably flexible—tube, which would render the execution of rapid passages impossible. On keyboard instruments, with one or more vibrators to each note, another difficulty would arise. Adjustments of the resonator would react on the vibrator, whether string, reed or edge tone, to such an extent as to cause considerable changes of the intensity, or even complete stoppage of the sound

Sounds received by membranes loaded on one side—to imitate the ear-drum and associated ossicles—have been analysed by Waetzmann[2]. His object was to find how much distortion was introduced by this asymmetric loading of the receiver, and he was thus able to explain the formation of 'subjective' combination tones in the ear.

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Armstrong College,
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Dec. 22.

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[1] NATURE 138, 1050 (1936)
[2] *Z Phys*, 1, 271 and 416 (1920).

Points from Foregoing Letters

BY growing sunflower plants which have already developed their lower leaves in nutritive solutions containing radioactive phosphorus, Prof G. Hevesy, K. Linderstrom-Lang and C. Olsen find that, as in the case of the maize plant, a considerable migration of phosphorus atoms takes place from the lower to the upper leaves during the subsequent growth The bulk of the phosphorus is present as inorganic phosphate, and probably moves about in the plant, but none of it escapes when cut leaves are placed in a nutritive solution. Germinating maize and pea seeds take up the labelled (radioactive) phosphorus in the germ but not in the endosperm, showing that there is no phosphorus exchange between the two.

Prof. Irvine Masson reports a number of new interrelated facts in the organic and inorganic chemistry of iodine, including the one-stage formation of aromatic iodonium salts, the direct replacement of aromatic hydrogen by the iodoso-group by a new substituting reagent, and the principles controlling the reactions between iodine, its pentoxide and its sesquioxide and a coloured suboxide, especially in sulphuric acid media.

Tables showing the influence of temperature and catalysts upon the position (*ortho-*, *meta-*, *para-*) taken by bromine and other halogen atoms when they are substituted in the benzene molecule are given by Prof. J. P. Wibaut and M. van Loon.

Some measurements of the conductivity of mixed solutions of bi-bivalent salts are described by E. A. O'Connor These are considered to favour the complete dissociation theory, although the measurements are not in agreement with the results to be expected from Onsager's equation

Dr. F. P. Bowden and T. P. Hughes give examples showing that polishing takes place when the melting point of the polishing material is higher than that of the solid to be polished. The relative hardness, as normally measured at room temperature, is comparatively unimportant. This agrees with the observations that the high temperatures developed during friction are sufficient to cause surface flow. Such high temperatures have been observed at the sliding contact of two different metals acting as a thermocouple

Using as criteria of 'organisms' the presence of a limiting surface, low speed of transmission, slow rate of increase, and lack of crystallinity, Prof. H. H. Dixon classifies viruses as autocatalysts and not as organisms.

Structural changes in the chromosomes of the pollen grains of the hyacinth and of *Tradescantia* are described by Miss M. Upcott These changes are apparently due to breaks and rejoins between the chromosomes and lead to the formation of bridges connecting the two daughter nuclei during certain phases of the division process (anaphase and metaphase).

Several new properties of the "hexlet" and propositions concerning four mutually touching circles and five mutually touching spheres are described by Prof. F. Soddy.

The growth-promoting effects upon oat and pea seedlings of certain synthetic organic compounds (thionaphthene-β-acetic acid, coumaryl-*l*-acetic acid) are briefly described by E. M. Crook, Dr. W. Davies and Miss N. E. Smith. There are indications that the pea and oat tests of these compounds are not strictly comparable.

Favourable results in the treatment of night-blindness by intramuscular injection of carotene or vitamin A are reported by Drs. E M. Josephson and M. Freibergor.

According to Prof. J. L. Synge, if thin tunnels of matter are removed from a continuous medium to permit the free passage of a light-pulse or particle, the difficulties recently raised by Dr. L. Silberstein, regarding the physical interpretation of Einstein's geodesic principles inside matter, disappear.

Research Items

Prehistoric Motives in Modern Chinese Art

MR. CARL SCHUSTER, who is at present engaged in collecting examples of folk design in western China, chiefly in the form of cross-stitch embroidery, points out in *Man* of December that these designs often show a marked divergence from the rest of Chinese art, and are evidence of early foreign influence. The design here under consideration in particular is a wavy line similar to the M or W marks which occur frequently in archaic Greek pottery and in predynastic Egyptian art, where they have been interpreted by Herbert Kuhn as signs for water and, by extension, for fertility. This interpretation has also been applied to the zig-zag which appears in European prehistoric pottery from neolithic to iron age times. The suggestion is supported by their occurrence on vessels which would have been used for storing liquid A favourite motive in western Chinese embroidery design is a vessel, out of which grows a plant, the Tree of Life. On these pots the zigzag decoration is persistent, but it rarely appears in any other examples of this class of work. The zigzag as a mark on vessels is not confined to embroidery. It also appears on vessels in stone carving, as, for example, on a wayside shrine. It also appears in blue tape on the seat covers of the rickshaws of the city of Ch'ungking in Szech'uan, where it forms an essential part of the design, though this has been much simplified. In the embroidery designs, folk art has sometimes borrowed from the professional. It shows the 'professional' scale pattern on the bottom of the vessel, while the popular zigzag appears on the neck, thus expressing the same idea in two 'languages'. As these embroideries are some eighty years old and are not made by the present generation, no trustworthy account of their meaning can be obtained. Of the alternative origins, independent invention and an unbroken cultural transmission, the latter is thought to be the more probable.

Tumours Transplantable with Viruses

DR. W. E. GYE and Dr F. Pentimalli each discuss the problem of the transmission of tumours from one animal to another by means of viruses, in papers read at the cancer congress in Brussels last autumn ("Reports of the Second International Congress of Scientific and Social Campaign against Cancer", Brussels, 1936). It is twenty-five years since Peyton Rous discovered fowl tumours which could be transmitted to other fowls with cell-free filtrates The agent concerned in the transmission of these tumours is particulate and approximately 0·1 micron in diameter. With the growth of the tumour, these particles multiply, but the fact that they never increase outside the cells of the host and that their behaviour in immunological reactions is like that of proteins suggests that they are non-living agents. Peyton Rous has recently experimented with a papilloma of a cotton tail rabbit which can be filtered like other viruses, and this virus injected into an animal bearing a non-malignant papilloma produced by painting with coal tar causes such a papilloma to become rapidly malignant. Dr. Gye suggests that the carcinogenic tar prepares the tissue so that it gives a malignant reaction to a virus When the virus of a fowl tumour is injected into mammals, the mammalian serum acquires the power of neutralizing the virus of the tumour, and this anti-tumour serum will inactivate extracts of the original tumour and of other fowl tumours even without complement. If extracts of normal fowl tissue are injected, the mammalian serum will only neutralize the fowl tumour virus in the presence of complement and differs from the anti-tumour serum in that the tumour neutralizing power is absorbed by normal fowl cells. The tumour virus thus seems to have two parts, one probably typical of the fowl and another more specific part possibly derived from nuclear material from the malignant tissue.

Japanese Cœlenterates

IN 1935 (*Mem. College of Science, Kyôtô Imperial University*, Series B, 10), Dr. Taku Komai described *Stephanoscyphus*, the scyphostome stage of the primitive peromedusa *Nauritho*ё from shallow waters around Seto. He now finds a second form ("On Another Form of *Stephanoscyphus*, found in the Waters of Japan", *ibid.*, 11, No. 3; 1936) of this peculiar cœlenterate, which is probably specifically distinct. This is provided with conical projections on the inner wall at regular intervals, exactly as in the forms previously described by Allman and Schulze from the Mediterranean, and these projections are absent in the specimens from Seto. On this feature and other differences, the author classifies the genus *Stephanoscyphus*, distinguishing four different kinds. In a second paper ("The Nervous System of Some Coelenterate Types. (1) *Coeloplana*") the same author uses the vital staining method with rongulit white. He finds that in *Cœloplana bocki* the dorsal side contains no nerves except in the marginal zone where nerve cells, probably sensory, are found in abundance. The ventral side shows nervous elements all over, but especially in the marginal region. In the polar plates "nerve-cell-like" bodies occur in the region between the central and marginal areas. Otherwise there is no element resembling nerves in the sense-organ or in the parts surrounding it.

The Sub-Genus *Protoperidinium*

IN a recent paper (Report of the Biological Survey of Mutsu Bay, 30. Notes on the Protozoan Fauna of Mutsu Bay. III, Sub-genus *Protoperidinium*: Genus *Peridinium*. *Sci. Rep. Tôhoku Imp. Univ.*, Fourth Series (Biology), Sendai, Japan, 11, No. 1. July 1936), Tohru Hidemiti Abé re-adopts the sub-genus *Protoperidinium* Gran and Paulson in a somewhat modified form, whilst Dr Bohm (Bull. 137, Bernice P. Bishop Museum) does not use it at all. Dr. Abé's paper only includes 7 species, 4 of which are new, and none of these is mentioned in Bohm's paper. The subdivision of the genus *Peridinium* is always controversial, and the fact that Dr Abé has found a close relation between the general features of the ventral area and its plate patterns on one hand, and the type of the hypotheca other than the ventral area on the other hand, together with some diversities in the type of ventral area and constancy in the structural relations of this area, seems to be a distinct advance in our knowledge of the structure of these forms. Six groups are recognized in the sub-genus, three of which are here considered, the other three being left for a later paper. The details of the ventral area in the species described are beautifully figured, and the paper is an important contribution to the morphology of the genus.

Germinal Layers and the Larva in Amphibia

IF a slit be made in the neurula of an Amphibian egg, it is possible by means of glass needles and a hair loop to remove the internal germinal layers, that is entoderm and mesoderm, entirely, or such parts of them as may be selected. O. Mangold (*Naturwiss.*, Nov. 27, 1936) has employed this method to analyse the extent of the co-operation between the germinal layers in the formation of the larva. The removal of the entire entoderm may result in a fairly normal embryo in appearance but lacking gill slits, gill bars, alimentary canal except for the ectodermal proctodœum, most of the blood corpuscles; also the heart is only poorly developed. On cutting the embryo transversely and removing the entoderm from the two halves, the front half develops into a more or less distorted head end often associated with the approximation of the eyes or the establishment of a cyclopic condition. The tail half produces an almost normal tail end including a proctodœum. If the entoderm is extracted whole, the anterior fifth swells to form a vesicle representing the fore gut, but the hinder four fifths remain in a clump not forming liver, pancreas, stomach, etc. Further experiments include the insertion of the entoderm of *Triton tæniatus* into the ecto- and mesoderm of *T. alpestric* in a normal, inverted, or reversed position.

Cordyceps and *Isaria* Fungi

Cordyceps militaris is one of the spectacular fungi; it forms perithecia upon lepidopterous larvæ. *Isaria farinosa* is also an entomogenous fungus which occurs upon a wide variety of insects, from which it produces small white, floury conidiophores. The mycologist Tulasne considered *I. farinosa* to be the conidial stage of *C. militaris*, and though considerable doubt prevailed, his conclusions were generally accepted. Mr. T. Petch has recently elucidated the problem (*Trans. Brit. Mycol. Soc.*, 20, Parts 3 and 4, Nov. 1936). He has shown that the two fungi are quite distinct. The conidial stage of *C. militaris* is not *Isaria*, but a species of *Cephalosporium*. The perithecial stage of *I. farinosa* is unknown; it has no connexion with *Cordyceps*.

Lilacs

THE term lilac is usually interpreted to mean the European shrub *Syringa vulgaris*. Flowers of this plant are indeed beautiful, but a paper by Mr. H. G. Hillier (*J. Roy. Hort. Soc.*, 61, Part 11; 1936) shows that most of the other twenty-seven species of the genus *Syringa* are no less worthy of attention by gardeners. Lilac species are, with the exceptions of *S. vulgaris* and *S. Josikaea*, Asiatic plants, and their advent to horticulture is due to the activities of plant collectors in comparatively recent times. *S. japonica*, *S. pekinensis*, *S. reflexa* and *S. pinnatifolia* are specially commended for attention by virtue of the photographs which embellish the paper, but full descriptions of many other species also appear. Practical considerations of propagation and culture, and a comprehensive description of varieties of the common lilac, are also included.

Non-Disjunction and Trisomics in *Oenothera*

AN analysis of the disjunction arrangements in an *Oenothera* having a ring of fourteen chromosomes has been made by Mr. C. E. Ford (*J. Genetics*, 33, No. 2), who found a non-disjunctional arrangement in 46 per cent of the pollen mother cells. In *O. biennis*, with rings of 6 and 8, he found only 17 per cent. In the ring of fourteen, three cytologically distinguishable types of non-disjunction were recognized: (1) double non-disjunction on opposite sides, (2) on the same side, (3) three-in-a-row non-disjunction. Three varieties of type (1) will occur, but all will produce non-viable gametes. Type (3) leads to the formation of type *A* gametes, having all the chromosomes of one complex plus one from the other complex, and certain classes of them will be viable. In type (2) the disjoining chromosomes may be separated by 1 and 9, 3 and 7 or 5 and 5 chromosomes in the ring, thus forming the *B*, *C* and *D* types of 8-chromosome gametes. There will be 14, 14 and 7 different gametes of these types respectively, thus making a total of 49 possibly viable different 8-chromosome gametes. As non-disjunction occurs in the megaspores while non-disjunctional pollen grains are not functional, and each of the 49 different 8-chromosome megaspores can combine with either complex of the pollen, 98 possibly viable primary trisomic mutants can result. The possible trisomics in species with chromosome rings of different sizes are also determined, as well as the catenations in various interchange trisomics. It is found that the latter should occur in *O. Lamarckiana* about once in 100,000 plants.

Solar Radiation at Calcutta

PROF. P. N. GHOSH, Dr. A. C. Ukil and Mr. M. K. Sen (*J. Ind. Med. Assoc.*, November 1936), in a paper on the extent and intensity of extreme ultra-violet solar radiation at Calcutta, review the literature and describe a photographic photometric method which they devised not only to determine the intensity of the extreme ultra-violet biologically active solar rays but also to ascertain their daily and monthly modifications at Calcutta. The method consists of two operations. The first consists in taking spectrograms of the desired radiation along with that of a standard source, while the second is a measurement of the degree of blackening produced in the different spectral regions by the two sources as well as the estimation of the characteristics of the plate in these regions. The authors' investigations, which are illustrated by tables and charts, show that the ultra-violet intensity of the biologically active region of sunlight at Calcutta is highest during June, though the maximum extension was found in July. It decreased rapidly, however, in May as well as in July. The curves for March, April and May indicated a very weak ultra-violet intensity, while during the period May to September the afternoon intensities were much more pronounced than those of the morning. In the winter months, the reduction in intensity was very marked during the mornings. In conclusion, the authors emphasize the importance of the estimation of intensity of biologically active rays in the selection of sites for sanatoria in different parts of India and especially in the different hill stations.

Excitation of Phosphors in a Neon Discharge Tube

INTERESTING work on the excitation of zinc sulphide and zinc silicate phosphors by ultra-violet and Schumann radiation is reported by A. Ruttenauer (*Phys. Z.*, **37**, 810; 1936). The phosphors were placed in the neon discharge, the exciting radiation being the ultra-violet region of the discharge (4000–2500 A.), and the resonance lines of wave-length 736 and 744 A. By a special arrangement of tubes, it was possible to separate the phosphorescence due to excitation by these two regions. The zinc sulphide phosphors were excited in both regions, but the phosphorescence in the Schumann rays was less intense the higher the current density. Commercial samples of zinc silicate were not excited at all; but it was found possible to prepare specimens which were strongly excited in the Schumann region, but not in the ultra-violet. The phosphorescence radiation converts the usual red colour of the neon discharge into yellow. It seems possible that discharge tubes containing phosphors may find commercial application.

The Micro-Gap Switch

IN a paper read to the Institution of Electrical Engineers on December 17, Prof. W. M. Thornton described the micro-gap switch, which should prove useful in the thermostatic control of the temperature of electrically heated water. The alternating current circuits to be broken are those of the heaters controlling the hot-water or air supply for buildings. To do this, the switch is operated by a bimetallic device which, in the hot-water thermostat, consists of a non-expanding rod contained within an expanding sleeve. The length of the gap is adjusted so that the A.C. current, after passing through its zero value, cannot restrike. On a 250-volt circuit, the opening of the gap is about 0·005 inch. When the contacts separate, the current can have any value from zero to the maximum. Oscillographic records show that at whatever point in the cycle the contacts open, the current stops at the next zero point and does not restrike. If a break greater than the free sparking distance were formed instantly in a non-inductive circuit, there would be no arc, for the contacts would not have time to get hot, no electrons would be emitted, and the arc or break-spark could not form. To keep the contacts cool at break, many devices have been invented. In general these are for large power circuits. For relatively small powers and circuits which are practically non-inductive, the micro-gap switch is available and it is stated to act perfectly.

Physico-Chemical Factors in Cancer

WORKING in Buenos Aires, Dr. A. H. Roffo has obtained tumours in more than seventy per cent of animals exposed to the sun or to the light from mercury vapour lamps. The tumours developed on those parts which are not protected from radiation, such as the ears, eyes, nose and forelegs, but also on other parts of the body if hair were artificially removed. The radiation produced an increase in cholesterol content of the skin, and cholesterol in the presence of ultra-violet light becomes photo-active, possibly by being changed to a hydrocarbon and emitting photo-electrons. The production of cancer by solar radiation may therefore be due to a physical radiation or to a chemical carcinogenic agent produced by the photochemical action of such radiation. The results of this work are discussed in a paper in the "Reports of the Second International Congress of the Campaign against Cancer" (Brussels 1936). The photoluminescence and fluorescence of cholesterol and the relation of other physical conditions to cancer is discussed in the same volume by Vles and de Coulon.

Mandelic Acid in Urinary Infections

THE treatment of the troublesome *Bacillus coli* infections of the urinary tract has advanced during the last two years by the introduction of mandelic acid. Several preparations of this acid can now be obtained for treatment (see NATURE, **138**, 649; 1936), one of the latest introductions being the "Collosol Brand Phospho-Mandelate" of the Crookes Laboratories, Park Royal, London, N.W.10. An essential condition for successful treatment with this drug is an acid condition of the urine, which at first was obtained by the simultaneous administration of ammonium chloride, the taste of which is, however, objectionable, and this is replaced in the Crookes Laboratories preparation by ammonium phosphate, which is not unpleasant as well as being more efficient for the purpose than ammonium chloride. On the first day of treatment, four doses of ammonium phosphate only (contained in a blue envelope in the package) dissolved in water are given to establish a proper acidity, and on subsequent days four doses of ammonium phosphate and of mandelic acid (contained in a white envelope) are similarly given in water. Test-papers are also supplied, by means of which the proper acidity of the urine may be determined. Six days' treatment will frequently clear up an obstinate and long-standing infection, provided this is caused by the *Bacillus coli*.

Photo-electric Photometry of Stars

MENTION was made in NATURE (**133**, 801; 1934) of a new photo-electric photometer constructed by J. S. Hall for obtaining infra-red magnitudes of stars. Dr. Hall has recently used another photometer of similar type in conjunction with the 24-in. refractor at Swarthmore College (*Astrophys. J.*, **84**, 369). Infra-red magnitudes of 281 *K*-type stars were obtained from comparisons of the effective stellar energy at 8300 A. with that of a controlled incandescent lamp, the zero point being determined from similar observations of *A*0 stars. These infra-red magnitudes were compared with Hertzsprung's photographic magnitudes to form one measure of the colour magnitude for each star, which was then combined with published values of colour from Sproul and Berlin-Babelsberg to give a mean value of colour. A mean of three accurate spectral classifications (Harvard, Mount Wilson and Victoria) was used as the adopted spectral type for determining the colour excess. A discussion of the results shows that the correlation between colour excess and absolute magnitude suggested in the previous paper is confirmed for giant stars of types *K*1-*M*0 and possibly for the *G*4-*K*0 types, though it is much weaker for the latter stars. As a method of determining absolute magnitudes of giant *K*-type stars it is simpler than the spectroscopic method, though probably not so accurate.

Prize Awards for 1936 of the Paris Academy of Sciences

AT the annual public meeting of the Academy of Sciences held on December 21, 1936, the prizes and awards for the year 1936 were announced as follows:

Mathematics.—The Poncelet Prize to Paul Lévy, for the whole of his mathematical works; the Francœur Prize to Claude Chevalley, for his work on the theory of bodies of classes.

Mechanics.—The Montyon Prize to Louis Bergeron, for his work on hydraulic machines; the Fourneyron Prize to André Tenot, for his work on hydraulic turbines; the Boileau Prize to Max Teissié-Solier, for his hydraulic researches on the natural turbulent regime; the Henri de Parville Prize to Henri Poncin, for his work in hydrodynamics.

Astronomy.—The Lalande Prize to Louis Boyer, for his work on the minor planets; the Benjamin Valz Prize to André Couder, for his work on optical instruments; the Janssen Medal to Henry Norris Russell, for his important work on stellar astronomy.

Geography.—The Delalande Prize to Jean Rothé, for his observations and researches on the physics of the globe and physical geography carried out in Greenland (Scoresby Sound); the Gay Prize to the Institut scientifique chérifien, for work on the natural resources of Morocco; the Binoux Prize to Edouard de Martonne, for the whole of his work on colonial cartography.

Navigation.—The Prix de la Marine to René Perrin, for his studies on the working of self-propelled torpedoes; the Plumey Prize to René Norguet, for his studies on marine boilers.

Physics.—The L. La Caze Prize to Jean Becquerel, for the whole of his work in magneto-optics; the François Hébert Prize to Georges Albert Boutry, for his researches on photo-electric cells and their applications; the Hughes Prize to Marcel Laporte, for his researches on the electric discharge in gases; the Paul Marguerite de la Charlonie Prize to Henri Abraham, for the whole of his scientific work; the Clément Félix Foundation to Mlle. Nine Choucroun, for the continuation of her work on electrophoresis.

Chemistry.—The Montyon Prize (Unhealthy Trades) to Paul de Graeve, for his work on phosgene; an honourable mention (1,500 francs) to Jean Le Bras, for his contribution to the study of the extinguishing powers of various materials on flames; the Jecker Prize to Charles Dufraisse, for his work in organic chemistry; the L. La Caze Prize to Paul Job, for his work on inorganic complex compounds and on the application of physical methods to chemistry; the Cahours Foundation to Arthur Brunel, for his researches on fungi; the Houzeau Prize to Maurice Rangier, for his work on uric acid and its complex compounds; the Charles Adam Girard Prize to Georges Kravtzoff, for his work on the electrolysis of organic salts of copper.

Mineralogy and Geology.—The Cuvier Prize to Emile Félix Gautier, for his work on the physical geography of Madagascar and the Sahara; the Victor Raulin Prize to Henri Longchambon, for his researches on clays.

Botany.—The Desmazières Prize to Camille Sauvageau, for his work entitled "Sur quelques algues phéosporées de Guéthary"; the Montagne Prize between Germain Chalaud, for his work "Groupe de Cryptogames: les Hepatiques", and Jean Chaze, for his work on the culture of the Saprolegniæ and the diseases of cultivated mushrooms; the De Coincy Prize to Désiré Bois, for the whole of his work.

Rural Economy.—The Demolombe Prize to Félicien Bœuf, for his work entitled "Les bases scientifiques de l'amélioration des plants".

Anatomy and Zoology.—The Da Gama Machado Prize to Pierre Cappe de Baillon, for his work on phasmid insects; the Savigny Foundation to René Dieuzeide, for his work on the Algerian coastal fauna and their parasites; the Jean Thore Prize to Gaston Portevin, for his book on the natural history of French Coleoptera.

Medicine and Surgery.—The Montyon Prize between Léon Delhoume (2,500 francs), for his book entitled "Dupuytren", Marius Piéry (2,500 francs), for his book on biological and medical climatology, and Pierre Rigaud (2,500 francs), for his book entitled "Le labyrinthe, étude physio-pathologique et clinique"; honourable mentions (1,500 francs) to Jacques Courtois and Raoul Lecoq, for their work on puerperal infections, and to André Feil, for his book entitled "Le travail de l'ardoise et la pathologie professionalle de l'ardoisier"; a mention (1,500 francs) to Maurice Sourdille, for his book "Traitement chirurgical de l'otospongiose"; citations to Emile Gilbrin and to Georges Fabiani; the Barbier Prize to Bernard Gouzon, for his book "Sur l'etude de quelques Porphyrines naturelles. Application aux pigments fluorescents de l'œuf des oiseaux"; the Bréant Prize to Jean Laigret, for his work on yellow fever and preparation of the vaccine; the Godard Prize to Pierre Foyel, for his book "Le tube urinaire dans le série animale"; the Mège Prize to Joseph Magrou, for his memoir on the scientific work of Maurice Nicolle; the Bellion Prize to Marcel Belin, for his book "Coquillages et fièvres typhoides"; the Baron Larrey Prize to Pierre Oudard, for his memoir on the organization and working of the health service of the navy at sea in time of war; the Charles Bouchard Prize to Mario Lebel, for his work on traumatisms of the liver; the Jean Dagnan-Bouveret Prize to Claudius Regaud, for the whole of his researches in histophysiology and in normal and pathological radiophysiology.

Cancer and Tuberculosis.—The Roy-Vaucouloux Foundation to Léon Volluz, for his work on experimental production of cancer with polycyclic hydrocarbons; the Louise Darracq Prize to Charles Oberling and Maurice Guérin, for their work on the production of tumours by means of transmissible leucæmia of fowls; the Eugène and Amélie Dupuis Prize to Ernest Coulaud, for the whole of his work on tuberculosis.

Physiology.—The Montyon Prize to Georges Vanhems, for his work on the biochemistry of potassium; the L. La Caze Prize to Charles Dhéré, for his physiological work especially on the spectrography of biological materials; the Pourat Prize to Roger Gautheret, for his memoir on the culture of plants, and attempts at the culture of meristematic tissues; the Martin-Damourette Prize to Daniel Bovet, for his pharmacological researches especially on the derivatives of aminomethylbenzodioxan.

Statistics.—The Montyon Prize to Michel Huber, for the whole of his work in statistics.

History and Philosophy of Science.—The Binoux Prize between Paul Nève de Mévergnies (2,000 francs), for his memoir on Jean Baptiste van Helmont, and Charles Cabanes (1,500 francs), for his work on Denys Papin.

Works of Science.—The Henri de Parville Prize between Georges Bruhat (3,000 francs), for his book on thermodynamics, electricity, optics and physical mechanics, Guillaume Grandidier (2,000 francs), for his atlas of the French colonies, protectorates and territories under French mandate, and Pierre Gauja (2,000 francs), for his study on "L'Académie des Sciences de l'Institut de France".

Medals.—The Berthelot Medal to Paul de Graeve, Paul Job and Maurice Rangier.

General Prizes.—Prize founded by the State (mathematical sciences) to Maurice Gevrey, for his work on partial differential equations; the Bordin Prize to Henri Termier, for his important geological studies on central Morocco and the northern Moyen-Atlas; the Lallemand Prize to Ivan Bertrand, for his memoir on micrography in infra-red light and its application to renal cytology; the Vaillant Prize to Père Lejay, for his researches on the determination of gravity in the Far East; the Le Conte Prize to the late Julien Costantin, for the whole of his work; the Jean Reynaud Prize to Alfred Lacroix, for the whole of his scientific work; the Baron de Joest Prize to Paul Robert, for his researches on anallagmatic geometry and its relations with projective geometry; the Houllevigue Prize to Etienne Wolff, for his researches in experimental embryogeny and teratogenesis; the Parkin Prize (2,400 francs) to Jean Jacques Bouckaert and Fernand Jourdan, for their work on the pharmacodynamics of the cerebral vessels; an encouragement (1,000 francs) to Bernard Ménétrel, for his memoir on intravenous activated carbon in therapeutics; the Saintour prize to Robert Weill, for his work entitled "Contribution à l'étude des Cnidaires et de leur nématocystes"; the Lonchampt Prize to Paul Meunier, for his researches on aluminium in animals; the Henri Wilde Prize to Georges Dupont, for the whole of his chemical work; the Caméré Prize to Lucien Chadenson, for his work in hydraulics; the Gustave Roux Prize to Henri Erhart, for his treatise on pedology; the Thorlet Prize to Paul Dorveaux; the Albert I of Monaco Prize to Fernand Holweck, for his work on the Holweck-Lejay pendulum; the Marquet Prize to Gustave Ribaud, for his researches on high temperatures; the Alexandre Darrasq Prize to Etienne Audibert, Ferdinand Vallette and Francis Michot-Dupont (20,000 francs each), for methods of preparing petrol and benzene from materials obtained in France.

Prizes of the Grandes Ecoles.—The Laplace Prize to Robert Gachet; the L. E. Rivot Prize between Robert Gachet, Paul Cusset, Charles Mallet and Albert Jouvent.

General Foundations for Scientific Research.—The Gegner Foundation to the late Maurice Parat, for his work on the physiology of the cell; the Jérôme Ponti Foundation to Henri Besairie, for his work on the geology of Madagascar; the Hirn Foundation to Albert Arnulf, for his work in applied optics; the Henri Becquerel Foundation to Carl Benedicks, for his discoveries on the homogeneous thermoelectric effect.

(*To be continued.*)

Progressive Teaching in Geography

THE GEOGRAPHICAL ASSOCIATION

THE Annual Conference of the Geographical Association was held at the London School of Economics on January 5-7.

At the first lecture meeting, Dr. L. Dudley Stamp dealt with Portugal in 1936 and entered a plea for geographers to accord separate consideration to Spain and Portugal rather than to group the two together, which they frequently do, as the Iberian Peninsula. The cultural background and history so clearly demarcate the two that the visitor cannot help being struck by the differences, which indeed recent events have emphasized. By means of lantern slides the remarkable changes witnessed in a traverse from north to south were demonstrated, and a tentative division of the country was suggested into the north-west, the north-east, the middle Douro basin (the port-wine area), the coastal belt, north centre, south centre (these two separated by the Tagus), the southern Sierra, and the Algarve.

On January 6, Sir William Beveridge took the chair at an important symposium on "Whither Population?" in which Prof. C. B. Fawcett stressed the spatial distribution of the world's population, and Dr. R. R. Kuczynski the changing distribution in time. Prof. Fawcett demonstrated that modern development and migration are *not* filling up the empty spaces of the world but, on the contrary, the great cities are increasing relatively to the whole and the pioneer fringe is moving back. Even in densely populated Great Britain, rural depopulation has been in progress for many decades, and one-fifth of the land surface has more than fifty-eight per cent of the people (compared with fifty-one per cent ten years ago). In Canada, forty-two per cent of the people live on less than one per cent of the land; in the United States, more than fifty per cent on less than two per cent; in Australia, more than fifty per cent in the capital cities alone. Dr. Kuczynski developed his now well-known theory of population increase—that the true measure is the relation between women of child-bearing age and births of female children—between the mothers of to-day and the mothers of to-morrow. Where this net reproduction-rate falls below 1, the population must decrease. It is actually below 1 in all the countries of northern and western Europe, except the Irish Free State and Poland. It reaches its highest European figure now in the U.S.S.R. (more than 1·2). In Japan it is about 1·4. At present in Great Britain it is about 0·75, representing a decrease of one per cent per annum. The population at this rate will fall below 30 million by 2000 A.D. and below 20 million in 2036. As Sir

William Beveridge, in a masterly summary, pointed out, this may be desirable, but the process of change is bound to be painful. The arrest of the decline can be accomplished only slowly and in one way alone—by increasing the *desire* of the people to have children. Reference was made to existing tax concessions as being a bad joke or, alternatively, a penny in the pound towards the cost of child-rearing. It was suggested that serious State action has nowhere been attempted. The two great questions are thus: Do we want to stop the decline? If so, can we?

A valuable discussion was that on broadcast geography lessons, at which the teachers, the inspectors, the B.B.C., and broadcasters were represented. There was general agreement that systematic lessons should not be attempted, but that first-hand travel talks to be used as 'background' material, and accurate as well as useful and stimulating in content, should be the aim

Dr. H. A. Matthews detailed suggestions for the study of local climate and had some remarkable illustrations of local variations—the frost pockets by walls so well known to gardeners, the contrasts between the wind rose at the head of a valley (with one calm day per month and predominantly south-west winds) and at a village in the valley only one mile away (with fourteen calm days and the wind predominantly north-west or down the valley).

Mr G. H. J. Daysh summarized his very important recent work on Tyneside and the north-east, emphasizing two points specially—the contrast between the reviving water-side areas and the stagnant inland coal mining areas, and secondly, his own faith in emigration as the solution.

Mr. S. H. Beaver dealt with the scope of railway geography, and two meetings were devoted to joint sessions with the Leplay Society—with Dr. Stamp on Poland and Dr. L. R. Wood on Norway.

Sir Josiah Stamp's presidential address on "Geography and Economic Theory" can only be described as epoch-making in that it defined clearly, for the first time, the points of impact of two modern disciplines and has provided a gospel for future workers.

INSTITUTE OF BRITISH GEOGRAPHERS

The Institute of British Geographers held its annual meeting at the London School of Economics on January 6–7, Prof. R. N. Rudmose Brown replacing Prof. C. B. Fawcett in the presidential chair.

Mr. W. V. Lewis developed the theme of glacial plucking and corrie formation from the *bergschrund* hypothesis of Willard Johnson, stressing the importance of glacial sapping at the foot of corrie cliffs and the potency of summer melting Dr. S. W. Wooldridge considered the later stages in the physiographical evolution of the London Basin, thus continuing his well-known work published in the *Proceedings of the Geologists' Association*

Mr. F. H W. Green gave a succinct and well-illustrated account of the water-meadow systems of Hampshire; Mr. K. H. Huggins suggested a functional classification of English towns into five major groups: primary production, major industries, other industries, local services and regional services. Miss A. F. A. Mutton presented a detailed study of the Black Forest region and Mr. R. A. Pelham a study of the wool industry in the fourteenth century.

L. D. S

Mathematical Association

ANNUAL MEETING

THE annual meeting of the Mathematical Association was held at the Institute of Education, London, W.C.1, on January 4-5. At the business meeting, Prof. L. N. G. Filon was elected president for the ensuing year, and the officers were re-elected as follows: *Treasurer:* Mr. K. S Snell; *Secretaries:* Mr. G. L. Parsons and Miss M. Punnett; *Librarian:* Prof. E. H. Neville; *Editor of the Mathematical Gazette:* Mr. T. A. A Broadbent.

The report of the Council refers to the continued growth of the Association, which now numbers nearly 1,600. The library of the Association has been enriched by gifts from the Royal Technical College, Glasgow, and Mr C. O. Tuckey; also by an exchange effected by Prof. Neville with the Centre National de Documentation Pédagogique, Paris, as a result of which a very complete collection of French textbooks has been acquired. Reference is also made in the report to reviews of French and German text-books which have appeared in the *Mathematical Gazette*. The Teaching Committees announce that a supplementary report on the teaching of geometry will appear shortly and also that a sub-committee has been appointed to collect information about mathematical films The Association has become affiliated to the Conference of Educational Associations.

The outgoing president, Prof. A. R Forsyth, in his address entitled "Applied Mathematics in School Training: Some General Considerations", compared the standards demanded of an entrance scholar to Cambridge at the present time with those demanded sixty years ago. He noticed that, while there has been some modification of method rather than of matter in pure mathematics, applied mathematics is in a general way practically the same at the present day as it was when he himself was an undergraduate. This, he considers, is scarcely less than surprising, having regard to modern applications, and he went on to offer some general observations on the ways in which this defect might be rectified.

Prof Georg Wolff, of Dusseldorf, read a paper entitled "The Development of the Teaching of Geometry in Germany". He referred to the revolt against the traditional teaching of Euclid which occurred in England partly owing to the work of the A.I.G.T. (afterwards the Mathematical Association) and partly owing to the attacks of Prof. Perry and others. He outlined the phases of a similar revolt which took place in Germany, culminating in the report of the German Sub-Commission of the International Commission on the Teaching of Mathematics. In the newest developments of the subject (which date from

1925), he directed attention to the emphasis placed on descriptive geometry, especially on general topics of transformation such as orthogonal and point projection and perspective.

The proceedings of the second day opened with a discussion on the teaching of astronomy. Mr. J. A. Edgar outlined the work which might be done with boys up to lower sixth form level and gave valuable suggestions for practical work in constructing star maps, plotting the plane of the ecliptic and the measurement of time. Mr. R. L. Marshall directed attention to some dangers which, in his opinion, might attend the addition of astronomy to the curriculum, while Dr. L. E. Lefèvre urged the claims of astrophysics in the work done by science specialists, referring especially to the various results obtained by spectrum analysis. In the ensuing discussion, Mr. W. F. Bushell mentioned the importance of the alliance between geography and astronomy.

Dr. R. R. Kuczynski read a paper on "Population Trends". He explained that, while an adequate device for the measurement of mortality has long been known, a good method of measuring fertility has only recently been evolved. He showed how these two measures can be combined to give the 'reproduction-rate' of a population. He stated that if fertility and mortality remain as at present, the population of western and northern Europe appears likely to drop from 194 to 150 millions by the end of the century. The U.S.S.R. is apparently an exception, and the figures here suggest an increase from 175 to 650 millions. He concluded by warning his audience that a very clear distinction should be drawn between estimates meant as forecasts and estimates meant to show what, on certain definite assumptions, the population trend would be. The figures given were to be taken as belonging to the second of these categories.

Mr. R. M. Gabriel, in the next paper, urged the inclusion of the history of mathematics in the course of study both of schools and universities. Of the different methods of presenting the history of the subject, he preferred that which dealt with the history of various topics as they occur in mathematical work. He pointed out how the history of the subject serves to throw a light on the character of times and men (for example, Cardan and Tartaglia in relation to the Renaissance; Newton in relation to the seventeenth century). He instanced several mathematical types in which a knowledge of mathematical history would assist both teacher and pupil. In the course of a useful discussion, Sir Thomas Heath, Mr. A. W. Siddons, Prof. E. H. Neville, Mr. M Black and Mr. G. L. Parsons offered additional suggestions with regard to topics and bibliography.

In the afternoon, Dr. A. C. Aitken read a paper on "Arithmetical Recreations". He stated that his observations were really concerned with approximation, which will assume greater importance as mechanical devices for calculation are developed. After a preliminary discussion of the mental equipment needed by a good computer, Dr. Aitken demonstrated rapid methods of division and squaring, and as an illustration of his methods, squared several numbers of three and four digits mentally with great rapidity. He next showed how the periods of recurring decimals can be determined These methods of approximate evaluation of a square root were considered and their relative errors dismissed. Dr. Aitken concluded with some remarks on the nature of memory, in which he stressed the rhythmic element, illustrating this by writing down from memory the first two hundred figures in the value of π.

The concluding paper was given by Mr. A. Romney Green on "Geometrical Design". He commenced by describing the construction of certain polar curves and showed how these curves can be used for vases, brackets and other articles capable of being made in the school workshop. He also directed attention to the close conformity with Nature exhibited by certain leaf-designs derived from these curves. He next referred to the use of the conic (drawn as an envelope) and pointed out the superiority of these curves (used in Greek mouldings) over the circular mouldings in general use. The paper was illustrated by slides, including illustrations of pieces of furniture designed by the author.

In consequence of the indisposition of the president, Mr. A. W. Siddons presided over the meetings on the second day. The meetings were well attended throughout, and the usual publishers exhibition was held. A full account of the various papers will appear in the *Mathematical Gazette*.

Mechanized Farming*

OXFORD CONFERENCE

THE second Conference on Mechanized Farming was held in Rhodes House, Oxford, on January 5–8, under the auspices of the agricultural departments of the University, and attracted about 350 visitors.

The opening papers dealt with agricultural and technical problems arising from the extended use of tractors. An important technical problem arises from the use of paraffin rather than petrol as fuel. Under ordinary agricultural conditions, the use of the heavier fuel frequently results in rapid deterioration of lubricating oil, due to its dilution with unburned fuel components. In practice, therefore, the immediate economies which result from the use of paraffin are liable to be offset by increased consumption of lubricating oil, or, since farmers generally do not change the diluted oil often enough, by rapid wear of the engine. Measurements on tractors in the field and on test show that the solution of the difficulty is to maintain the temperature of the cooling water at as near boiling point as is practicable, to avoid changing over from the starting petrol to paraffin until a sufficiently high engine temperature has been reached, and to load the tractor as fully as possible.

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* Papers can be obtained from the Institute for Research in Agricultural Engineering, University of Oxford, 1*s* 6*d*. post paid. A supplement embodying the informal discussions is to be published at a later date.

Another group of papers was concerned with cultivation problems. Mechanization offers so many opportunities of simplifying the traditional routine of cultivation, for example, by the use of rotary cultivators or trains of implements, that it becomes important to examine scientifically both the traditional treatments and the newer technique which may supplement them. Two papers described the work which is being done with this object at Rothamsted and Cambridge. It was suggested that certain tillage operations which are traditionally supposed to conserve soil moisture cannot be expected, in the light of modern theories of soil water movement, to exercise much direct control, although they may conserve soil moisture indirectly by removing the competition of weeds. Again, in statistical field experiments the ultimate effects of tillage operations on crop yields are frequently insignificant, although well-marked effects in soil structure can be demonstrated, for example, by the use of an instrument which automatically records the resistance to the penetration of the soil by a steel probe. Both papers concluded that traditional methods are liable to include many operations the utility of which is doubtful. This conclusion was criticized in another paper written from the farmer's point of view. It was suggested that the mental attitude of the experimenter towards cultivation operations is often at fault: that to regard the ultimate yield in a statistical experiment as the sole criterion is misleading: and that modern experimental technique is too rigid for the study of what may be considered as still an art.

Another paper opened a discussion on the maintenance of fertility, with particular reference to the part played by organic manures. It was suggested that the function of organic matter might appear less important as the science of tillage is developed and more is known about the application of such elements as boron, manganese and zinc. On the other hand, a better understanding of the part played by auxins, animal hormones and plant toxins might lead to a contrary conclusion.

Considerable interest was also aroused by several papers on grass-drying. These, however, were concerned more with questions arising from fitting the new process into farming routine than with drying technique.

Other subjects which received consideration at the Conference were equipment enabling tractors to be used for row crop work and recent developments in combine harvesting

Science News a Century Ago

The Analysis of Organic Compounds

"AT a meeting of the Medico-Botanical Society held on January 25, 1837, Mr Everett made some observations on the essential oil of almonds, the result of the examination of which by different continental chemists, led to the hope that the mathematical accuracy impressed upon inorganic compounds would soon be developed in organic compounds In the analysis of almonds, a substance called amygdaline was produced From this substance the German chemists have produced a liquid hydruet of benzoin, which by contact of atmospheric air, produces benzoic acid With this discovery, M Berzelius was so pleased as to suggest to MM Dumas and Leveque (to whom the scientific world is indebted for this information) to give it a name signifying 'Dawn of Day' or 'Orb of Day', illustrative of the new era which it opened in organic chemistry. M Mitscherlich, of Berlin, has also by the distillation of benzoic acid with quicklime, obtained an oily fluid identical with that procured in the condensation of oil gas, and described by Faraday as a liquid bi-carburetted hydrogen."—(*Athenæum*)

Structure of the Brain in Marsupial Animals

ON January 26, 1837, Richard Owen, Hunterian professor of anatomy to the Royal College of Surgeons, read a paper to the Royal Society "On the Structure of the Brain in Marsupial Animals". The official abstract of the paper said: "The author describes a remarkable modification in the commissural apparatus, apparently provided with a view to establish communication between the cerebral hemispheres, which he has observed in the brains of marsupial animals and which has hitherto been regarded as constituting the essential difference between the brains of oviparous and mammiferous vertebrata . . On comparing the structure of the brain in the Beaver and in the Wombat, he finds that the corpus callosum, or great commissure which unites the supraventricular masses of the hemispheres in the former, as well as in all other placentally developed mammalia, and which exist in addition to the fornix, or hippocampal commissure, is wholly absent in the latter animal: and that a similar deficiency exists in the brain of the Great and Bush Kangaroos, of the Vulpine Phalanger, of the Ursine and Mange's Dasyrus, and of the Virginian Opposum. . . ."

Cultivation of Rice in England

THE *Athenæum* of January 28, 1837, records the attempts of Mr. Anderson, the curator of the Apothecaries Garden at Chelsea, to cultivate mountain rice from Nepal, the experiment having been made to see whether it could be grown in Great Britain as an agricultural crop. The seed was sown in March in a hot-house and soon germinated. In May, when the seedlings were removed to the greenhouse, they had become stout healthy plants. At the end of June, they were transferred to a sheltered place in a basin for aquatic plants, having nine inches of water and twelve inches of mud They grew and promised well until the beginning of August, but the weather becoming cool they all sickened and died without flowering.

Medical Literature in 1836

"DURING the year 1836 there were published in France alone upwards of 300 volumes on the various branches of medical science. These 300 volumes, added to the numerous brochures, memoirs and other smaller tracts which have appeared, raise the quantity to 115,000 pages, which together with the journals and theses brought out at the same time render the total about 180,000 pages. Now should there be found a reader intrepid enough to undertake the perusal of all this, his monthly task must be to wade through nearly 16,000 pages, and his daily performance must be on the average 500. So much for French medical literature merely; add English, American, German, etc. !"—(*London Medical Gazette*, January 28, 1837)

University Events

Aberdeen.—The King has, on the recommendation of the Secretary of State for Scotland, approved the appointment of Prof. John Stirling Young, professor of pathology in the Queen's University, Belfast, to be regius professor of pathology, in succession to Prof. T. Shennan, who has resigned.

Cambridge.—D. V. Davies and Dr. W. R. M. Morton have been appointed University demonstrators in the Department of Anatomy.

At Gonville and Caius College, Prof. J. A. Ryle, regius professor of physic, has been elected into a professorial fellowship.

At Pembroke College, W. E. Burcham, Trinity Hall, has been elected into the Stokes studentship for research in physics. Mr. Burcham is engaged in research work in the Cavendish Laboratory.

At St. John's College, Prof. H. A. Harris, professor of anatomy, has been elected into a professorial fellowship.

London.—The Court of the University has accepted an offer of the Harry Price Library of Magical Literature to be on permanent loan in the University Library, and has passed a vote of thanks to Mr. Harry Price for the benefaction.

Dr. F. E. Zeuner has been appointed hon. lecturer in geochronology at the Institute of Archæology.

Societies and Academies

Paris

Academy of Sciences, December 28 (*C.R.*, 203, 1477–1556).

Louis Blaringhem: A new variety of *Zea Mays* with mahogany-coloured seeds.

Gabriel Bertrand and Lazare Silberstein: New researches on the comparative amounts of sulphur, phosphorus and nitrogen in plants cultivated on a given soil. Figures are given for fifteen species of plants. Exceptional results were obtained with celery: whilst in forty-six species of plants the ratio sulphur to phosphorus did not exceed 4·02, celery gave a ratio of 11·1.

Charles Poisson: Some magnetic rocks in the neighbourhood of Tananarive.

Alexandre Myller: The mean torsion of a surface.

Albert Edrei: Certain limit invariants of integral series.

Victor Lalan: Kinematics and the theory of groups.

Octav Onicescu: Physical laws expressed by statistical chains.

Georges Fournier: The upper limit of the atomic numbers. On the basis of certain geometrical assumptions, 136 would be the maximum atomic number.

Pierre Jolibois and Robert Bossuet: Some properties of a spark arising from the surface of an electrolyte connected to the negative pole.

Georges Costeanu and Pierre Barchewitz: The absorption spectrum of ammonia in the very near infra-red (6000 A.–9500 A.).

Jean Lecomte: Infra-red absorption spectra and the modes of vibration of organic compounds possessing an ethylene linkage.

Joseph Berthenod: Connexions by means of couplings with permanent slipping.

René Delaplace: The thermal conductivity of the gaseous saturated hydrocarbons at low pressure. Results for hydrogen, methane, ethane, propane, normal butane and isobutane are given as curves. For pressures between 0·001 mm. and 0·2 mm. of mercury, the homologues of methane have thermal conductivities increasing with their molecular weights.

Wilfried Heller: The slowing down of thixotropic solidification by the amino-acids.

Jean Chédin: The quantitative study of the intensity and the depolarization of some Raman lines emitted by sulphonitric mixtures.

Pierre Peyrot: Absolute measurement of the light diffused by liquid benzene.

Albert Portevin and Eugène Herzog: The action of various additions in small proportions on the marine corrosion of extra-mild steel. Results are given graphically of the effects of the presence of aluminium, chromium, nickel, silicon and phosphorus.

Paul Laffitte and André Parisot: The detonation of ammonium nitrate. Summary of results obtained by the photographic recorder method.

Louis Médard and François Déguillon: The Raman effect of some organic sulphur compounds.

Raymond Delaby: The βγ-ethylenic nitriles and some of their derivatives.

Léon Palfray, Sébastien Sabetay and Pierre Mastagli: The reducing action of benzylalcoholic potash and of sodium benzylate on aldehydes. Studies on three aldehydes of different type, cuminic, œnanthic and α-amylcinnamic aldehydes.

Gustave Vavon and Israel Chilouet: The structure of the menthylamines.

Albert Kirrmann and Robert Jacob: Study of the allyl transposition: a trichlorisobutene.

Robert Forrer: The intensity of the orbital interaction in salts The factor of the ions.

Mlle. Véra Malycheff: Contribution to the study of the soils of western Morocco. The brown soil formed at the expense of hamri.

Raymond Jouaust, Robert Bureau and Louis Eblé: The probable causes of the sudden fading of short radio-electric waves and their relation with magnetic phenomena. There is no evidence to connect these disappearances with magnetic storms.

Pierre Marie: The utilization of the Foraminifera in stratigraphy.

Robert Lemesle: The vessels with scalariform perforations of *Eupomatia* and their importance in the phylogeny of Polycarps.

Léon Bertin: A series of Leptocephalus belonging to the genus *Saccopharynx*.

Mme. Yvonne Khouvine, Boris Ephrussi and Morris Henry Harnly: The extraction and solubility of substances intervening in the pigmentation of *Drosophila melanogaster*.

André Kling and Guy Lecordier: The influence exerted by two war vesicants and by their products of hydrolysis on the values of the interfacial tensions of lipids towards physiological serum and on their absorption.

Mlle. Lise Emerique: Avitaminosis A and nitrogen metabolism.

Mme. Marguerite Aitoff: The transformations of the fermentation reactions of a dysenteric bacillus by passage through animals.

Max Aron: Serological researches on the nature of the principle contained in the urine of cancer patients.

Jean Cuillé and Paul Louis Chelle: Can the disease known as "tremblante du mouton" be inoculated? This disease is infectious and inoculable. The virus exists in the nerve centres.

Cape Town

Royal Society of South Africa, October 21.

G. D. B. de Villiers and **S. M. Naudé**: Effects of oil sprays on the transpiration of peach twigs. Oil sprays diminish the transpiration of twigs by about fifty per cent. Twigs sprayed with oil build up a greater reserve of sap than the unsprayed twigs. Hence when the buds open up, less danger exists of their drying out and the phenomena of delayed foliation and die-back occurring. Screening tends to decrease the transpiration in comparison with an unscreened tree Such trees, sheltered from the sun's rays in winter by screens or windbreaks, develop more normally than unsheltered trees.

I. Donen: Studies in deciduous fruit. (4) Distribution of nitrogenous fractions in the pulp of the Kelsey plum (*Prunus salicina*) Extracts of the nitrogenous fraction in the pulp of Kelsey plums were obtained by (*a*) water extraction of fresh tissue, (*b*) alcoholic extraction of frozen tissue, (*c*) expressing the juice, and (*d*) water extraction of pulp dried at 50° C. In young fruit, preservation of the tissue by freezing or drying resulted in hydrolysis of protein. In mature fruit the distribution of total soluble nitrogen, amide, amino acid and ammonia nitrogen, in the resulting extracts is not greatly affected by any of the methods of extraction used. (5) Preliminary observations on the relationship between nitrogenous metabolism and internal breakdown of Kelsey plums in cold store. Changes in the proportions of protein and non-protein nitrogen as well as changes in the ammonia, amino and amide nitrogen fractions in the flesh of Kelsey plums were followed by analysis of fruit stored at 35°, 50° and 70° F. Rapid hydrolysis of proteins takes place in plums under all conditions of storage, but the course of protein hydrolysis stops short at the amino-acid nitrogen stage. Conditions of maturity and storage which interfere with the course of progressive breakdown of nitrogenous compounds are also the conditions which interfere with the normal ripening of the fruit

W. E. Sharples: A Middle Stone Age site at Tygerberg, near Prince Albert.

T. A. Stephenson, A. Stephenson and **C. A. du Toit**: The South African inter-tidal zone in its relation to ocean currents. (1) A temperate Indian Ocean shore.

H. Zwarenstein: Experimental induction of ovulation (see Nature, Jan. 16, p. 112).

B. F. J. Schonland, D. B. Hodges and **H. Collens**: Combined oscillographic and camera studies of lightning. The leader process in all cases observed lowers a negative charge towards ground. The stepped leader involves an intermittent decrease of negative electric moment with corresponding radiation in the form of a ripple which always precedes the main radiation field caused during the return stroke. The dart leader process involves a continuous decrease in moment. Discharges taking place in a thundercloud are less important sources of atmospherics than those passing to ground.

Cracow

Polish Academy of Science and Letters, November 9.

M Petrovitch: Remark on the zeros of the Laplace-Abel integrals.

L Kozlowski: Kerr's electro-optical phenomenon in mixtures of nitrobenzene and hexane. For mixtures of low concentration, the relation between the Kerr coefficient and temperature is nearly linear. There is an anomaly in the region of the critical temperature of solution.

M. Centnerszwer and **M. Blumenthal.** (1) The thermal dissociation of lithium nitrate. Lithium nitrate, at a temperature above its melting point, decomposes into lithium nitrite and oxygen. The reaction is reversible, and the author has determined the Nernst equation. (2) The thermal dissociation of silver nitrate.

H. Liche: Observations on the behaviour of the Gerrides (heteropterous Hemiptera).

M. Bulawa: The lymphatics in the skin of the teleosteans.

Moscow

Academy of Sciences (*C R.*, 4, No. 1; 1936).

W. Sierpinski: Semi-continuous functions.

P. P. Lazarev and **Z. V. Boulanova**: (1) The influence of muscular work on the adaptation in peripheric vision. (2) Changes in the peripheric visual adaptation in infants during a day.

P. P. Lazarev and **M. R. Semenovych**: Changes in the peripheric visual adaptation during a year.

A. Obručeva and **A. Frumkin**: Attainment of a potential by platinum in solutions of silver salts.

I. A. Goljanickij and **I. S. Belonosov**: Reduction of the inactivated *l*-ascorbic acid.

O. S. Vialov: Classification of oysters (*Ostreinae*).

A. S. Serebrovskij: Second variant of the M-σ^2-triangle method.

E. Šestakov and **L. I. Sergeev**: Changes in the permeability of protoplasm and the dynamics of frost resistance of winter cereals in connexion with their passage through the light stage.

E. G. Andreeva: The proportions of the leg bones of some *Bovinae*.

A. J. Bazikalova: A new form of Amphipoda from Lake Baikal (*Gammarosphaera insularis*, gen. et sp. n.).

Vienna

Academy of Sciences, October 29.

Stefan Meyer: Possible existence of an isotope of polonium in the thorium series.

Erich Tschermak-Seysenegg: True, derived, and doubtful wheat-rye hybrids (wheat-like forms).

Rudolf Inzinger: Infinitesimal geometry of contact transformations.

W. J. Muller: Theory of metal potentials (1).

L Kahovec and **A. W Reitz**: Studies of the Raman effect (61). Raman spectra of organic substances (benzene derivatives).

November 5.

Otto Ampferer. Were the Alps unglaciated between the Wurm and the final glacial periods ?

Zora Klas: *Thiosiphon*, a new species of sulphur bacterium

Franz Urbach and **Helene Schlesinger**: Mechanical and acoustical tests of pianofortes.

Anton Kailan and **Walter Melzer**: Influence of neutral salts on velocity of esterification and viscosity in solutions of hydrochloric acid in ethyl alcohol.

Max Toperczer: The earthquake at Obdach on October 3, 1936

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, January 25

University College, London, at 5.—Dr. H. R. Ing: "Chemical Structure and Pharmacological Action" (Succeeding lectures on February 1, 8, 15, 22 and March 1.)*

Institute of Actuaries, at 5.—F. J. C. Honey: "The Estimated Population of Great Britain, 1941–1971".

Bedford College for Women, at 5.15.—Prof. R. F. A. Hoernlé: "Theory of Knowledge". (Succeeding lecture on January 26.)*

London School of Hygiene and Tropical Medicine, at 5.30.—Prof. W. Bullock, F.R.S.: "The Development of Bacteriology with an Account of some of the Pioneers who made it a Science" (Heath Clark Lectures. Succeeding lectures on January 28 and February 1, 4 and 8).*

Royal Geographical Society, at 8.30.—A. R Glen: "Northeast Land, 1935–36".

Wednesday, January 27

Royal Society of Arts, at 8.—J. T. Randall. "Luminescence and its Applications".

Thursday, January 28

King's College, London, at 5.30.—Arthur Gardner: "English Mediæval Sculpture". (Succeeding lectures on February 11 and 25, and March 11.)*

Friday, January 29

Geophysical Discussion, at 4.30.—(at the Royal Astronomical Society).—Discussion on: "Terrestrial Heights" to be opened by Dr. J. de Graaff Hunter, F.R.S.

North East Coast Institution of Engineers and Shipbuilders, at 7.—Prof. A. L. Mellanby: "Land and Marine Steam Generators, with Particular Reference to Future Developments" (Andrew Laing Lecture).

Royal Institution, at 9.—Sir William Bragg, F.R.S.: "Recent Crystallography".

Saturday, January 30

British Mycological Society, at 11.—(at University College, Gower Street, London, W.C.1).—Symposium and Discussion on "Antagonism of Micro-organisms" to be opened by G. Samuel.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Civil Engineer in the Rangoon Development Trust—Messrs Binnie, Deacon and Gourley, Artillery House, Artillery Row, London, S.W.1 (January 27)

Two Assistant Chemists for the London Shellac Research Bureau—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (January 30).

Assistant Guide-Lecturer (archæology and natural history) in the Leicester Museum and Art Gallery—The Director (February 10).

Professor of Zoology in the University of Cambridge—The Vice-Chancellor (February 26).

Professor of Physiology in the University of Cambridge—The Vice-Chancellor (March 4).

Professor of Geology in the University of Oxford—The Registrar (March 6).

Professor of Social Anthropology in the University of Cambridge—The Vice-Chancellor (March 9).

Assistant Director of Metallurgical Research in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1

Official Publications Received

Great Britain and Ireland

British Chemicals and their Manufacturers. the Official Directory of the Association of British Chemical Manufacturers (Incorporated). Pp 466. (London: Association of British Chemical Manufacturers.) Free [41

University of Cambridge School of Agriculture Memoirs. Memoir No. 8: A Brief Summary of the Papers published by the Staffs of the School of Agriculture and its Associated Research Institutes during the period Oct 1st, 1935–Sept. 30th, 1936. Pp 54. (Cambridge: School of Agriculture.) 1*s*. net. [41

Department of Scientific and Industrial Research: Water Pollution Research. Summary of Recent Literature Vol 10, 1937. Pp. ii+36. (London: H.M. Stationery Office.) 2*s*. net. [51

Booklet 7. Geology's Interest hinges on Changing Climates. Pp. ii+34. (London: Moses B. Cotsworth.) 2*s*. 6*d*. net. [71

Technical Publications of the International Tin Research and Development Council. Series A, No 48: The Production of Black Anodic Coatings on Tin and Tin Alloys By Dr. R. Kerr and D J Macnaughtan. Pp. ii+7+2 plates. (London: International Tin Research and Development Council.) Free. [111

British Industries Fair, 1937, Olympia and White City, London, February 15th to 26th Organised by the Department of Overseas Trade. Special Overseas Advance edition. Pp. xvi+400+Ad 128+Ad. xii 1*s*. Alphabetical Lists of Exhibits. Pp. 128. (London: Department of Overseas Trade.) [111

Other Countries

Memoirs and Observations of the Czech Astronomical Society at Prague. Vol. 1, No 1: Activité solaire en année 1934 Par B Nováková Pp. 11. Vol. 1, No. 2: Nebulosités diffuses et obscures d'Orion. Par F. Schuller. Pp. 4+1 plate (Prague: Czech Astronomical Society.) [41

U.S Department of the Interior. Geological Survey. Professional Paper 182. The Tertiary Floras of Alaska. By Arthur Hollick: with a Chapter on the Geology of the Tertiary Deposits, by Philip S Smith Pp. iii+185+122 plates. (Washington, D.C.: Government Printing Office.) 1 00 dollar [41

U.S. Department of the Interior Geological Survey. Water-Supply Paper 773–C: Artesian Water in the Florida Peninsula. By V T. Stringfield. (Contributions to the Hydrology of the United States, 1936.) Pp. iv+115–195+plates 6–16. 20 cents. Water-Supply Paper 773–D: Ground-Water Resources of Kleberg County, Texas. By Penn Livingston and Thomas W. Bridges. (Contributions to the Hydrology of the United States, 1936.) Pp. ii+197–232+plates 17–21. 10 cents Water-Supply Paper 777. Water Levels and Artesian Pressure in Observation Wells in the United States in 1935; with Statements concerning Previous Work and Results. Prepared under the direction of O E. Meinzer and L. K. Wenzel Pp. iii+268. 30 cents. Water-Supply Paper 784: Surface Water Supply of the United States, 1935 Part 4: St. Lawrence River Basin Pp. 170. 20 cents. Water-Supply Paper 787. Surface Water Supply of the United States, 1935. Part 7: Lower Mississippi River Basin. Pp 150. 20 cents. Water-Supply Paper 791: Surface Water Supply of the United States, 1935. Part 11: Pacific Slope Basins in California. Pp. 361. 45 cents. Water-Supply Paper 793: Surface Water Supply of the United States, 1935. Part 13. Snake River Basin. Pp. 197 25 cents. Water-Supply Paper 794: Surface Water Supply of the United States, 1935. Part 14. Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp 167. 20 cents. (Washington, D.C.: Government Printing Office.) [41

The Biochemical Research Laboratories of the Franklin Institute. Pp. 77. (Philadelphia, Pa.: Franklin Institute.) [41

Forest Research and Indian Industry: the Work of the Forest Research Institute at Dehra Dun and its Utility to Government Departments and Industrialists in India Pp. iv+24+9 plates (Delhi: Manager of Publications) [41

U.S. Department of Agriculture. Farmers' Bulletin No. 1759: Game Management on the Farm. By J. N Darling, H. P. Sheldon and Ira N. Gabrielson. Pp. ii+22. 5 cents. Farmers' Bulletin No 1760: The Use of Bluegrass Sod in the Control of Soil Erosion. By R. E. Uhland. Pp. ii+13. 5 cents. (Washington, D.C.: Government Printing Office.) [41

New Zealand Department of Lands and Survey Annual Report on Public Domains and National Parks of New Zealand. Pp. 5. (Wellington: Government Printer.) 6*d*. [41

Department of Agriculture, Mauritius. Sugarcane Research Station. Bulletin No 10 Some Data on the Effect of a Late Heavy Dressing of Nitrogenous Fertilizer on the Growth and Metabolism of Sugarcane in Mauritius. By Dr H Evans. Pp. 10. (Port Louis Government Printer.) [41

Science Reports of the Tokyo Bunrika Daigaku, Section A. No 54. Resultantentheorie bei Formen in zwei Variablenreihen Von Tikara Tôya. Pp. 111–121. (Tokyo: Maruzen Co, Ltd) 20 sen. [81

Catalogues, etc.

X-Ray Couches. Pp 8. (London: Newton and Wright, Ltd)

Navigation, Geography, Travels, Shipbuilding, Trade and Commerce, Economics; with a Collection of French Royal Administrative Acts relating to the Navy, the Post and Road Transport in France (Catalogue 42.) Pp. 97. (London: E. P. Goldschmidt and Co, Ltd.)

Calendar for 1937. (Edinburgh: Heriot-Watt College.)

Chronica Botanica Calendar 1937. (Leiden: Chronica Botanica, Ltd)

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Native Races and Nationalism in Africa

THE development of nationalist ideas as an effective political force in eastern Asia and, more particularly, in India, has afforded a justification for those who hold that a like course of events may be anticipated sooner or later among the native races of Africa. Negro Africa, that is, Africa south of the Sahara, they would maintain, is an unsurpassed forcing house for ideas such as have inspired the more loudly vocal element in recent and current political agitation in India. For these regions of Africa are the meeting-place of two utterly diverse races, white and black, who are poles apart in physical character, mental outlook, tradition and culture, and of whom, while one, everywhere numerically the inferior, is politically and economically dominant, the other is rapidly transcending the limitations as well as outgrowing the opportunities of tribal code and indigenous culture. The natural division thus existing in the community, and reinforced by social and political barriers, must inevitably, it is held, give rise to a group consciousness on the part of native peoples, which unless checked or diverted, will tend to the more unstable and politically dangerous forms of racialism and nationalistic ideation.

Fortunately, diagnosis of possibilities in the trend of the development of native outlook is not entirely a matter of speculation. In Africa south of the Zambezi, where conditions are most favourable to the rise of nationalism, the Union of South Africa has for a guide in its approach to the native question experience of native reaction to a variety of European contacts extending over a long period of time; while the mining industry for nearly half a century has brought native administration into contact with the problems which arise out of the employment of labour on a large scale. But we may go even a stage further than general considerations, which emerge from an investigation of past history, and lay our finger on specific movements and events of recent occurrence pointing in the direction of an emergence of a sense of the solidarity of native interests, which if racial rather than national in character, is none the less significant of growth towards a feeling of community and of the power of a common direction in action and sentiment. This at least would appear to be the salient lesson to be learned from the valuable survey of recent happenings and tendencies in South, East, and West Africa, given by Lord Hailey in his address on "Nationalism in Africa" before the Royal Empire Society on January 19, when he summarized his study of the situation, as well as the results of observations made on his recent tour through Africa. His conclusions were the more worthy of careful note, since he was at pains to point out that while well aware of the opinion which views, not without alarm, the possible trend of development in native African political opinion towards nationalism, he himself is not among the prophets, but merely records as an observer.

In another matter Lord Hailey had taken his stand with no little wisdom. He refrained from any attempt to define nationalism, assuming that the character of this political and economic attitude or doctrine was sufficiently familiar to his audience to need no definition; but he indicated that he meant by 'nationalism' the governing force of a uniting will directed to national advancement in combination with certain social and economic factors, such as had manifested itself in European history during the period beginning in the eighteenth century and had appeared recently in Asia. Taking advantage of this elasticity in his point of view, he was able to bring under consideration aspects of native activity which on a stricter interpretation of the term might have to be excluded, and while admitting variety in the meaning of 'nationalism', enabled him to seek for such evidence as would indicate that native self-consciousness was becoming an "effective factor"—a new phenomenon, creating a new problem. Hence, as he pointed out, it is not merely opposition to Government that gives a movement significance in this sense, but rather such events as would testify to the growth of racial feeling or afford proof that the natives of different tribes or areas could combine on a common basis. For such an exhibition of growing consciousness it is natural to look to circumstances in which the material factor is more prominent, as for example in the curtailment of land, or the creation of unequal economic conditions. In taking, therefore, the Union of South Africa as his natural starting point, Lord Hailey is in accord with the view that the occasion and opportunity for the development of nationalism will most probably be found south of the Zambezi.

Before passing on to note some of the more important events and tendencies, to which in Lord Hailey's opinion this special significance may be attached, it is perhaps worth while to point out that whereas the white population of the Union of South Africa is determined at all costs to protect from native intrusion the white civilization which has been built up there, the native population, on its side, at least in so far as represented by the more thoughtful and influential of its leaders, is equally convinced that segregation and conservation of the elements of native solidarity is fully as necessary for the well-being of the native community. It is from the promoters of this movement and from this line of thought that nationalism in South Africa, if or when it comes, will draw its strength. On the other hand, in the labour movements to which Lord Hailey referred, it is perhaps not so much racial feeling as the colour bar which has been operative. The two are by no means identical; and in view of the wide area and varied tribal units from which recruits are drawn, labour perhaps has been often of too heterogeneous a character to warrant it being regarded as of great significance in a racial sense, although naturally of evidential value in relation to the ability of the native to combine.

It was this heterogeneity, perhaps, as much as any single factor, which led to the collapse of the famous (or infamous) Industrial and Commerical Union, which was initiated under Soviet influence and at one time numbered 250,000 members. Nevertheless, it has to be remembered that it was held by those who investigated the movement officially after the riots at Port Elizabeth in 1922 that it did afford some evidence of Bantu racial consciousness. The members, however, were either detribalized, or not at the moment under tribal control, the mine labour, numerically the most important, being, as already mentioned, recruited from tribes at a distance. It is also to be noted in this connexion that in East Africa such trouble as has occurred from time to time in riots at Nairobi and elsewhere, as a rule, has been caused for the most part by detribalized natives. Except under abnormal conditions, tribal institutions favour the settled order. This is a fact which should not be overlooked in estimating the character and motives of movements which appear to lead in the direction of nationalism.

Of the circumstances affecting the solidarity of the native communities in the Union, by far the most important has been the question of land. It touched every member of tribal and rural community alike. As vital to native existence, it unified Bantu opinion throughout the Union in a common cause and to a degree scarcely witnessed before if at all. So far back as 1913, when Botha's land legislation was introduced into Parliament, this question was responsible for the formation of the short-lived African National Congress. It endured as a source of unrest until further legislation in 1936, when the question was complicated by the proposal, which was carried, to abolish the Cape Franchise, the restricted but highly valued native vote. Although, as Lord Hailey points out, this in itself produced no lasting effect or permanent organization, it did much to promote unity by bringing together members of the native races for discussion and protest with a common aim. An African convention in 1935 set up an organization to achieve reforms by constitutional means, but it is too soon to pronounce on its merits.

While Lord Hailey does not appear disposed to attach too great weight to the movement towards Separatist Churches, such movements are frequently an outlet, sometimes a source and inspiration, for nationalist movements of a formidable character. One of the most serious difficulties of the Kenya administration which assumed something like nationalist proportions was the Kikuyu female circumcision controversy.

A brief reference to conditions in other parts of Africa must suffice. In East Africa, circumstances not unlike those of South Africa, though on much smaller scale, have produced similar reactions in the formation of associations for the advancement and formulation of native interests. In the older colonies of West Africa, the education of natives on European lines has produced an intellectual class which seeks wider recognition of native rights through existing constitutional means. Nor is it necessary that the French and Belgian colonial empires should detain us, for in the former, as Lord Hailey points out, everything is directed to France—an orientation which finds expression in the representation of colonial interests in the legislature of the mother country by a native deputy; while under Belgian rule, both in the colony and the mandated territory, commercial rather than political development of native resources is the aim Lord Hailey might perhaps have added that under French rule, in actual practice something very much in the nature of the indirect rule of the British dependencies is the result.

In pursuit of his intention to act as an observer only, Lord Hailey, while noting that the trend towards the nationalist idea is approved by some, but strongly condemned by others, made no attempt to sit in judgment. Nevertheless, the question is one that will be posed by the mere efflux of time, and insistently will demand an answer. It will have been noted that the movements to which attention has been directed have all been separatist in character. They have emphasized the fission in the community, which results from the association of black and white. Is this inevitable? This raises a large question, which involves the whole future of the African races. It is obvious that neither under the policy of indirect rule nor of segregation, as in South Africa, will the African peoples stand still. The rapid advances of the last few years are a sufficient negation of any such conception. It is the belief of those who hold to the advantages of indirect rule, as well as of those who see the possibilities of advance under other systems, that the future of Africa lies in the co-operation of the two races. For this, and to determine the lines upon which it should be pursued, the assistance of the more advanced and intellectual members of the African peoples must be secured. If, as many think, the movement towards racial or national self-consciousness is an inevitable phase of development in Africa, time should be taken by the forelock, and this force, great as it must and will be, should be harnessed to the constructive task of building up a united community, rather than weakening the social structure of Africa by setting a gulf between the elements which should co-operate.

Unsolved Soil Problems

Fifty Years of Field Experiments at the Woburn Experimental Station

By Sir E. John Russell and Dr. J A. Voelcker; with a Statistical Report by W G. Cochran. (Rothamsted Monographs on Agricultural Science) Pp. xvi +392 +4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 21*s*. net.

CROP husbandry, the first occupation of man, which must ever remain essential to the maintenance of human life, has been pursued through all the ages as an art and a craft. The bearing of science upon it is a very recent development which is probably still only in its initial stages. Crops grow in vital association with two media, the air and the soil. It is barely a century ago that, following the discovery of photosynthesis, the main facts about the relationship of the crop to the air became generally known. The essential facts about the relationship of the crop to the soil are still clouded in mystery. In spite of all the development in the study of plants on one hand and of soils on the other, very little is known of the relationship of one to the other, and we are still largely dependent upon empirical experiments in order to determine the effect upon the plant of any particular treatment of the soil. Moreover, as this account of the Woburn experiments shows very clearly, the successful conduct of empirical experiments is beset with great difficulties.

Field experiments to test the effect upon the crop of applications to the soil began about a century ago with the work of Boussingault in France. The now classical Rothamsted experiments were commenced shortly after, and in 1876 the Woburn Experimental Station was commenced by the Royal Agricultural Society on land given for the purpose by the Duke of Bedford. The Woburn Station was originally designed to deal with the specific problem of determining the increased value of animal manure following the feeding of concentrated food. Prior to the beginning of these experiments, it had been the practice in many districts for an incoming tenant to compensate the outgoing tenant for that part of the money spent upon concentrated foods which was deemed to have passed to the manure and which therefore became the property of the incoming tenant. The passing of the Agricultural Holdings Act in 1875 made such compensation compulsory. J. B. Lawes, moreover, had for some time previously been concerned with the fact that there was no scientific basis for assessing the residual manurial value of feeding stuffs, and he gave invaluable assistance in the initiation of the Woburn scheme. A number of other field experiments were started at Woburn, and their progress over fifty years is reviewed in this book.

The story of the experiments is in a sense three times told in this book In the first part Dr. Voelcker, who succeeded his father as the Director of the Woburn Station, gives a categorical account of the work. In the second part Mr. W. G. Cochran gives a statistical examination of the results, and in the third part Sir John Russell summarizes the results in their bearing upon agriculture.

A first reading of an account of the Woburn experiments is disappointing, and in a certain sense this book is the story of failures. This sense of disappointment and of apparent failure arises, however, from the fact that many of the experiments at Woburn have not given the results that were anticipated, and the real value of the book lies in a full consideration of that fact. The residual manurial experiment which dominated the beginning of the Woburn work was designed to compare the effects of feeding cotton cake containing 6·6 per cent nitrogen and maize meal containing only 1·7 per cent, but whether fed to bullocks under cover or sheep folded on the land, there ensued no evidence of the superiority of the cake over the corn, and the result is frankly admitted by the authors to be both disappointing and mysterious. The ploughing-in of green manure has figured prominently in the experiments, and the results suggest that green manuring and the ploughing-in of legumes are by no means certain to benefit a succeeding wheat crop.

The Woburn experiments, however, have by no means all led to negative results. From the beginning there have been continuous barley and wheat plots, differently manured on a plan not unlike that of the classical experiments at Rothamsted. These plots have been valuable in confirming the chief findings of the Rothamsted plots.

The outstanding result of the continuous barley experiments at Woburn is the development of acidity in the soil following the continuous application of ammonium sulphate. This has resulted in a complete failure of the barley crop. The oxidation of the ammonium radical to nitric acid means that an application of ammonium sulphate is virtually an application of sulphuric and nitric acids, and the Woburn plots will always remain the classical demonstration of this fact. The effect has not been seen at Rothamsted because of the relatively large supply of calcium carbonate in the soil. Sir John Russell rightly says that in the whole range of British field experiments there has probably been nothing more striking than this effect of ammonium sulphate on the Woburn barley.

One great lesson from the book under notice as a whole is the fact that the conduct of field experiments is by no means the straightforward procedure that it was thought to be at the time the Woburn experiments began. The necessity for statistical treatment of results was not thought of in those days, and consequently, even in the continuous barley and wheat experiments, the design of the experiment has been such as to limit what the statistician can do with the results. This is a fact which is fully admitted by the authors, who also point out that another lesson from these experiments is that, once a continuous experiment has been designed, modifications at a later date should be avoided. The results of the barley and wheat experiments would have yielded more to the statistician if it had not been for changes in the scheme of manuring.

The supreme difficulty in field experiments, which has led to the modern methods of design giving results that can be dealt with statistically, is the variation of soil. Apart from certain warp soils, there is almost certainly no such thing as a soil that is uniform either horizontally or vertically. The Woburn soils seem to be particularly unfortunate in their variation. A section on the soils at Woburn is contributed by Dr. E. M. Crowther. It gives an account of the effect of the treatments upon the organic matter and exchangeable bases and will be read with much interest by soil chemists. The soil is a light sandy loam derived from drift overlying Lower Greensand. The variations are particularly marked in the subsoil.

Everyone interested in field experiments will be grateful for this book and for both the positive and the negative results of the Woburn experiments. They each have their value, and whatever may be the future of Woburn, the work already carried out there will certainly remain classical.

Thirty Years for the Public Health

The Last Thirty Years in Public Health: Recollections and Reflections on my Official and Post-Official Life. By Sir Arthur Newsholme. Pp. 410 +13 plates. (London: George Allen and Unwin, Ltd., 1936.) 15s net.

TO the many who read, enjoyed and appreciated the first volume of reminiscences of Sir Arthur Newsholme, published a little time ago under the title of "Fifty Years in Public Health", the appearance of this second instalment of what he calls his "Recollections and Reflections on my Official and Post-Official Life" will be much welcomed. Both volumes are written with enthusiasm, which is not at all surprising since they have reference exclusively to activities in the field of public health, and from the day he entered it until this very moment, it is probable that there has been nothing that Sir Arthur has been so enthusiastic about as public health. Public health administration, public health progress, public health organization—these, it is safe to believe, since there are his works—this and a multitude of others—for evidence, have been, in effect, his unique concern Probably it is because of this that his career has been so successful.

It is because of it that these two books—that of fifty years and this of thirty years—have so much of value: not only immediately, to those of this and Newsholme's own generation of health workers, but also historically as well. As a matter of fact, so very unwilling has Sir Arthur been to devote space to references to himself, his own life and activities, and so anxious to refer to the public health problems that were tackled and the schemes that were evolved during the period of which he writes, that in spite of what he himself says, it is much more of a historical than a personal document he has produced.

The years with which in this present volume Sir Arthur deals are those from 1908 to the present. In the volume he divides the period into two—the first, 1908–1919, when he was, as he claims, "at the head of the Medical Department of the State's Central Health Organisation"; the second from 1919 to the time of writing, when, though he seems to have worked very hard, he had opportunities at any rate for having a much more interesting time than ever before, whether at Brighton, as the greatly trusted Medical Officer of Health, or at Whitehall as the immediate successor of Sir William Power and in the line of giants like Sir John Simon, Sir George Buchanan and Sir Richard Thorne Thorne.

That Sir Arthur was really happy following his transplantation from Brighton to Whitehall may be doubted. What he has to say here and there in Part 1 of the volume under the heading "Official Life in Whitehall" does not convince that he was. Since while Medical Officer of the Local Government Board—which preceded and was absorbed by the Ministry of Health—he was able to see launched schemes in which he had for long been deeply interested, it might have been supposed that there was real reason for happiness Among matters on which he had written and spoken much and also attempted to set moving long before he left local for central administrative circles were tuberculosis and venereal disease control and infant and child welfare. During his period of service at Whitehall, schemes in regard to these were well established, or the ground at least was well prepared for their establishment. Similarly, it should be remembered, and in the volume there is included, very properly, a reminder, that it was very largely due to the efforts of Newsholme that there was recognition of the need for securing that both on behalf of the child and of the mother herself greater attention should be given to motherhood and to maternal welfare. It is in Part 1 of the volume that Sir Arthur deals with matters such as these and the years 1908–19, that he spent at Whitehall. That there is very much more that he would like to say of this period is very clear.

At the same time, however, there is more than a hint that there was much more that he would have liked to have got done and some things that perhaps he would have liked to have seen done in a different way. Also there is full evidence that the part he played in the progress made was one of extreme importance.

The remaining parts of the book reveal mainly that while at the head of the Government Health Department Sir Arthur added vastly to the already great reputation he enjoyed throughout the world of public health Under the headings "Recollections of American Public Health and Social Work" and "The Increasing Socialisation of Medicine", he shows that instead of passing into retirement on the day he left Whitehall, actually he entered upon a new phase of his career. From a variety of directions came invitations and demands for assistance, guidance and advice. Acceptance of these invitations and the meeting of these demands, the record indicates, caused him to make or renew contacts all over the world, but more particularly in the United States, and brought him, it cannot be doubted, a wonderful new measure of happiness.

In the American chapters Sir Arthur tells of the years spent at Baltimore as lecturer in the School of Hygiene of Johns Hopkins University. He gives also much interesting and valuable information with regard to public health administration in the United States and makes generous reference to American achievements in public health and tropical medicine.

In the third and final part of the book, which Sir Arthur devotes to a discussion of the increasing socialization of medicine, he has again much to say of things American. Probably, however, the most interesting chapters in this part are those relating to the visit paid to Soviet Russia in 1933. To an extent in these he fills in gaps left in the description given in another book of his, "Red Medicine; Socialised Health in Soviet Russia", written in collaboration with Dr. J. A. Kingsbury, at that time secretary of the Milbank Fund. Obviously what he saw in Russia impressed him, though not always favourably. He recognizes, however, the value attached to the social work now in progress in that country, and believes that developments even more valuable, from some of which the nations as a whole may have something to learn, are certain to take place.

As a matter of fact, these would appear to be the conclusions that in general Sir Arthur would wish to have drawn from what he has written in this book and its predecessor. In his life-time, he finds, almost incredible advances have been made, with unparalleled additions to human knowledge, that, having been applied, have resulted in profound improvement in the health and living conditions of the people as a whole. Great as has been the progress and the improvement, however, he still believes in the possibility of advances even greater and more important—believes, indeed, that the best is still to come.

An indefatigable worker and possessed of an enthusiasm for public health that has never flagged, the contributions that Sir Arthur himself has made to the progress that the past has shown and that the future holds are vast. It is good that he has written this book about these things. It has great value and great interest not only for those engaged or concerned in health work, but also for the more general reader.

Diesel Engineering

(1) Elements of Diesel Engineering: an Introductory Manual easily understood, covering the whole field of Design, Working, Maintenance and Repair of Stationary, Marine, Aircraft and Road-Transport Types of Diesel Engines. By Orville Adams. Pp. xvi+478. (London: Constable and Co., Ltd., 1936.) 18*s*. net.

(2) Diesel and other Internal-Combustion Engines: a Practical Text on the Development, Principles of Operation, Construction, Details and Performance of Stationary and Portable Diesel, Gas and Gasoline Engines. By Prof. Howard E. Degler. Pp. vii+237+5. (Chicago: American Technical Society; London: Crosby Lockwood and Son, Ltd., 1935.) 10*s*. 6*d*. net.

(3) Diesel Engines: Excessive Lubricating Oil Consumption. By P. H. Smith. Pp. ix+85. (London: Constable and Co., Ltd., 1935.) 3*s*. 6*d*. net.

IN addition to publications arising from its importance from scientific, technical and commercial points of view, the Diesel engine has to a quite considerable extent encouraged the production of books suitable for the instruction of drivers and others whose livelihood may depend on a broad, though not necessarily deep, knowledge of its principles, details and operation. The need for this class of book arises, to some degree, from the restriction of the practical training given to those placed in charge of machinery, more particularly that used for transport.

(1) It is expressly in order to assist the practical man in this position as well as to enlarge the field of view of the engineering student, and to help both to a fuller understanding of the operation and working principles of the Diesel engine, that "Elements of Diesel Engineering" has been written. The development and application of this type of engine are recognized in America as offering the most promising future for the mechanically-minded young man, and large numbers of students have come forward to prepare themselves to take advantage of these possibilities. While to the trained engineer there is a strong family resemblance between the various internal combustion engines, and differences in detail are readily recognizable as functional, the change from one cycle of operations to another, from one system of fuel supply to another, or from a familiar to a new method of ignition involves for the average driver a complete break with the tradition to which he has become accustomed.

This introductory manual, written in non-technical language, offers practical information of a descriptive and critical nature as to the construction, operation and maintenance of the Diesel engine and discusses the main features of its various parts and the qualities and properties of suitable fuels and lubricants. Although thermodynamics is not dealt with, the thermal principles are explained and mechanical theory also receives attention. Of great value are the numerous illustrations, which are clear and well produced.

(2) In the same category may be mentioned "Diesel and other Internal-Combustion Engines" which has been prepared with a similar end in view. In smaller scope it deals with all the types and gives more prominence to thermodynamic and other theory, but in an explanatory rather than an analytical manner.

(3) In a virile little book, Mr. Philip H. Smith, out of his wide experience as inspecting engineer to Lloyd's underwriters, deals with the excessive consumption of lubricant which characterizes the Diesel engine. The remedies and palliatives which he recommends as having been tried and proved effective are for application to engines in service; but his remarks and conclusions are worthy of the closest attention by designers, who have the greater opportunity of developing them under favourable conditions.

The sphere of the Diesel engine was described in a lecture last year to the Royal Society of Arts by G. Mackenzie Junner, editor of the *Commercial Motor*, entitled "The Oil Engine and its Influence on Road, Rail and Air Transport" (*J. Roy. Soc. Arts*, July 24, 1936). On the road, owing to its greater cost, the Diesel engine is advantageous over the petrol engine only in cases of heavy loads or long mileage. In rail transport it has to compete with its very economical rival the steam engine, but the author can point to notable advantages in that it is immediately available when wanted and can be shut down with equal promptitude, thus saving wages and fuel costs preparatory to and following the period of useful operation. In the air its merits, though as yet far from fully developed or manifested, lie in its less inflammable and less volatile fuel, in the absence of sensitive carburetters and ignition systems and in its immediate readiness for service without a prolonged period of warming up. Of these three spheres of employment, the paper offers a general survey of considerable interest.

A New Natural History

Natural History
Edited by Dr. Charles Tate Regan. Pp. 896 + 16 plates. (London and Melbourne: Ward, Lock and Co., Ltd., 1936.) 25*s*. net.

DR. TATE REGAN is to be congratulated on having succeeded in giving the student and the intelligent reading public a really well-balanced and accurate account of zoological natural history in one volume of less than a thousand pages. He is fortunate in having as his collaborators a panel of experts, each of whom is an acknowledged authority on the subject with which he is concerned. He himself deals with fishes; mammals are in the safe hands of Mr. R. I. Pocock; Mr. W. B. Alexander, of Oxford, is responsible for the bird section and Mr. E. G. Boulenger, director of the Aquarium at the London Zoo, for reptiles and amphibians, while invertebrates are split into insects and those other than insects, and are dealt with by Miss D. Aubertin and Mr. G. C. Robson respectively. A systematic arrangement of sections has been adhered to by each author, which makes the whole an easy book of reference.

The most modern system of classification has been applied in every case and it will doubtless come as a shock to many readers to find, for example, that such old and familiar friends as the lion, tiger, leopard and jaguar no longer belong to the genus *Felis* but have been translated to a new and very select genus *Panthera*, while several of the other cats such as the so-called clouded leopard and the serval have been exalted to entirely new genera. Each section has a useful introductory chapter which deals with the main attributes of the order concerned and also with related forms which have become extinct.

Apart from the letterpress, which meets both the needs of the general reader and the serious student, the volume is illustrated throughout with a collection of more than a thousand photographs of, in most cases, living animals taken by expert animal photographers in Nature and in zoos all over the world. In addition, there is a number of coloured plates reproduced from pictures by famous animal artists. Here is indeed a book of great scientific accuracy and detail which also has a popular appeal and which at the price is highly concentrated value. G. M. V.

Manual of Public Health:

Laboratory Practice. By Prof. J. R. Currie and contributors. Pp. xix+378. (Edinburgh: E. and S. Livingstone, 1936.) 21*s*.

It is an ambitious project to attempt to survey the whole of laboratory practice appertaining to public health in one volume, including as it does such varied subjects as chemistry, bacteriology, protozoology, helminthology, entomology and meteorology, but on the whole we think the author and his collaborators have succeeded.

The sections on protozoology, helminthology and entomology are excellent, and the respective authors, Dr. Staig, Miss Jepps and Dr. Mears, have written adequate summaries, as completely up-to-date as could be expected in subjects which are in a state of flux, and the numerous illustrations, many of which are original, increase the value of these sections. In meteorology, all the essential subjects appear to have been dealt with. In the introduction, it is suggested that the medical officer of health should be reasonably well informed on public health chemistry, and the section on chemistry conveys, we think, sufficient information to ensure this. The description of the quantitative test for benzoic acid does not, perhaps, mention all the precautions necessary, and the Werner Schmidt method for fat in milk might have been dealt with in less cumbersome form.

The section on bacteriology is the weakest in the book and is very 'sketchy', though the author to some extent disarms criticism by stating that a preliminary training in the subject is assumed, and the purpose of the article is to show how to get under way with the procedure required. Some of the details of the Rideal-Walker test of disinfectants are inaccurate, and under 'water' it would have to be almost sewage to show the presence of *Cl. welchii* in so small a quantity as 5 c.c.

The book is well produced, has adequate and excellent illustrations throughout, and a good index.

Great Earthquakes

By Dr. Charles Davison. Pp. xii+286+12 plates. (London: Thomas Murby and Co., 1936.) 17*s*. 6*d* net.

This volume may be regarded as a sequel to the author's monograph, "The Japanese Earthquake of 1923" (1931), about the great Japanese earthquake of September of that year. Eighteen other important earthquakes of the last two centuries are now described. Most of the shocks caused serious loss of life and extensive damage, but the selection is primarily of those which have been investigated in such detail that the results are of value towards an understanding of the nature and origin of great earthquakes.

The earliest shock of the series is the Lisbon earthquake of November 1, 1755, in which the greater part of the city was destroyed and the loss of life ran into tens of thousands; the latest is the shock off the Sanriku coast of Japan on March 3, 1933, when more than three thousand people were drowned by the sea-waves due to the earthquake. Among the best known of the other shocks are the Mino-Owari (Japanese) earthquake of 1891, the Assam earthquake of 1897, the San Francisco earthquake of 1906, the Italian earthquake on December 28, 1908, in which Messina and Reggio were destroyed, and the Hawke's Bay (New Zealand) earthquake in February 1931.

For each earthquake are given details of the nature and effects of the shock in the surrounding regions, of the loss of life and material damage, of the earth movements and other phenomena accompanying the disturbance, and descriptions of the aftershocks. The geographical distribution of the intensity is generally shown by maps of the isoseismal lines. The seismic history of the various regions is a valuable feature, having been prepared from works which are not easily accessible.

The Annual of the British School at Athens

No. 34: Session 1933–1934. Pp. ix+198+49 plates. (London: Macmillan and Co., Ltd., 1936.) 50*s*. net.

The thirty-fourth issue of the "Annual of the British School of Archæology at Athens" differs from its predecessors in omitting formal matter and the useful annual review of archæology in Greece by the Director which have appeared in these volumes hitherto In future this material will be issued separately to subscribers to the funds of the School. The present volume, therefore, contains only papers, two in number, by members of the School. Mr. R. F. Cook discusses "Fikellura Pottery"—a group of ceramics, possibly better known under the name "Samian", which is not adopted here for good and sufficient reasons, as set out by the author. The second paper is on "Lakonian Vase Painting" by Mr. E. A. Lane. It carries further and adds to the study of material which has previously been the subject of investigation by a former member of the School, Prof. J. P. Droop, to whose conclusions, more especially in chronology, alternative suggestions are sometimes made. Both papers are very fully and admirably illustrated.

The B.D.H. Book of Reagents for 'Spot' Tests and Delicate Analysis

Fifth and enlarged edition. Pp. viii+96. (London: British Drug Houses, Ltd., 1936.) 2*s*. 6*d*.

The latest developments of chemical analysis have led to a demand for spot tests which can be carried out quickly and in large numbers and afford direct evidence of the presence of minute traces of various substances. The reagents are all organic substances. In this monograph these substances are listed, together with the elements for which they are agents. A selection, seventy-one in number, has been made from the many which have been proposed after careful trial in the B.D.H. laboratories. It is believed that all these reagents are now made in Great Britain, a testimony to the success of the Safeguarding of Industries Act. Each test is described in sufficient detail with references to the original literature: many of them are of quite extraordinary delicacy.

The Field of Clinical Science

LORD NUFFIELD'S GIFTS TO OXFORD

By Prof. T. R. Elliott, C.B.E., F.R.S.

MEDICINE as a charity for the sick poor has for hundreds of years been entrusted with the gifts of kindly minded men and women. But the great advances in recent times of medical knowledge, whether directly won or derived from kindred sciences, have shown such promise of abundant help for all, rich and poor alike, that the gifts are now directed with a broader hope upon medicine itself. Such gifts, and they have followed one another in an astonishingly rich profusion since the beginning of this century, do not derive from a purely intellectual interest in science. Their aim is practical, for the welfare of humanity; they are guided by the sense that medicine itself, the instrument, must be sharpened with a keener power of penetration into the tangled problems of disease. Merely to multiply hospitals is not enough, for there is still substance to justify the indignant comment of Tristram Shandy's father on the physicians' motto, *Ars longa, vita brevis,* "Life is short, and the art of healing tedious; and who are we to thank for the one and the other but the ignorance of quacks themselves—and the stage loads of chymical nostrums, and peripatetic lumber, with which in all ages they have at first flattered the world, and at last deceived it".

The practical art itself can make little true progress unless medicine is brought closer and still closer to the discipline of scientific thought. But the word 'science' in itself carries no reference to laboratories and their modern uses. It simply connotes exactness of knowledge. Plato in his Republic defined 'opinion' as a faculty wandering between ignorance and knowledge, and too often resting near the former state. It is not the traditional reliance on doctor's opinion, but proof of every clinical rule and determination of the laws co-ordinating the phenomena of disease that are needed if the subject is to take rank as a science.

There are faint-hearted people within medicine who feel that the complications of each individual patient and his disease are so manifold that the clear generalizations of an exact science can never be applicable in practice, and that the latter must always remain at the level of an individual art. Others who are outside of the clinical group believe that discoveries of far-reaching value, the issue of a science that is creative as well as exact, will so rarely have their parentage among clinicians that it is fruitless to attempt to foster their birth in other homes than those of the ancillary sciences, such as physiology, biochemistry, and bacteriology. If both these views were true, clinical medicine might remain a useful art but it could never gain the exactitude and fruitfulness of a science Good judges have decided otherwise, and laid plans for the embodiment of their views. To the practical English mind it is important to note the origin of these plans and their subsequent vigorous growth.

In 1913 the Royal Commission on University Education in London published its final report. Lord Haldane was chairman, and associated with him were Lord Milner, Sir Robert Morant and others, none of whom held medical qualifications. The great fracture of the War has broken the continuity of memory in many affairs, and it often escapes notice that many of the recent developments in London were foreshadowed in and owed their origin to the arguments of that report. In dealing with the teaching of medicine, Lord Haldane and his colleagues concluded that clinical medicine is capable of being treated scientifically, and that for this purpose the subject should be dealt with by men of the kind spoken of as university professors, who would do for medicine what other men do for physiology or chemistry. In order to enable each of such clinical professors to develop his subject by both teaching and research, it was proposed to equip him with a 'hospital unit' or service of beds, laboratories and assistants, all under his general control.

Soon after the War, in 1919, Sir George Newman announced a grant from the Board of Education for the immediate establishment of a number of such clinical units in certain medical schools of London, and their directors were afterwards given the status and responsibilities of professors in the University. The primary conception owed much to the examples already given by Germany and the United States, and at the outset it was nourished by great gifts from the Rockefeller Board. But time has proved its strength; and the Regius professorships of medicine in Great Britain, which are among the oldest established of all our university chairs, are now being one by one transformed into posts held by men who do not aim at individual reputation in practice but seek to establish their subjects on a broader basis as an exact science. Lord Nuffield's gift of £2,000,000 to the University of Oxford for a school of advanced teaching and research in the clinical subjects emphasizes both the momentum of this change and the hopes that ride by its side.

Exactness in medicine as a science, whether curative or preventive, has all too short a range of ascertained knowledge. The vastness of the unmapped stretches, where disease must be met and somehow or other dealt with as it arises day by day, makes the science seem so small and the art of medicine almost the only means for ready action. Who can best be entrusted with the duty of riding out to extend the borders of the known ? Physiologists and biochemists have claimed the honour, justly pointing to the work they have already done. But to Lord Nuffield and his advisers it seemed right to choose men who belong to a different group, clinicians, and his choice lacks neither precedent nor good argument.

In the same year as that in which the Royal Commission outlined its plan for medical education in Great Britain, research in medicine was suddenly given State recognition and endowment on a great scale by those decisions of Government which created what is now known as the Medical Research Council. Though always devoting the greater part of its resources to laboratory work by bacteriologists, chemists and others not in direct contact with the sick, the Council from the outset resolved to foster research by actual clinicians. It was happy in its first choice of a man to be given full opportunities for such work. Sir Thomas Lewis, with his beds, laboratories, and assistants at University College Hospital, London, has given knowledge of the highest value to medicine by his studies of diseases of the heart and blood vessels. So emphatic a success justified the Council in developing similar posts for clinical research in other medical schools ; and with the assurance of such possibilities for work in front of them, even before the advent of Lord Nuffield's endowments for clinical research, some of the ablest of the younger men in hospitals have chosen for their life's work research in that particular field which Sir Thomas Lewis by his recent writings and addresses has sought particularly to identify under the name of clinical science.

Neither the name nor the idea is new. But the steady advocacy and the proof of its importance have created a group of workers who will make of it almost a new science in Britain. Including as it does all exact knowledge concerning human disease, it is in that respect nothing more than the science of medicine, to which so many workers in the past have added from their various points of view. The fresh impress is in the emphasis on the possibility, and the need, of developing a science directly related to medicine and dealing with the clinical phenomena of disease.

The accepted medical sciences, as distinct from clinical science, comprise all those biological studies which contribute to the understanding of disease and which were originally developed by medical men because they felt the need for such ancillary knowledge. Physiology, bacteriology and the rest have shown such vigorous growth that each now prospers with the independence of a pure science. The separation was inevitable ; but thereby clinical medicine lost much of its own repute for scientific work, while the ancillary sciences acquired the term of being 'fundamental' because they revealed the main facts and laws of the working of the healthy body through which the disturbances wrought by disease might be analysed. For argument, let it be granted that in the future the deepest discoveries of far-reaching importance will be made by research in these separate studies. Such discoveries cannot be used at once in practical medicine. Some intermediate group of workers, equally trained in exact scientific judgment, must test and prove the way in which they may be applied to the management of human disease. The physiologist has learned that what is true for the frog may be untrue for the cat ; and even what is true in healthy man may not be true in disease. If life must be measured in terms of life, then medicine must be measured in terms of medicine. That is the responsibility of clinical science.

The British school of physiology has a world-wide eminence. Its great discoveries regarding the nervous control of the viscera and blood vessels were among its earliest achievements, and little has been added to the details of that analysis in the last thirty years. Time moved on, and still almost nothing was gained from that great store of knowledge until at last clinicians themselves began to test by experiment its applicability to diseased states in man. In this direction clinical science is complementary to the fundamental sciences, and as essential as they are for the progress of practical medicine. But the clinician is the first to be aware of the insistence of a medical problem and to define it : in the end, only he can test the accuracy of the proposed solution. The needed discovery will often be his own, but if it chances to be made by a laboratory worker in other biological sciences, it is plainly to the advantage of the latter in so far as public support of their sciences is concerned that the applicability of such discovery to practical medicine should be proved with the least possible delay. Indeed, those aspects of pure physiology and pathology which require experiments on animals would not be accepted as justifiable if they did not yield knowledge that finally gives help to both man and the animals.

There should, therefore, be no jealousy between clinical science and the sister subjects. Each relies on the other where medicine is concerned. For the fundamental sciences there may be fears that such great gifts as those of Lord Nuffield, opening too wide an irrigation channel over the new fields, may compromise their hopes of support. But the clinical work must be done, and the study of medical patients is costlier in all forms of maintenance than that of any other laboratory work. It cannot be stinted. For clinical science in its newer aspect there is a human need of intellectual sympathy and encouragement. Its work and its own proper discoveries tend to be disregarded in the domains of pure science, unless they happen to contribute facts or laws that are seen to be important also in those fields of work. The science must therefore stand in its own ground if it is to gain adherents and fulfil the responsibilities which are proper to it.

Some events in the history of medical progress more than a hundred years ago may be looked at in this reference. Thomas Young, whose intellect devised a theory of light and colours and went far in deciphering Egyptian hieroglyphics, was a physician. After years of study he wrote a book on consumption of the lungs, and to that subject even his great scientific powers could contribute nothing beyond a device for identifying pus cells in sputum by the coloured rings produced by the uniformly sized globules when the sputum was squeezed into a thin layer between two glass plates. Three years later, Laennec in Paris published his epoch-making observations on the use of the stethoscope and of physical signs for exact analysis, as proved by subsequent necropsy, of diseased states of the lungs. These discoveries were missed even by the inquiring genius of Thomas Young, and yet they were so great as to make all his treatise idle reading. Though demonstrably true, they are barely noticed in the history of scientific thought because they belong only to clinical medicine. They derived nothing from and contributed nothing to other sciences; but they had the exactness of proved knowledge and in that sense became a part of medical science.

Much of the best in medicine is knowledge of this type, gained by direct observation of the phenomena of sickness; but being self-contained and not linked by any clear laws with the generalizations of other sciences, it tends to be judged as falling below that which would entitle it to the rank of a science and being little more than the furnishing of a practical art. The exclusiveness of such a judgment might well be challenged. On the other hand, Young's observation on the sputum, though it added nothing to medical knowledge and only introduced an ingenious device, would by modern custom probably be spoken of as scientific because it was derived from the established body of mathematical and physical knowledge. The present fashion is to assume that there is nothing scientific in medicine unless it has been either derived from or re-affirmed by experimental tests in laboratories of the fundamental sciences.

Certainly in the past, medicine has taken a first but only half-hold of many discoveries, and then let them slip unproved out of her grasp because she lacked the technique of experiment and proof that has been the foundation of the biological sciences. The control of rickets and the whole range of modern progress in nutrition have thus tended to pass to the credit of physiology. But physiologists have their own problems to solve, and it is essential to the advance of a pure science that its quests should not be limited by the narrow horizon of what is visibly capable of practical use. There will be a long and wasteful delay in the progress of both the science and art of medicine unless the means are strengthened for prompt study of clinical questions by every available form of science, and equally for the testing and transference into clinical knowledge of any hopeful new discovery in physiology or the other sciences. Every part of such work will be scientific, while its direct concern with the questions of human disease is stated in its name of clinical science.

Engineering and metallurgy derive the whole of their scientific thought from the fundamental studies of physics, chemistry and mathematics. Geology derives still more widely. Yet in these subjects an independent science exists, and is creative in its own field. Clinical science in England at the moment makes use largely of the physiological approach to medical problems. With such methods clinical workers have made advances that are momentous in their own science, though some of them are of little import to physiology. The analysis of the different forms of irregularity of the heart-beat, their relationship to failure of the heart, and the appropriate therapy by digitalis provide one such instance. The delightful success of American work on the treatment of pernicious anæmia is almost entirely due to clinical research, while it has given to physiology new knowledge about the ripening of red blood cells that includes a process of such fantastic strangeness that no sane physiologist would have allowed himself even so much as to dream of its possibility. Each science learns from and helps the other.

Physiologists have taught all the 40,000 medical men in Great Britain. These practitioners of medicine are busy with their own technical art, and that is neither physiology nor clinical science, though it is inspired by each. Year by year their work grows more effective, thanks to progress in scientific knowledge of disease. Lord Nuffield's gift will augment the number of those aiding this advance by work in clinical science, and still leave them few in comparison with those in the other medical sciences whose work is less directly related, and therefore less immediately applicable, to the treatment and prevention of disease.

Chemical Exploration of the Stratosphere*

By Prof. F. A. Paneth

STUDENTS of the history of astronomy may remember that those of the natural philosophers in old Greece who favoured a geocentric conception pictured the universe as being built up of several spheres surrounding the earth. According to Aristotle, the sub-lunar world consisted of the four elements, each tending to its "natural place"; innermost was the core of the earth, surrounded by layers, first of water, then of air, and fire, wherever found, trying to rise to the top layer. Next came the realm of the "quinta essentia", the substance of the celestial bodies; but these were not supposed to circle in one and the same sphere. In order to explain the movements of the planets, Aristotle saw himself compelled to assume not less than fifty-six spheres in the sky, all concentric with the earth.

It looks somewhat like a revival of these old ideas that to-day science speaks of many concentric layers in the earth, sea and atmosphere. Since the development of modern seismology and geochemistry, it is known that the earth consists of at least four regions: a core of liquid iron in the centre, then a medium shell of, probably, sulphidic ores, covered by two outer shells of rocks of different densities. Fairly recently, in the early part of this century, it was discovered by Teisserenc de Bort that the thermal qualities of the atmosphere show a break when the height of about 11 km. (in our latitudes) is attained. In the lower part, called the 'troposphere', the temperature decreases regularly with increasing altitude until, at the height mentioned, about − 53° C. is reached. From here onwards, however, the temperature remains nearly constant at any height accessible to direct meteorological measurements. We have obviously entered a layer of the atmosphere in which different physical conditions prevail: the 'stratosphere'.

For a while it was assumed that the constant temperature of the stratosphere might extend to the top of the atmosphere. But from 1922 onwards it became clear that the structure of the atmosphere is much more complicated. We now know from indirect evidence, interpreted by Lindemann, Dobson and Whipple, that in regions at present beyond the reach of any thermometer, between 30 km. and 40 km., the temperature of the atmosphere begins markedly to increase again, and that this warmer layer is responsible for the reflection of sound waves; that at about 100 km. and again at 300 km. there exist strata of ionized air which play a role in the reflection of radio waves (Kennelly-Heaviside and Appleton layers); and that in the highest parts of the atmosphere a gaseous mass of about 1,000° C. is to be assumed. However complicated this may sound (even if we add that oceanographers nowadays distinguish between a 'troposphere', the upper layer of the sea in which the temperature decreases with descent, and a 'stratosphere' of fairly constant temperature below) we may still console ourselves by the thought that the modern scientific picture of the onion-like structure of the earth, sea and air is yet much less involved than the speculation of the ancient philosophers, and that its exploration advances quickly, thanks to the co-operation of various sciences.

While the temperature and the electrical state of the stratosphere have been the subject of many investigations, its chemical composition has seldom been studied. But so early as 1912, Tetens pointed out that a chemical investigation of the composition of the stratosphere would be the best, if not the only, means of deciding the question raised right at the beginning by the discovery of the stratosphere: Does the constancy of temperature mean that there is no convective motion of air-masses; does it prove the absence of winds?

It is not difficult to see why the chemist should be able to settle this question. If it were possible in a long vertical tube containing a homogeneous mixture of two gases of different densities to prevent every disturbance from outside, then we should expect the relative proportion of the gases no longer to remain constant throughout the length of the tube, but the heavier gas to concentrate near the bottom, the lighter near the top. This is a consequence of Dalton's law, which states that the variation with height of the density of each gas is the same as if it alone were present. The conclusion has never been experimentally verified, as it is scarcely possible to keep vertical gas columns of sufficient lengths—100 m. would be a good start—free from all disturbances. Only as a historical curiosity it may be mentioned that in the classical book on acoustics by Chladni (1802), an experiment is quoted by a Vienna professor who succeeded in separating the nitrogen and oxygen of atmospheric air in a vertical tube of not more than five feet length, simply by leaving it alone for one year!

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* From the Friday Evening Discourse at the Royal Institution delivered on November 6.

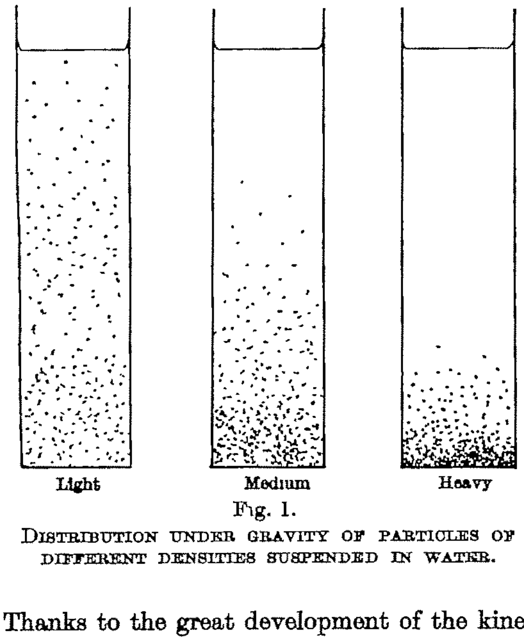

Fig. 1.

DISTRIBUTION UNDER GRAVITY OF PARTICLES OF DIFFERENT DENSITIES SUSPENDED IN WATER.

Thanks to the great development of the kinetic theory of gases we can, however, predict in every detail what is bound to happen in long vertical columns; and on a reduced scale it is possible to test the conclusions in a model experiment. Einstein was the first to point out that little particles suspended in water are subject to the same two conflicting tendencies as the molecules of a gas; on one hand they try to settle down, due to the force of gravity; on the other, their tendency to diffuse drives them asunder in all directions, including the one opposed to gravitation. As a result their equilibrium distribution must follow the same well-known 'barometric altimetry formula' for the decrease of concentration with height as does atmospheric air; with the one difference that, owing to the enormous contrast between the weight of visible particles and that of gas molecules, the phenomenon of thinning out with height must become perceptible at much smaller distances. The density of oxygen, for example, decreases to half its original value if we ascend to a height of about 5,000 m.; in a suspension of microscopic particles in water, the concentration should fall to half the initial value within a minute fraction of a millimetre, the rate of decrease depending, amongst other factors, on the specific weight of the particles.

Einstein's predictions have been tested experimentally by the French physicist Perrin and others. Fig. 1 illustrates on an enlarged scale what has actually been seen under the microscope. Each of the three suspensions, of heavy, medium and light particles, shows the regular decrease of concentration with height, following the barometric formula; but the one with the heaviest particles displays the phenomenon within the shortest range. If we mix the three emulsions by stirring, the particles will at first be homogeneously distributed throughout the whole column of water; but as soon as we leave them undisturbed—that means subjected no longer to large-scale mixing, but only to the forces of diffusion and gravitation—the height distribution peculiar to each of them will be restored, and so the percentage concentration of the heavier particles will increase near the bottom, of the lighter particles near the top.

Let us apply this knowledge to the atmosphere. It consists of a complicated mixture of gases.

TABLE 1.

COMPOSITION OF THE TROPOSPHERE (PER CENT BY VOLUME).

Nitrogen	78·08	99·99
Oxygen	20·95	
Argon	0·93	
Carbon dioxide . .	0·03	
Neon	$1{\cdot}8 \times 10^{-3}$	
Helium	5×10^{-4}	
Krypton . . .	1×10^{-4}	
Xenon .	1×10^{-5}	
Ozone	variable; $> 1 \times 10^{-6}$	
Radon (average near ground)	6×10^{-18}	
Hydrogen	doubtful; $< 1 \times 10^{-4}$	

In Table 1 the composition of atmospheric air is given. The content of water vapour, as is well known, is so variable that I have omitted it entirely; the table refers to dry air. The carbon dioxide, ozone and radon content, for different reasons, is also far from being constant. But the other gases are apparently present in the percentage given wherever in the whole troposphere a sample of atmospheric air may be collected. (Statements to the contrary in the older literature, by Wigand, Tetens and E. Erdmann and H. Lange, were based on very few inaccurate experiments and can be regarded as disproved; it is most unfortunate that they should still be quoted.*) This equal distribution is perfectly understandable as an effect of the frequent stirring of the troposphere by winds; but if it be true that in the stratosphere no mixing beyond the slow one due to diffusion takes place, we should expect to find there a partial separation of the gases according to their different densities. A careful chemical analysis of air samples taken at various heights in the stratosphere is, therefore, a means of testing the question of the stillness of the stratosphere air.

As to the chemical analysis of air, we may confine ourselves to the determination of a few representative constituents. By far the easiest measurement is that of oxygen, and this gas has, therefore, been chosen by most laboratories; its absorption can be effected by phosphorus, heated copper or pyrogallic acid, or it may be removed by catalytic combustion with hydrogen. Its density, however, is only slightly greater than that of air (see Table 2) and for this reason it is not nearly the best for the present purpose; but the determination of the heavier argon is not so simple, and that of the minute traces of the very heavy gases, krypton and xenon, quite impossible in small air samples. As a specimen of a gas lighter than air, helium is the most suitable, since the lightest known gas, hydrogen, is not present in any measurable quantity; for the determination of helium we have developed a micro-method which enabled us to measure quantities of a few millionths of a cubic centimetre with an accuracy of 1 per cent.

TABLE 2

DENSITIES OF THE ATMOSPHERIC GASES.

	Formula	Molecular weight (O = 16·000)	Density (Air = 1·000)
Helium	He	4 002	0·1381
Neon	Ne	20·183	0 6963
Nitrogen	N_2	28·016	0·9670
Oxygen	O_2	32 000	1·1053
Argon	A	39·944	1·377
Carbon dioxide	CO_2	44·00	1·529
Ozone	O_3	48 000	1 624
Krypton	Kr	83 7	2·868
Xenon	X	131 3	4·525

(To be continued.)

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* See, for example, NATURE, 137, 459 (1936).

Obituary Notices

Dr. R. J. Tillyard, F.R.S.

THE death of Dr. R. J. Tillyard took place in Australia on January 13, as the result of a motor-car accident on the road between Canberra and Sydney. Since Tillyard was one of the best known entomologists of the present day, his decease will come as a shock to his colleagues in many parts of the world.

Born on January 31, 1881, Robin John Tillyard was the son of J. J. Tillyard, of Norwich. His education was at Dover College and Queens' College, Cambridge, where he gained a mathematical scholarship. He became senior optime in 1903 and graduated M.A. in 1907. Ill-health, especially rheumatism, led him to seek a livelihood abroad, and he went to Australia in 1904 as mathematics master at Sidney Grammar School. In 1909 he married Miss Patricia Craske, a daughter of Mr. W. R. Craske, J.P., of Borstal, Rochester.

On gaining a Government studentship at the University of Sydney, Tillyard relinquished the career of schoolmaster and in 1915 became Macleay fellow of the Linnean Society of New South Wales, an office which he held until 1920. A short period before the Great War he became involved in a railway accident which incapacitated him for a long time and permanently altered his bodily figure. During these years he had a young family to provide for on slender means. At this juncture, he owed much to his wife's skill and devotion in managing all family affairs over a difficult period. In spite of being still an invalid, he took a B.Sc. research degree at the University of Sydney and, some years later, became a D.Sc. In 1920 he was appointed chief of the Department of Biology at the Cawthron Institute, Nelson, New Zealand. Tillyard remained at Nelson until 1928, when he became Chief Commonwealth Entomologist for Australia—a new and highly paid post with more exacting duties. He held this post for six years but, owing to health reasons, he had to retire, the Federal Government granting him a proportional pension.

Tillyard's early researches were concerned with dragonflies and, beginning from about 1905, he published a long series of papers on these insects, mostly in the *Proceedings of the Linnean Society of New South Wales*. His most important original study in this field is his paper "On the Rectal Breathing Apparatus of Anisopterid Larvæ" which was published by the Linnean Society of London (1916). It is a work of outstanding merit and secured for him the Crisp Medal and Award of that Society. About 1915 he became interested in the wonderful Neuroptera of Australia, publishing many papers on these insects. His work on the Chrysopidæ showed with remarkable clarity how the intricate venation of these creatures is prefigured by the tracheation. After publishing his well-known book "The Biology of Dragonflies" (1917), Tillyard completed a study of venation and its bearings on the phylogeny of the Holometabola. The outcome were his papers on the "Panorpoid Complex" wherein, by a closely reasoned analysis, he claimed that under this title were to be grouped all the higher orders other than the Coleoptera and Hymenoptera.

Tillyard's many contributions on fossil insects placed him as the foremost authority on the subject in his day. The rich beds of Upper Triassic and Lower Permian age in Australia, and of Lower Permian date of Kansas, provided him with a wealth of material. In a relatively short time, Tillyard did much towards changing our knowledge of Permian and Triassic insects from being the most fragmentary into becoming among the most complete of any geological period. He also made many remarkable accessions to our knowledge of the affinities of various orders in bringing to light generalized or annectant types. With so extensive an output of work to his credit, it is scarcely surprising that here and there his conclusions led him astray.

After resigning his last appointment, Tillyard regained much of his health, and one of his last efforts was a conjoint memoir with the late Sir W. T. E. David on Proterozoic fossils of the Adelaide Series (1936). Only three weeks ago a letter by him in NATURE (January 9) made known a Mecopteroid insect bearing upon the ancestry of Diptera.

As an applied entomologist, Tillyard's notable work was the successful introduction of the Chalcid, *Aphelinus mali*, into New Zealand. As an agent controlling the woolly aphis of the apple, it greatly benefited growers by minimizing the necessity for insecticides. Tillyard was a whole-hearted believer in biological control, and initiated schemes for the repression of noxious plants, by introduced phytophagous insects, for both New Zealand and Australia. The results, however, have not, so far, borne out his earlier expectations.

Tillyard's predominant interest was in insect phylogeny and, in this connexion, he published papers on almost all the lower orders and especially on the more primitive forms. Altogether, he must have published about two hundred papers. The great part of this work is of high quality and will aid and stimulate those who come after him. He also found time to write a large text-book on the "Insects of Australia and New Zealand" (1926), profusely illustrated from drawings made by his wife.

For a number of years past Tillyard was keenly interested in psychical phenomena. At one time, these matters absorbed his attention to an extent which perplexed some who knew him. He believed in the necessity for proper scientific analysis of such manifestations and took every opportunity of gaining first-hand experience.

At the time of his death, Tillyard was an honorary fellow of Queens' College, Cambridge: he graduated Sc.D. (Cantab.) in 1920 and became F.R.S. in 1925. He is survived by his wife and four daughters.

A. D. IMMS.

Sir David Semple

WE regret to record the death, which occurred on January 7 at the age of eighty years, of Sir David Semple. Sir David graduated with honours at Queen's University, Belfast, and also took a diploma in public health before entering the Army Medical Corps, as it then was, as early as 1883. After service in India and elsewhere, he became associated with Almroth Wright as assistant professor of pathology at the Army Medical School at Netley from 1904 until 1909, and the good work he then did in bacteriological research opened up a varied and valuable career. Much of his earlier work was in connexion with anti-typhoid inoculation and other immunological researches, and this led to his appointment as a member of the committee for investigation of enteric fever in India from 1905 until 1909; this committee did important work which led to enteric being dethroned from its unenviable position of constituting by far the most important cause of sickness and mortality in the British Army in India.

In 1905 the first Pasteur Institute of India was founded at Kasauli in the Himalayas, not far from Simla, under a committee which had been largely instrumental in raising funds for its establishment, and David Semple's reputation already stood so high that he was selected as the first director during the early critical years, 1900–5. Here he did what was probably his most important work in introducing the use of carbolized hydrophobia-infected rabbits nervous system in graduated doses; for this has enabled the vaccine to be preserved and sent for use to hospitals and dispensaries all over India, with the great advantages of enabling the treatment to be carried out without the delay and expense of sending the patients many hundreds of miles to a central Pasteur Institute.

In 1905 Semple was called upon to occupy the more important post of director of the newly established Central Research Institute of India, also at Kasauli, which was now organized as the headquarters of the newly established Bacteriological Department of the Government of India for general medical research purposes. He had now completed more than twenty years service in the Royal Army Medical Corps, as it had now become, so he retired from that service with a pension, and served in his new post until 1913. During a portion of that time he was a member of the Central Malarial Committee and of the Scientific Advisory Committee for Medical Research under the Government of India. His work was now mainly of an administrative nature, and he did much to help and encourage younger research workers attached to the Research Institute. On retiring from service in India under the age rules in 1913, he was fortunate enough to find fresh administrative employment in Egypt as Director-General of the Public Health Department from 1913 until 1918, when he eventually returned to England to a well-earned rest.

Semple was of a retiring disposition, but a sound patient worker, and it was only those who had the privilege of his friendship who fully appreciated his worth.

Prof. K. K. Mathur

PROF. KRISHNA KUMAR MATHUR's premature death on July 18, 1936, at the age of forty-three years, has deprived India of an eminent geologist and educationist. After finishing his secondary education, Mathur joined Agra College, where he came in close contact with the inspiring personality of Prof. N. C. Nag. Later he continued his studies at the Imperial College of Science and Technology, where he took the associateship of the Royal School of Mines in mining and mining geology, and the B.Sc. degree in mining, with first-class honours, of the University of London. There, too, he stood first among the successful candidates of his group and was awarded the De la Beche Medal.

Soon after his return to India, Prof. Mathur's services were secured by the Benares Hindu University as the University professor of geology in the year 1921. There he soon established himself as a great teacher and administrator. The Department of Geology owes its growth and development to Prof. Mathur, who was its head from the very beginning. His personality attracted students from all parts of India. At Benares he built up a school of geology, which is all-India in its character. His indomitable spirit in the face of hardship and his great love for the science of geology were a source of great inspiration to his students, who are spread far and wide in India, some of them holding important offices. His colleagues in the University held him in the highest esteem, and when he was appointed principal of the College of Science, constituted in 1935, everyone was indeed very happy at the selection.

In the field of research Mathur's principal contributions comprise the petrology of the Deccan Trap igneous activity. He carried out investigations of the various differentiates and threw much light on the genetic processes leading to the formation of the different types. His presidential address to the Geology Section of the Bombay meeting of the Indian Science Congress in 1934 on this subject will continue to be a valuable work of reference for a long time to come. His research activities also extended to stratigraphy, mineralogy and colloidal chemistry.

Amongst the scientific workers in India, Mathur held a prominent position. He was vice-president of the Geological, Mining and Metallurgical Society of India for two sessions. He was a foundation fellow of the United Provinces Academy of Sciences (now the National Academy of Sciences), the Indian Academy of Sciences, and of the National Institute of Sciences in India.

On the personal side, Prof. Mathur was a man of strong principles and high ideals. As an administrator, his sense of justice was great, which won for him love from all quarters. He was strict in imposing rules but very liberal in judging faults. He was simple, sincere and a great philanthropist. His purse was always open for the poor student and for the cause of science. He carried his greatness with charming modesty; he was a selfless and conscientious worker.

Prof. D. F. Fraser-Harris

PROF. DAVID FRASER FRASER-HARRIS, whose death occurred on January 3, was born on February 24, 1867, the eldest son of Mr. David Harris, of Bath. He studied medicine at the University of Glasgow, where he obtained the Neill Arnott Prize in physiological physics in 1890 and the British Medical Association Prize on the effects of alcohol in 1892. He qualified in 1893 and for the next five years was senior assistant to the professor of physiology and Muirhead demonstrator in physiology at Glasgow. He then went to St. Andrews as acting professor of physiology until 1908. He also lectured on physiology and hygiene at Manchester and Birmingham, where he obtained the degree of doctor of science and was made a member of a committee to investigate artificial respiration apparatus.

Prof. Fraser-Harris was an original member of the Biochemical Society and president of the Scottish Microscopical Society in 1908–9. In 1911 he was appointed professor at Dalhousie University, Halifax, Nova Scotia, which he represented on the Medical Council of Canada, and he remained there until 1924, when a breakdown in health compelled him to resign his appointment.

Prof. Fraser-Harris was a lucid and prolific writer on the physiology of the nervous system and the history of medicine. In addition to being general editor of the Modern Health Series, to which he contributed "Nerves—Master System of the Body" (1927), he was author of "The Functional Inertia of Living Matter: a Contribution to the Physiological Theory of Life" (1908), "Coloured Thinking" (1928) and "Morpheus or the Future of Sleep" (1928). As member of the editorial board of *Medical Life*, the official organ of the American Society of Medical History, he contributed a number of interesting essays to that journal on eminent undergraduate observers, medical presidents of the Royal Society, Shakespeare's perception of the functional importance of the brain and other medico-literary topics. His interest in other branches of medicine is shown by his publication last year of a little work entitled "Aural Therapy in Relation to Deafness" and an article in the *Medical Press and Circular* of October 28 on "The Duke-Fingard Method as applied to the Respiratory System". He is survived by his widow and a son, a sub-lieutenant in the Navy.

We regret to announce the following deaths:

Sir John A. F. Aspinall, past-president of the Institutions of Mechanical and Civil Engineers, and also of the Institution of Civil Engineers of Ireland, on January 19, aged eighty-five years.

Prof. David Ellis, professor of bacteriology and superintendent of the Schools of Pharmacy and Bakery in the Royal Technical College, Glasgow, on January 16, aged sixty-two years.

Dr. Marshall A. Howe, director of the New York Botanical Gardens, an authority on the seaweeds and liverworts of North America, on December 24, aged sixty-nine years.

News and Views

Genetic Theory and Practice in the U.S.S.R.

A REPORT of the fourth session of the Lenin Academy of Agricultural Sciences, which was held in Moscow in December last, has been received from the Soviet Union Year Book Press Service, 623–4 Grand Buildings, Trafalgar Square, London. Apart from seventy-one special papers, there was a general debate on the present position of research in genetics. This apparently took the form of an attack on modern genetic theory by experts who have been engaged in the study of practical problems unrelated to genetics. The grounds of the attack were ostensibly twofold. First, geneticists like Muller and Vavilov were said to have neglected the Marxian principle of the unity of theory and practice in failing to keep their work in touch with the needs of farmers. Secondly, the primary assumptions of genetics were held to be invalid. Presumably, in the absence of other evidence, the second contention was deduced from the first. The attack was reinforced by pointing to work like that of Michurin and Lysenko which, unhampered by academic prejudice, has yielded results of immense practical value by methods of trial and error.

MICHURIN is described as a "self-made practical plant breeder"; his published work has unfortunately not been translated into any foreign language. He is understood, however, to have made hybrids and discovered sports in various economic plants of a kind never produced elsewhere. Lysenko, on the other hand, is well known as the author of the technique of vernalization, which he invented apparently without knowledge of the previous experiments conducted abroad on the same subject. This worker went further than the other disputants and promised that the physiological behaviour acquired by plants under his treatment could be inherited, winter wheat being turned into spring wheat and *vice versa.* If this were true, the tedious methods of plant breeding now practised by orthodox geneticists in Prof. Vavilov's institutions would of course be superfluous.

THE situation revealed by this discussion is astonishing in more than one respect. It is a commonplace and as old as Aristotle for scientific men unfamiliar with experimental methods to set forth Lamarckian doctrines in explaining evolution. For experimental workers to set out a Lamarckian method for the advancement of practical breeding is, however, something new and particularly remarkable in the Soviet Union, where the moral bias of this ancient myth might well have made it suspect. Still more astonishing is it to find that these arguments are combined with a charge of doctrinal incompetence against Muller and Vavilov, who, while making fundamental contributions to genetic theory, have probably done more than any other living workers in this field to show its practical value to mankind.

Scientific Freedom

THE following resolution was adopted at a meeting held on December 31 by the American Society of Naturalists during the recent Atlantic City meetings of the American Association for the Advancement of Science: "The American Society of Naturalists observes with regret an increasing tendency in certain parts of the world to require of investigators the conformity of their research to officially prescribed doctrines. This society wishes to emphasize that intellectual progress is compatible only with perfect freedom in the conduct of investigation and in the announcement both of results and of conclusions based upon those results. Attention is called also to the fact that the scientific world can place no reliance upon reports of research carried on under conditions which limit its freedom by an enforced agreement with any preconceived views or dogmas."

American Flood Devastation

LESS than a year has elapsed since, on March 28, 1936, we recorded a serious flood visitation suffered on the west of the Atlantic, and now once more the peril of the waters is rife in many eastern States of North America. Due to extremely heavy rainfall, the Mississippi and Ohio Rivers have been steadily and rapidly rising, overflowing their banks and inundating the surrounding country. The whole of the Ohio valley is affected and it is estimated that, up to the time of writing, some 750,000 people have been rendered homeless in thirteen States, with every expectation of a greatly increased total. The deaths so far number more than a hundred and many people are missing. Pittsburgh (Pennsylvania) with a population of 700,000, and Cincinnati (Ohio) with a population of 450,000, are menaced with a repetition of the tragic experience last year when many of the inhabitants in the former town lost their lives. At Cincinnati, the river has risen to the abnormal height of more than 70 feet, the highest level recorded for almost fifty years. Wheeling, a busy industrial centre in West Virginia, is threatened with the complete submergence of the island on which part of the town is built.

PERHAPS the most exciting incident of the calamity has been the compulsory opening at Portsmouth (Ohio) of the main sewer sluices to relieve the heavy pressure of water against the river embankments, which it was feared were on the point of collapse. After dramatic warning by factory sirens and locomotive whistles to enable the residents to evacuate houses and buildings and find refuge on higher ground, water from the river was allowed to flow into the business quarter of the city to a depth in places of 10 ft. At Cincinnati, the situation was further imperilled by the escape of oil from the Standard Oil Company's storage tanks, which caught fire and transformed the river surface into a sheet of flame, extending for a distance of four miles and doing damage estimated at about £200,000. Fire broke out, too, at Louisville (Kentucky) where martial law had to be proclaimed, as also at Columbus (Ohio). The sufferings of the homeless are increased by inclement weather conditions, with intense cold, snow and sleet. President Roosevelt has issued a proclamation stating that it is imperative to raise a fund of at least £400,000 to relieve the destitution of the victims.

Flooding in Southern England

THE catastrophic experience in the United States is reflected in a minor degree in the southern counties of England, where persistent rains have caused inundations in Kent, Sussex, Berkshire, Wiltshire, Northamptonshire, Bedfordshire and elsewhere. The valley of the Thames in many places is under water and the river is running more than 'bank high', the rate of flow having reached 8,700 million gallons per 24 hour day, as compared with the 9,000 million gallons recorded on January 3 last year, during a period of exceptionally heavy rainfall. The standard daily average for the month of January is 2,407 million gallons. Although the latest indications are that the peak level has been passed, yet, with an outlook presaging more rain in all districts, the prospects of an early subsidence of the flood waters are by no means reassuring, and much discomfort to marooned residents and interference with road traffic is being experienced.

Leopold von Schrötter (1837-1908)

A COMMITTEE of prominent Viennese physicians and laryngologists has recently been formed to commemorate the centenary of the birth of the man, equally illustrious as laryngologist and physician, whose full name and titles were Hofrat Prof. Dr. Leopold Ritter Schrötter von Kristelli. He was born at Graz on February 5, 1837, the son of the eminent chemist who discovered amorphous phosphorus. He studied medicine at Vienna, where he qualified in 1861. From an early stage in his career he took a keen interest not only in diseases of the chest, which he had an unrivalled opportunity of studying under Prof. Skoda, the great authority on this subject, but also in laryngoscopy, the importance of which to the physician he was the first to emphasize. During his subsequent career he occupied the important positions of director of the first laryngological clinic to be established and later the chair of clinical medicine in the University of Vienna. His principal work was a book on diseases of the larynx, trachea, nose and throat, which for a long time was the standard publication on this subject. He also contributed important articles to various systems of medicine on diseases of the heart and pericardium and syphilis of the larynx. Lastly, he deserves recognition as being one of the first to introduce sanatoria for the treatment of pulmonary tuberculosis, and to combat the pessimistic outlook of the medical profession regarding the cure of this disease. His death took place on April 22, 1908.

Severance of Britain and the Continent

IN another column of this issue of NATURE (see p. 200) there appears a brief account of an archæological investigation of the submerged land-surface of the Essex coast by a sub-committee of the Fenland Research Committee. Questions of land elevation and submergence are naturally of much interest to prehistorians, more especially in relation to questions of dating, as well as of the possibilities and means of contact and communication between early cultures and peoples. One of the most important of such inquiries is that of the period at which separation of Britain from the Continent took place. In the same issue of the *Proceedings of the Prehistoric Society* in which the report on the submerged area of the Essex coast appears, Mr. Philip Ullyott, of the Department of Zoology, Cambridge, opens up a new line of evidence for dating this severance in "A Note on the Zoogeographical History of North-western Europe". In this he examines the geographical distribution of certain types of flat-worms (planarians) belonging to the same group and living in fresh-water, but adapted to different temperature ranges. His conclusion, in brief, is that the distribution of these types suggests that Britain must have separated from the Continent after the average summer temperature had exceeded 12° C., but before it had reached more than 16° C.

THANKS to the studies of Scandinavian workers, the curve of mean summer temperature during post-glacial time is known fairly accurately. It is, therefore, possible to say that the breaking of the land surface, across which the flat-worms migrated in fresh-water from the Continent to Britain, must have occurred during the Boreal period, but before its later stage, when the temperature curve rose to its maximum during post-glacial time. This conclusion agrees remarkably closely with the evidence of palæobotanical investigation, which points to an early Boreal phase, c. 6800–5000 B.C. As is pointed out in an editorial note, there is archæological support for this dating in the close connexion of the Baltic and Britain in the Continental period, while certain types become infrequent in Britain in the late Boreal period, and by Atlantic times the forest culture of south-east Britain had become quite distinct from the Ertebölle of Denmark and Schleswig-Holstein.

Snow

IN his Friday evening discourse at the Royal Institution on January 22, Mr. Gerald Seligman discussed "The Nature of Snow". He commenced by showing how the molecular structure of ice accounts for the hexagonal structure of ice crystals. He reproduced Tyndall's experiment of forming 'negative crystals' in ice by passing a beam of light through it. A cinematographic reproduction of the same experiment showed the formation of these 'crystals' under high magnification. Ice evaporation is stimulated by a comparatively high temperature, and the reverse process—reconsolidation—by a low temperature. Mr. Seligman stressed the importance of sublimation in every question affecting snow and snowcraft. The life-histories of different types of snowflakes under varying atmospheric conditions were then dealt with. Passing now to *firnification*, or the changes of the snowflake after lying on the ground, Mr. Seligman showed the complete cycle from newly-fallen snow to advanced firn snow by photomicrographs taken by him in the Alps and by scenic views illustrating the different kinds of snow surfaces encountered by the mountaineer or explorer. The process is essentially one of a consolidation of the fine, newly-fallen snow, occasionally containing as much as 89/90 of air, to one of pure ice containing little or no air at all. The final stage of firnification, the genesis of glacier ice, has never been fully recorded, and this is to form the subject of a research now in course of preparation by the lecturer who showed tools for the purpose lying on the table. Dealing briefly with new snow avalanches, Mr. Seligman used some of his microphotographs of firnification to show why snow slopes do not as a rule become dangerous until the temperature has risen after a snowfall—a practical point of value to the ski-runner. Turning next to the effects of wind upon snow, Mr. Seligman showed photographs of a number of wind-formations, including sastrugi, cornices, and snow 'wind-packed' or hardened by a wet wind. Wind-packed snow causes wind-slab avalanches, which consist of hard brittle drifts of snow lying loosely on steep slopes. These, if disturbed, break into blocks and form dangerous avalanches. A knowledge of the weather conditions which cause this type of avalanche has already proved of value to Everest climbers.

Harry Price Library of Magical Literature

To celebrate the transference of the library and records of the University of London Council for Psychical Investigation to the new University building in Bloomsbury, a dinner was held on January 22 at the Hotel Splendide. The occasion was also a mark of the Council's appreciation of the valuable work which Mr. Harry Price has done for psychical research and of his generosity to the University, and an illuminated testimonial to that effect was presented to him. The chairman, Dr. C. E. M. Joad, in complimenting Mr. Price, pointed out that in the early stages of all sciences, the experiments were carried out by private individuals at their own expense, and that it was to co-ordinate such activities and avoid acrimonious correspondence and personal animosities, that the Royal Society itself was founded. Mr. Price, in his reply, gave a short survey of the positive results of his many years of investigation, and concluded that sufficient evidence has been obtained to justify scientific investigation of telekinesis, thermal variations, teleplasmic masses, secondary trance personalities and extra-sensory perception of various kinds. The future of psychical research, he said, lies with the universities, and already there are six universities abroad taking the study seriously. The evening concluded with a demonstration by Mr. and Miss Tree, the foremost vaudeville telepathists in Britain. Their performance is remarkable for the extraordinary rapidity with which their code-system can be worked.

The Society of Smeatonian Civil Engineers

AMONG the least known engineering societies is that of the Smeatonian Society of Civil Engineers, which to-day exists mainly for social intercourse and has a small but select membership. When it was founded in 1771 it had as its aim the furtherance of professional knowledge. Its history has never been written fully, but on January 20, at a meeting of the Newcomen Society held at the Institution of Civil Engineers, Mr. S. B. Donkin gave an interesting account of its early fortunes. From the technical point of view, the most lasting result of the Society was the publication in 1812 of the four volumes of the "Reports of the late John Smeaton". In the preface to this and in two minute books are contained what is known of the Society in its early days. It was the increasing demands being made on canal, harbour and bridge builders which led to the formation of the Society, it being felt that good results would accrue from members of the civil engineering profession meeting together to discuss their various projects. That they did so in a friendly manner can be seen from the minute of a meeting in 1778 which "was spent canallically, hydraulically, mathematically, philosophically, mechanically, naturally and socially". The original society founded in 1771 came to an end in May 1792, but was almost immediately revived when, as the minute records, "The first meeting of this new institution The Society of Civil Engineers was held on the 15th of April 1793 by Mr. Jessop, Mr. Mylne, Mr. Rennie and Mr. Whitworth". Smeaton had been a leading figure of the old Society but he had died in October 1792. Soon after the revival of the Society, it learnt that Sir Joseph Banks had purchased all Smeaton's manuscripts and drawings, and it was with his concurrence the Society undertook the publication of Smeaton's "Reports". At the dinners, later on, five toasts were instituted, one of which was to "The memory of our late worthy brothers—Mr. Smeaton, Mr. Mylne, Mr. Watt and Mr. Rennie", and these toasts are still the order of the day at dinners of the Society. The Society, it may be added, had little, if anything at all, to do with the formation of the Institution of Civil Engineers, which arose from the efforts of half a dozen young engineers with their fortunes still to make.

Recent Acquisitions at the Natural History Museum

THE human remains from the Pleistocene deposits of Kenya Colony, on which much of Dr. L. S. B. Leakey's work is based, have been presented to the Department of Geology by the president and council of the Royal Society, through Dr. Leakey. The Mineral Department has received from the proprietors of the Hup Tuck Kongsi mine in the State of Selangor, Federated Malay States, the gift of an unusually large mass of cassiterite, showing numerous well-developed crystals. Cassiterite, which is more popularly known as tinstone, is almost the only source of tin and is therefore a valuable ore. Very occasionally it has been found in large enough crystals for cutting as gem-stones. The crystals in the present mass are at the best translucent at the surface. In colour they are mainly reddish brown, but some are black. Dr. Germaine A. Joplin, of the University of Sydney, has given a series of igneous rocks described by her, and rocks described in the Records of the Geological Survey of New South Wales are a donation from the Curator of the Mining and Geological Museum, Sydney. Dr. K. S. Sandford has presented the series of rocks which he collected when with Major Bagnold's expedition in 1932 and has since described. An opaque crystal of scheelite from Perak, larger than any hitherto in the Museum, has been given by Mr. John Weekley. Of considerable historical interest is the diary kept by Robert Allan (1806–63) during a visit to the Mediterranean in 1830, which has been given by Miss B. M. Clay, one of his descendants. Robert Allan was the son of Thomas Allan (1777–1833), the Edinburgh banker, whose mineral collection was bought after his death by R. H. Greg and acquired by the British Museum in 1860. Many of the minerals and rocks collected during this expedition are in the Mineral Department.

THE Department of Botany has received 1,650 plants collected by Messrs. G. Sherriff and F. Ludlow in Bhutan and Tibet. The route followed was from the Assam plains near Gauhati, through eastern Bhutan. Tibet was entered up the Nyan Jang Chu, a river rising north of the main Himalayan range which cuts its way through the range and flows south to join the Manas River. The plateau region was crossed and one of the headwaters of the Subansiri River was followed down. There six months were spent with Tsari as a centre, an area which proved very rich in alpine flora, some of the grassy hill-sides, above the tree-line, being literally covered with Primulas. After the flowering season was over, seeds were collected. It is probable that several interesting horticultural plants will be introduced to British gardens, for a number of new species of *Primula* and a new *Mecanopsis* were found. The specimens are exceedingly well preserved and the collection is a most valuable addition to the series of Himalayan plants in the Department. Among purchases are 600 flowering plants from the west-central district, Sikang, of China, the first consignment of a set of Dr. Harry Smith's collections on his recent expedition; the herbarium of A. L. Hübl, containing 4,600 specimens chiefly from Austria, and the moss herbarium of the well-known Dutch bryologist Fr. Verdoorn, comprising about 3,200 specimens.

Alcohol and Motor Accidents

AT a meeting of the Society for the Study of Inebriety on January 12 reported in the *British Medical Journal* of January 23, Dr. H. M. Vernon stated that though the maximum of road traffic accidents during the last two years was a little less than in 1934, the fatalities still averaged 18 a day and the injuries more than 600. Half the deaths were among pedestrians and a fifth among pedal cyclists, while drivers of motor vehicles and their passengers had only a third to a fourth as many accidents as pedestrians. Although the data of the Ministry of Transport indicate that only 1 in 80 of the road fatalities are due to persons obviously under the influence of drink, the evidence from America suggests that alcohol plays a much larger part in motor accidents. Alcohol even in moderate quantities frequently affects driving capacity, and in particular causes drivers unconsciously to increase their speed, which is the most important factor in the causation of fatal accidents. Examination of the blood or urine by Widmark's method shows the following correspondence between the alcohol content and the clinical symptoms. In persons with 1 part of alcohol per 1000 in the blood, 40–60 per cent were found to be "under the influence"; of those with 1·7 parts, 80–88 per cent were so affected, and of those with 2 parts all were affected. Dr. Vernon has come to the conclusion that abstinence from alcohol should be practised for several hours before driving as well as during its course, as the rate of disappearance of alcohol from the blood is very slow.

Communal Aerials for Radio Reception

IN large towns and cities, the provision of a good aerial generally presents many difficulties, especially in houses divided up into self-contained flats. In the latter case, it would be necessary to erect on one roof a number of separate aerials which would satisfy the varying requirements of the listeners. In some places also there is an almost insuperable difficulty owing to interference from electric motors and other electric devices. Some years ago the Philips Research Laboratories at Eindhoven, Holland, evolved a communal aerial system which they call the 'Antennaphil' which surmounts most of the difficulties met with in practice. A description of it is given in the *Journal* of the Philips Research Laboratories of August last. In this system an aerial of suitable dimensions is erected at a spot where interference is limited, for example, at a height of twenty feet above the roof. Through a specially screened conductor made as short as possible, the aerial is connected to an aerial signal amplifier, from which the incoming signals are transmitted to a number of receiving sets through a lead-covered cable which acts as a screened distributing circuit. Up to fifty sets can be connected to an aerial fitted with this form of amplifier. If the distance of the spot from which reception, practically free from interference, can be received is a few hundred yards, then the number of sets is less. But even up to a distance of 1,000 yards, several sets can be supplied. An aerial of this type has been in use at the laboratory for several years at a distance of 200 yards, and has ensured reception free from all interference. It is proved that a concentric cable of suitable dimensions is the best to use for high-frequency distribution.

"For Intellectual Liberty"

THE Society "For Intellectual Liberty", which was founded early in 1936 as a rallying-point for intellectual workers concerned with the active defence of peace, liberty and culture in the present conditions of the world, has recently issued its first bulletin.

The Society was formed as a result of an appeal from the French Comité de Vigilance des Intellectuels Antifascistes, which in January called a conference where it was decided to form an International Federation of Intellectual Workers. The bulletin in question describes the growth and activities of the British group from its original membership of fifty. The group has worked in close touch with the National Council for Civil Liberties, from which it differs chiefly in its wider concern with domestic and foreign affairs, and with various committees for the assistance of victims of Fascism and latterly with organizations to provide help for the Spanish people. It is not a party political organization and its present supporters are drawn from all shades of political opinion. It is broadly democratic and international in outlook, and by arranging for discussions among its members seeks to find the greatest measure of agreement on such questions as the need for a Popular Front or of the best way of forming it; on the question of armaments, the League of Nations and collective security, and on the practicability of removing, by economic or political action, the causes of war. The Honorary Secretary is Margaret Gardiner, 23, Haymarket, London, S.W.1.

Birth- and Death-Rates for 1936 in England

ACCORDING to a return published by the Registrar-General, the birth-rate in England and Wales during the year 1936 is provisionally estimated at 14·8 live births per thousand of the population, and the crude death-rate at 12·1 deaths per thousand of the population. The number of deaths of children under one year, per 1,000 live births, was 59. The birth-rate for 1936 is 0·1 above that for 1935, and 0·4 above that of 1933, the lowest on record. The crude death-rate is 0·4 above that of 1935 and 0·7 above that of 1930, the lowest on record. The infant mortality is 2 above that of 1935, which was the lowest on record, and is the same as that of 1934, the previous lowest on record. In 122 county boroughs and great towns of England and Wales, including London, the birth-rate during 1936 is provisionally estimated at 14·9 live births per thousand of the population, the crude death-rate at 12·3 deaths per thousand, and the deaths of children under one year at 63 per 1,000 registered live births. The corresponding figures for the 143 smaller towns with estimated resident populations of from 25,000 to 50,000 at the 1931 census are estimated as follows: birth-rate, 15·3, crude death-rate 11·7 and infant mortality 55. In the Administrative County of London the corresponding figures are estimated at: birth-rate, 13·7, crude death-rate, 12·5, infant mortality, 66. These figures are provisional, and may be subject to readjustment before the publication of the Registrar-General's Statistical Review in July.

Sir George Beilby Memorial Awards

THE administrators of the Beilby Memorial Fund, consisting of the presidents, treasurers and secretaries of the Institute of Chemistry, the Society of Chemical Industry and the Institute of Metals respectively, have announced awards of a hundred guineas each to Dr. B. S. Evans and Dr. W. H. J. Vernon. Since 1919, Dr. Evans has been attached to the Research Department of Woolwich Arsenal, where he now holds the position of a scientific officer. He has devised numerous analytical methods for the separation and determination of metals, and contributed the chapters dealing with the methods of analysis applicable to lead, bismuth, arsenic, antimony, tin, iron, chromium and metallic constituents of steel in Mitchell's "Recent Advances in Analytical Chemistry". Dr. Vernon was appointed investigator to the newly-formed Atmospheric Corrosion Committee of the British Non-ferrous Metals Research Association in 1921. His experimental work was carried out at the Royal School of Mines, South Kensington, under Sir Harold Carpenter until 1927, when the investigation was taken over by the Department of Scientific and Industrial Research and continued at the Chemical Research Laboratory, Teddington, under Sir Gilbert Morgan. In the course of this work, which included early quantitative determinations of invisible oxide films on metals, a number of generalizations on atmospheric corrosion phenomena (ferrous and non-ferrous) has been established. Dr. Vernon's publications have included "A Bibliography of Metallic Corrosion" (Arnold), the first and second reports to the Atmospheric Corrosion Research Committee (each of which formed the subject of a general discussion by the Faraday Society) and numerous papers.

Awards of the Institution of Electrical Engineers

THE Council of the Institution of Electrical Engineers has elected Dr. Alexander Russell, principal of Faraday House Electrical Engineering College, to be an honorary member of the Institution. The Council has made the fifteenth award of the Faraday Medal to Prof. André Blondel, of Paris. The Faraday Medal is awarded by the Council of the Institution not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution.

International Congress on the History of Science

ON the occasion of the one hundred and fiftieth anniversary of the birth of Jan Evangelista Purkyně (or Purkinje), a distinguished Czech biologist, the fourth International Congress on the History of Science will be held in Prague on September 22-27. The Congress, under the presidency of Prof. Quido Vetter, will discuss papers dealing with (1) the development of the sciences during the eighteenth and first half of the nineteenth centuries; (2) the history of science in education; and (3) historical themes not included above. The contributions will not be restricted to the natural sciences only, medicine and the technical applications of science (for example, in agriculture) being also included.

Soviet Scientific Films

A MICRO-CINEMATOGRAPHIC study of the human capillaries is to be made by the medical cinematographic department of the Soviet Commissariat of Health. According to Mr. Volkof, the head of the department, the chief advantages of the scientific medical film in medicine lies in the possibility it opens up of modifying the time range of experiments to meet requirements. Action can be accelerated or slowed down at will. Moreover, the photomicrograph flashed on the screen frequently discloses many details unseen to the eye even with the aid of the microscope.

The Influenza Epidemic

THE Minister of Health has had special inquiries made through the regional medical officers of the Ministry into the local prevalence of the influenza epidemic. It appears that generally there is at present an extension from south to north, but that the distribution is patchy. Prevailing medical opinion is that the present outbreak, though widespread and highly infectious, is for the most part mild, most of the deaths being among the elderly. In the week ending January 9, there were 768 deaths ascribed to influenza in 122 great towns, as compared with 325 for the previous week, and the number of notifications of primary and influenzal pneumonia increased from 1,513 to 2,321.

The Night Sky in February

BETWEEN February 1 and February 28, the length of the night in the latitude of London decreases from $14^h\ 54^m$ to $13^h\ 13^m$. New moon occurs on February $11^d\ 7{\cdot}6^h$ and full moon on February $25^d\ 7{\cdot}7^h$. The planet Venus in the evening sky is a brilliant object; and in conjunction with the crescent moon on February $14^d\ 23^h$ will make a striking spectacle. On February 15 at 23^h, the planet will pass within $3'$ of the star δ Piscium (magnitude 4·6). Venus is at greatest elongation (47° E.) on February 5. Mercury is a morning star at greatest western elongation (26°) on February 7, when it rises about $1^h\ 12^m$ before the sun. On February 9 at 7^h, Mercury is in conjunction with the moon, the planet being 2° south of the latter. In mid-February, Saturn sets about two hours after the sun. On February 20, the plane of the rings passes through the earth, and the appearance of the ring system in large telescopes will be of special interest. In 1920 and 1921 when the system could be viewed in similar circumstances as will occur on February 20, it was found that the rings did not completely disappear—a fact which has a bearing on their thickness and structure. On February 13 at 15^h, Saturn will be in conjunction with the moon, the planet being 8° S. Jupiter rises near daybreak in the south-east; its magnitude is – 1·5. The most favourable times for observing the light changes of Algol (R.A. $3^h\ 04^m$, Dec. 40° 43′ N.) are as follows: February $2^d\ 2{\cdot}4^h$, $4^d\ 23{\cdot}2^h$, $7^d\ 20{\cdot}0^h$, $22^d\ 4{\cdot}1^h$, $25^d\ 0{\cdot}9^h$ and $27^d\ 21{\cdot}8^h$. The radiant for the α Leonid meteors on February 22–28 is at R.A. $10{\cdot}4^h$, Dec. 14° N.

Announcements

THE French Government has awarded the rank of Chevalier of the Legion of Honour to Prof. J. B. S. Haldane, professor of genetics, University College, London, for his scientific services to France.

PROF. ARTHUR HOLMES, professor of geology in the Durham Division of the University of Durham, has been elected a foreign correspondent of the Geological Society of America.

THE John Anisfield Award has been given to Drs. Julian Huxley and A. C. Haddon for their book "We Europeans: A Survey of 'Racial' Problems", with a chapter on "Europe Overseas" by Prof. A. M. Carr-Saunders, which was reviewed in NATURE of November 9, 1935, p. 736. The judges of the award are Prof. Henry Pratt Fairchild of the University of New York, Prof. Donald Young of the Social Science Research Council, and H. S. Canby of the *Saturday Review*. The prize is given for "a sound and significant book published in the previous twelve months on the subject of racial relations in the contemporary world".

AT the annual meeting of the New York Academy of Sciences held on December 21, the following honorary members were elected: Prof. K. S. Lashley, of Harvard University; Prof. Henri Breuil, professor of prehistory in the Collège de France; Dr. Julian S. Huxley, secretary of the Zoological Society of London; Dr. Aleš Hrdlička, curator of physical anthropology in the U.S. National Museum; Dr. A. C. Haddon, formerly reader in ethnology in the University of Cambridge; Sir Arthur Hill, director of the Royal Botanic Gardens, Kew; Prof. Maurice Caullery, professor of zoology (evolution) at the Sorbonne, and Prof. Octave Duboscq, professor of marine biology at the Sorbonne.

LORD NUFFIELD has given a silver trophy which will be awarded to the town or village collecting the most money, per head of population, for the annual Empire Day appeal for the British Empire Cancer Campaign. In 1931 Lord Nuffield gave £25,000 to the British Empire Cancer Campaign to be invested to provide a research fellowship at the Mount Vernon Hospital.

AT the annual meeting of the Royal Meteorological Society, held on January 20, the following officers were elected: ***President***, Dr. F. J. W. Whipple; ***Treasurer***, W. M. Witchell; ***Secretaries***, H. W. L. Absalom, W. Dunbar and E. L. Hawke; ***Foreign Secretary***, J. F. Shipley; ***New Members of Council***, Miss Elen E. Austin and R. S. Read.

A PRIZE of £20 with a diploma is awarded annually by the Royal Asiatic Society for an essay on a selected subject. The object of the competition is to encourage interest in the history and civilization of the East among non-Asiatics. Alternative subjects for 1937 are: (*a*) "Tamerlane" and (*b*) "The Relations of the Greeks with the East". Essays must be in the hands of the secretary by October 1. Further information can be obtained from the Secretary, Royal Asiatic Society, 74 Grosvenor Street, London, W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 199.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Museums and their Type Specimens

IN NATURE of January 9 (p. 62), reference is made to a paper published by Dr. R. Broom in the *Annals of the Transvaal Museum* (18, 397–413; 1936), in which he complains that four type-specimens in the British Museum have been maltreated while being investigated by Dr. Boonstra; one, a type described by Owen, and the others by himself. Speaking generally of type-specimens, "in some cases," he says, "even the matrix ought not to be removed for sentimental reasons". He would scarcely permit a type "to be broken up in the interest of the morphologist. . . . But any museum which allows type-specimens to be cut in slices or to have parts ground away always seems to me to be guilty of a gross breach of trust". As for the British Museum, "apparently any visitor can cut up types in any way he fancies".

It is unlikely that many readers of NATURE will suppose the Trustees to be so careless of the collections as the last sentence suggests; nor will they be led astray by Dr. Broom's generalizations on the sectioning of type-specimens. But Dr. Broom should remember that the study of many groups of fossils, for example, Palæozoic corals, would be at a standstill, instead of (as indeed it is) going rapidly forward, if type-specimens were not sectioned as a matter of course. It is clear that it is for the responsible officers alone to decide to what extent it is desirable to develop or otherwise treat a type-specimen. Perhaps more surprising is Dr. Broom's attitude to morphology as shown by the remark quoted above. So long as the Natural History Museum is an institution of progressive research, as in fact it is, so long the type-specimen of a fossil species placed there has no value other than a morphological value. Palæontology is based on morphology, and to refrain from removing matrix from a type "for sentimental reasons" is to place a type fossil on a par with a mere personal relic.

Dr. Boonstra came to England in 1933 to study under Prof. D. M. S. Watson. He was then palæontologist to the South African Museum, and even at that time was noted for his experience and skill in developing Karoo reptiles. He could not, therefore, be described as "any visitor". In view of his known skill, and on the understanding that Prof. Watson was supervising his work, Dr. Boonstra was allowed to develop certain specimens, among them being those about which Dr. Broom complains. In Prof. Watson's opinion, Dr. Boonstra's work upon the specimens, far from having damaged them, has enhanced their value.

It may also be added that Dr. Broom has not seen the specimens since they were developed by Dr. Boonstra.

Prof. Watson allows me to quote his comments upon each of the four specimens concerned:

"(1) Owen's type of *Theriognathus microps*. Dr. Broom's claim is in effect that no old type should ever be re-prepared. This is an impossible position, held by no museum of importance in the world. The specimen (No. 47065) in its original state was undeterminable specifically, generically and *ordinally*! It was in fact entirely valueless. We do know now to what group it belongs. Its outer appearance has been very little altered by preparation.

"(2) The type of *Burnetia mirabilis* (R. 5697). This was described and figured by Broom when still covered with a coat of matrix. I began to prepare it, and found that the matrix coat was very irregular in thickness, so that its outer surface bore little relationship to that of the skull, and that the contact between bone and matrix was such that there would be no difficulty in making an accurate preparation. Sufficient flecks of matrix remain attached to the skull to show that Dr. Boonstra's preparation was well done, and that the present form of the skull is genuine.

"(3) The type of *Cerdodon tenuidens* (49420). The specimen is indeterminable. The exposed surface has not been touched at all by preparation. The attempts to cut a median section failed because so little of the skull was visible, and really amounts to no more than the removal of useless matrix. The specimen is completely incapable of preparation, since there is practically nothing but a weathered surface.

"(4) *Ictidosuchoides longiceps* (R. 5744). The information which can be gained from this specimen has been very greatly increased by Dr. Boonstra's preparation. Dr. Broom objects that Dr. Boonstra, by grinding away the edge of the maxilla, has destroyed two small canine teeth and removed all evidence of the shape of the maxillary margin. The technique of grinding faces on fossil skulls which are difficult to prepare was, I believe, first used extensively by Dr. Broom himself on Texan and S. African materials in the American Museum, and is sometimes of use. Dr. Boonstra's use of it on this skull was restrained and reasonable. He ground down into the lingual surface of the maxilla, so that its outer surface remains untouched, the margin being preserved. There is thus in my opinion no justification for Dr. Broom's strictures."

W. D. LANG.
(Keeper of Geology.)

British Museum (Natural History),
South Kensington,
S.W.7.
Jan. 14.

Electrical Stimulation of the Human Cochlea

It has been shown by Jellinek and Scheiber[1], and since confirmed[2,3,4], that stimulation of the human cochlea by audio-frequency alternating currents results in a sensation of tone corresponding in pitch to the frequency of the stimulus. The possibility that the mechanism of excitation is by direct stimulation of the cochlear nerve fibrils has an important bearing upon existing views on audition, in so far as it would provide clear evidence in support of the 'telephone' theory. It has been suggested as an alternative possibility that the electrical currents excite the nerve elements indirectly by setting in motion, in a manner not understood, those cochlear elements which are normally set in motion by physiologically applied sound waves. Such a mechanism of excitation would imply localization of the response according to frequency by resonance, and so would make possible an explanation of the observed phenomena upon the basis of the Helmholtz resonance hypothesis. This 'movement' theory of excitation is strongly supported by experimental evidence which is now described. As stated by Hartridge[5], sudden reversal in the phase of a continuous musical tone results in the human subject in a sensation described as a 'phase change beat'. This, in accordance with the resonance hypothesis, has been correlated with a transient arrest of the basilar fibres due to the opposition of the applied force following the phase reversal to the after swings due to resonance. Further, objective evidence of the occurrence of such an arrest has been provided by a recent study of the auditory tract potentials in the cat[6].

In the light of these findings, it has been considered justifiable to attribute the 'phase change beat' to the intervention of resonant moving parts between the nervous elements and the applied stimulus. The experimental demonstration of the occurrence of a 'phase change beat' in response to an electrical stimulus undergoing periodic phase reversal would therefore clearly be subject to the same explanation and so support the 'movement' theory of excitation. Stimulation of the human ear upon these lines has accordingly been carried out. The electrical output of the phase-reversing photo-electric siren already described[6] was used at a frequency of 1,024 ∼ with leads to the external auditory meatus (filled with saline) and to a metal plate on the forearm.

Under these conditions the phase change beat was found to be clearly observable. Further, the beat was heard at an intensity some 8 db. above that of the threshold for perception of the tone itself. This difference was found to approximate closely to that observed when the phase-reversing stimulus was applied to the ear mechanically, namely, by means of a moving-coil loud-speaker. This correspondence is considered to provide further evidence that the mechanism of excitation involved in the normal mode of audition is similarly involved by electrical stimulation. In addition, observations have been made upon the response of the human ear to interruptions of four and ten cycles duration in continuous tones of 1,024 ∼. Here also the stimulus was generated by a suitable modification of the photo-electric siren and was applied to the ear electrically and also by means of the moving-coil loud-speaker.

With an interruption of four cycles duration, the beat due to the interruption was observed at an intensity some 18 db. above that of the threshold for the tone itself. With an interruption of ten cycles duration, the difference between the beat and tone thresholds was smaller (10 db.), in accordance, presumably, with a change in ratio of the factors of intensity and duration of interruption which govern perception of the flicker of sound.

In all cases, the differences in threshold for tone and beat observed with the electrical mode of stimulation were found to approximate closely to the corresponding differences found by the mechanical mode represented by the loud-speaker method of stimulation.

This finding must again be considered to provide confirmation of the movement theory of excitation of the human cochlea by audio-frequency electrical stimulation.

C. S. Hallpike.
H. Hartridge.

Ferens Institute of Otology,
Middlesex Hospital, W.1,
and Dept. of Physiology,
St. Bartholomew's Medical College,
E.C.1.
Jan. 14.

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[1] Jellinek, S., and Scheiber, T., *Wien. Klin. Woch.*, **43**, 417 (1930).

[2] Perwitzschky, R., *Z. Hals, Nasen, und Ohrenheilk*, **26**, 477 (1930).

[3] Fromm, B., Nylén, O., and Zottermann, Y., *J. Physiol.*, **80**, 3*P* (1933).

[4] Gersuni, G. V., Volokhov, A. A., *J. Physiol. U.S.S.R.*, **17**, 1259 (1934).

[5] Hartridge, H., *Brit. J. Psychol.*, **12**, 142 (1921).

[6] Hallpike, C. S., Hartridge, H., and Rawdon-Smith, A. F., *Proc. Roy. Soc.* (in the press)

Sir Grafton Elliot Smith and Work on Early Man in China

In looking back over the history of the research on early man in China, it is of interest to realize how precarious was the adventure we entered upon. At the present time, we have five more or less complete skulls, four large skull-fragments, twelve mandibles, and nearly one hundred isolated teeth—indeed an imposing 'sum' of specimens of *Sinanthropus*. However, the impressive point in this history is the fact that the vital generic characteristics of the distinct hominid were deduced from a diagnosis based, not upon this large number of specimens, but upon *one single molar tooth*. This specimen, which heralded a period of great scientific activity, was placed at our disposal in 1927 by the late Dr. Davidson Black.

After this birth of *Sinanthropus*, on account of the dearth of material and the difficulty of drawing conclusions from one isolated tooth, Dr. Black's claims were not everywhere accepted. It was Sir Grafton Elliot Smith who, as an authority in the field of early man, first accepted *Sinanthropus* as a distinct genus of the hominid; and it was Sir Grafton Elliot Smith who gave the needed support and impetus to Dr. Black, which encouraged him to carry on his scientific explorations in China.

The discovery of a skull in 1929 proved that *Sinanthropus* was not a product of Dr. Black's imagination, but that on the contrary he had been quite justified in his classification of a new genus in human palæontology. In November 1930, the Cenozoic Research Laboratory of the National Geological Survey of China invited Sir Grafton to take the long journey to the Far East in order to examine the new specimens and to visit the very site from which they had been taken. Thus it was Sir Grafton who, among all the anthropologists from outside the laboratory, was the first to handle the skull and to discuss it with Dr. Black.

After a painstaking examination of the specimens and a lengthy inspection of the site at Choukoutien, Sir Grafton announced his complete agreement with the geological and palæontological bases upon which the claims for the antiquity of *Sinanthropus* were based. Upon his return to England, Sir Grafton delivered a series of lectures and issued several important publications fully supporting our conclusions concerning the antiquity of *Sinanthropus*. Furthermore, he compared Peking man exclusively with early man from other localities, and stated his belief that the Lower Pleistocene man of China was contemporary with *Eoanthropus* and *Pithecanthropus*.

While it is a source of much gratification to realize that research on early man in China is being actively prosecuted, our joy in these achievements is lessened when we realize that the energetic promoter, the powerful protector, the kindly friend, of all these scientific investigations, Sir Grafton Smith, is gone. One hears frequent mention of the work of the members of the Cenozoic Laboratory—their research, their accomplishments—but it is doubtful whether their undeniably sincere efforts and scholarly achievements would have been so widely known and so quickly accepted but for the backing of such an authority as Sir Grafton. His approval naturally carried the greatest weight with European scientific workers.

After the sudden death of Dr. Davidson Black in May 1934, Sir Grafton grieved, not only for the loss of a friend, but also for the consequent setback to the search for early man in China. We in China suffered even more, because ours was the difficult problem of finding another anthropologist willing and capable of carrying on Dr. Black's half-finished task. It was Sir Grafton who, at the request of the director of the Geological Survey of China, and of the Rockefeller Foundation, recommended Prof. F. Weidenreich to succeed Dr. Black. We deeply appreciate the honour of having so wise and experienced an anthropologist as Prof. Weidenreich to carry on this vital research, but the thought is always foremost with us that it was Sir Grafton who introduced him to us.

In addition to material in his books, Sir Grafton wrote frequent articles concerning the search for man's ancestors in China, which were published in weekly or daily papers. Every fresh discovery made in China would be followed by a review of Sir Grafton's. His enthusiasm in his desire to help us surmounted even the unfortunate state of his health, which prevented him from writing much towards the last.

Very recently, having learned through a letter from me that we had requested the Rockefeller Foundation for a three-year grant, Sir Grafton wrote immediately, stating the importance of the continuation of our research work on early man in China. His appeal, written from the Queen Mary Hospital at Sidcup, appeared in *The Times* about a month before his death, and was undoubtedly influential in securing us continued financial support.

The death of Sir Grafton is indeed a signal loss to the entire scientific world. To us, in China, where the modern sciences are but newly and insufficiently developed, and where our need is great for the interest of authorities in other parts of the world, this new lack will be felt with especial keenness. We have lost, not only an ardent advocator, but also a sympathetic and well-loved friend.

W. C. PEI.

Institut de Paléontologie Humaine,
Paris (13e).
Jan. 11.

A Condensing Monochromator for X-Rays

IT has long been recognized that some of the halos observed on X-ray photographs of liquids and amorphous substances may be spurious and due to the white radiation peak. Some of the observed reflections obtained from concentrated solutions of tobacco mosaic virus[1] were under suspicion for this reason, and the use of a nickel filter did not serve to resolve our doubts. Consequently, it was necessary to attempt to use monochromatic radiation. This was achieved as described below. As shown in Fig. 1, the use of monochromatic radiation decisively establishes the spurious nature of the innermost reflection.

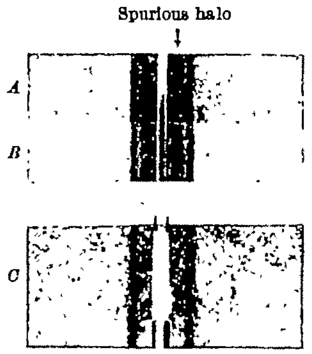

Fig. 1.
TOBACCO MOSAIC VIRUS. ELIMINATION OF SPURIOUS HALO BY USE OF MONOCHROMATIC RADIATION. *A*, UNFILTERED RADIATION, COPPER TARGET. *B*, FILTERED THROUGH 0·0005 IN. NICKEL FOIL. *C*, MONOCHROMATIC RADIATION. SPECIMEN TO FILM DISTANCE, 40 CM.

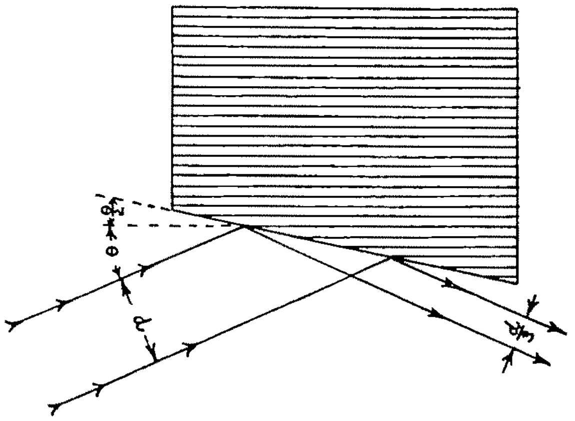

Fig. 2.
CONDENSING EFFECT OF SURFACE GROUND AT AN ANGLE $\theta/2$ WITH BRAGG PLANES.

As the exposure times necessary with the available X-ray sources, using a 0·0005 in. nickel filter, were of the order of 40 hours, it was obviously essential to develop a monochromator which would not increase the exposure time to prohibitive length. Stephen and Barnes[2] had suggested the use of single copper crystals cut at an angle of 40° with the 311 plane.

Such an arrangement, they suggested, would give a concentrated beam of polarized copper $K\alpha$ X-rays. This arrangement, to my knowledge, has not been tried. For the work in question, it was desirable to have a very intense source of comparatively unpolarized radiation. Various crystals were tested as monochromators and both cleavage surfaces and crystals ground as suggested by Stephen and Barnes were used. For all the crystals tested, the face was ground at an angle $\theta/2$ with the reflecting planes. For small Bragg angles θ, this should give a concentration of 3 : 1 (Fig. 2). It was thought desirable for two reasons to use a moderate concentration in these preliminary experiments, contrary to the suggestion of Stephen and Barnes, first to reduce the absorption of the reflected beam, and secondly because there was no need for a beam finer than the slit used.

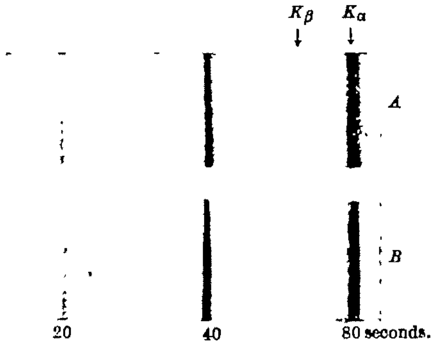

Fig. 3.

EFFECT OF GRINDING FACE OF PENTAERYTHRITOL CRYSTAL AT AN ANGLE OF 5° WITH CLEAVAGE SURFACE. *A*, GROUND SURFACE; *B*, CLEAVAGE SURFACE.

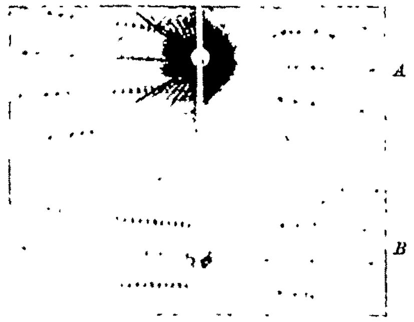

Fig. 4.

15° OSCILLATION PHOTOGRAPHS OF DI-HYDRO LUMISTEROL ACETATE. *A*, UNFILTERED RADIATION; *B*, MONOCHROMATIC RADIATION FROM GROUND FACE OF PENTAERYTHRITOL CRYSTAL. TIME, 3 HOURS; CRYSTAL TO PLATE DISTANCE, 3 CM.

In view of the success of these preliminary experiments, further work is in progress to determine the optimum angle of grinding for pentaerythritol, the crystal finally chosen. This can easily be obtained from aqueous solution in large crystals; it has a perfect *c* face cleavage, and the second order reflection is very intense. The Bragg angle is 10° for copper radiation, so the degree of polarization introduced into the reflected beam is not serious. Fig. 3 shows the concentrating effect of grinding the crystal so that the face makes an angle ($\theta/2$) of 5° with the reflecting planes. These reflections were obtained from a single pentaerythritol crystal, one side of which was a cleavage face and the other side ground as stated above. No slit was used and the crystal to film distance was 120 cm. The concentrating effect of the ground surface is very marked.

The same crystal was then set up as a monochromator using the ground surface, and test exposures made on an analysing crystal, di-hydro lumisterol acetate (Fig. 4, *A* and *B*). In *A* the direct unfiltered beam from a Philips Metallix copper tube was used, in *B* the monochromatic radiation. The same slit system was used, but with the monochromator, the front slit was removed as the monochromatizing crystal itself acts as a slit of very small width. If one takes into consideration the lack of background and the smaller size of the reflections obtained with the monochromatic radiation (with the possibility therefore of using a larger slit), it can be safely said that for equivalent intensity and size of reflection the use of a monochromator as described involves no appreciable increase of exposure time. Considering that these experiments were done very roughly and that optimum conditions were certainly not realized, it is not too optimistic to believe that work with monochromatic radiation can be done with the same ease as, or greater ease than, with heterogeneous radiation.

I. FANKUCHEN.

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Cambridge.
Dec. 30.

[1] Bawden, Pirie, Bernal and Fankuchen, NATURE, 138, 1061 (Dec. 19, 1936).

[2] Stephen and Barnes, NATURE, 136, 793 (Nov. 16, 1935); 137, 582 (March 28, 1936).

Layer-Line and Debye Photographs by means of the Characteristic X-Rays of the Crystal Itself

THE anomalous X-ray reflections from rotating crystals reported by Clark and Duane[1] and first ascribed to characteristic radiation of the crystal itself have since been regarded as due to other phenomena. The *Quellen-Strahlung* of W. Kossel[2] emitted by single-crystal anticathodes and found by G. Borrmann[3] on exciting the crystal with X-rays is not able, however, to account for the layer-line and Debye photographs produced by us[4] using either an X-ray source giving only 'white' radiation or a tube with copper or iron anticathode.

The photograph of a rotating crystal reproduced in Fig. 1 shows interferences among the ordinary reflections due to the copper K_α-radiation, which must be ascribed to the rubidium K-radiation of the crystal itself. A series of photographs has also been taken using rotating single crystals of cæsium nitrate and strontium sulphate, powdered rubidium salts and sodium bromide and copper, iron and zinc wires. In the Debye photographs of copper and iron wires using an aluminium anticathode, not only the well-known reflections due to the face-centred (Cu) or body-centred (Fe) cubic lattice were observed, but also reflections corresponding to the simple cubic lattice. Using an ordinary X-ray tube with copper anticathode these 'forbidden' reflections, though faint, could still be observed in the Debye photographs of a copper wire.

The last fact makes it rather probable that the new effect is partly due to the direct interference of the characteristic radiation emitted by the excited atoms, this radiation thus showing a certain degree of coherence. It is clear, however, that a secondary interference of the primary fluorescence radiation must play a part, since a crystal of ammonium nitrate embedded in bromoform and rotating in a beam of 'white' X-rays gave a layer-line photograph of the crystal in question corresponding to the wave-length of bromine K-radiation. As to the question of the coherence of the fluorescence radiation, the modern view on the exciting act makes a certain degree of coherence rather plausible.

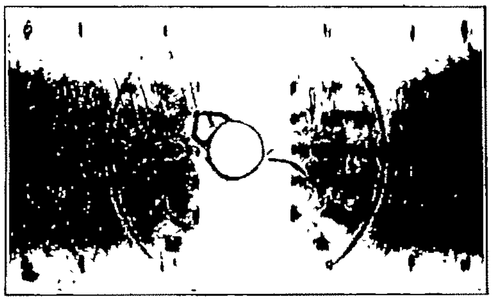

Fig. 1.

We shall deal in a more detailed way also with the theoretical side of the effect in a forthcoming communication.

CHR. FINBAK.
O. HASSEL.
Institute of Physical Chemistry,
University of Oslo.
Dec. 12.

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[1] Clark, G. L., and Duane, W., *Proc Nat. Acad. Sci.*, 9, 422 (1923).

[2] Kossel, W., Loeck, V., and Voges, H., *Z. Physik*, 94, 139 (1935)

[3] Borrmann, G., *Naturwissens*, 23, 591 (1935).

[4] *Norsk geologisk Tidsskrift*, 16 (1936)

The Existence-Range of the β Hume-Rothery Phases

FROM the data given in Dr. Hansen's recently published elaborate work[1], "Equilibrium Diagrams of Two-Component Alloys", and various other original diagrams, I have tried to find some regularities in the existence-ranges of the β Hume-Rothery phases. The term 'existence-range' indicates that range (expressed by the valency electron concentration) which lies between the maximum and the minimum solid solubilities of the second component in β phases. The accompanying table was obtained. (In this table, the maximum solid solubility in α solid solution and the minimum solid solubility in γ phase are also given.)

The following conclusions can be drawn from this table.

(1) When the atomic size factor is favourable for the formation of electron compounds[2] (Hume-Rothery phases)—according to Hume-Rothery, the size factor is favourable, as long as the difference of the atomic diameters of two components is kept within 15 per cent—the existence-range of the β Hume-Rothery phases are, approximately, 1·37∼1·57 for zinc alloys, 1·42∼1·58 for cadmium alloys, and 1·38∼1·62 for aluminium alloys, respectively. It is a very interesting fact that the existence-ranges are approximately constant, where the second component is the same. For example, in copper-zinc, silver-zinc and gold-zinc systems, the ranges show approximately constant values, namely, 1·37∼1·57.

(2) When other factors[2] (such as size factor, negative valency effect, etc.) are favourable, the maximum solid solubility of the second component in α solid solution is a little greater than the minimum solid solubility of the same component in β phase, as can be seen in the systems copper-zinc, silver-cadmium, copper-aluminium, and silver-aluminium. Hence the existence-ranges of α- and β-phases overlap by a few atomic per cent (in most cases 1 per cent). For example, in the copper-zinc system, the maximum solid solubility of zinc in α solid solution and the minimum solid solubility of zinc in β phase are 38 and 37 per cent, respectively.

A similar relation is likely to be found in the existence-range boundaries of β and γ phases, although with less accuracy.

M. HARA.
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College of Science,
Kyoto Imperial University,
Japan. Nov. 7.

System	Difference of atomic diameter (per cent)	Maximum solid solubility in α-phase (atomic per cent)	Maximum solid solubility in α-phase (valency electron concentration)	Existence-range of β-phase (atomic per cent)	Existence-range of β-phase (valency electron concentration)	Minimum solid solubility in γ-phase (atomic per cent)	Minimum solid solubility in γ-phase (valency electron concentration)
Cu–Zn	+ 7·7	38	1·38	37 ∼ 56	1·37 ∼ 1·56	57	1·57
Ag–Zn	– 4·7	38	1·38	38 ∼ 57	1·38 ∼ 1·57	60	1·60
Au–Zn	– 4·5	31	1·31	36 ∼ 57	1·36 ∼ 1·57	64	1·64
Cu–Cd	Size factor is not favourable.						
Ag–Cd	+ 5·5	43	1·43	42 ∼ 57	1·42 ∼ 1·57	57	1·57
Au–Cd	+ 5·7	36	1·36	43 ∼ 58	1·43 ∼ 1·58	61	1·61
Cu–Al	+ 10·9	20	1·40	19 ∼ 31·5	1·38 ∼ 1·63	31·5	1·68
Ag–Al	– 1·8	20·6	1·41	19·7 ∼ 31	1·39 ∼ 1·62	—	—
Au–Al	Existence of β Hume-Rothery phase is doubtful.						

Remarks on the table.

1. As the numerical values of the atomic diameters, those[2] given by Hume-Rothery are used.
2. All the numerical values of the atomic percentage indicated are those of the second component in each system.
3. "Valency electron concentration" means the ratio "valency electrons : atoms".
4. The negative sign of the difference of the atomic diameters means that the atomic size of the second component is less than that of the first component, and the positive sign means that the former is greater.

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[1] Hansen, M., "Der Aufbau der Zweistofflegierungen" (1936); published in Japanese by the Zairyoh-kenkyuhkai (1936).

[2] Hume-Rothery, W., "The Structure of Metals and Alloys" (1936).

Assimilation of Different Organic Substances by Saprophytic Flagellatæ

THE ordinary sewage flagellate, *Polytoma uvella*, which contains no chlorophyll, is, as I showed in 1920[1], an acetate organism. It builds up its body and the starch abundantly deposited in it from fatty acids, while it cannot utilize sugars. Since *Polytoma* lives in decaying protein solutions, I concluded that amino acids must be hydrated under desamination to supply to the *Polytoma* its specific food. In the meantime, it was shown that fatty acids, and especially acidic acid, are very important for the nutrition of micro-organisms. I have investigated a number of organisms with life conditions more or less similar to those of *Polytoma*—pigment-free forms from groups nearly related to those assimilating carbon dioxide[2]. I found that in all cases acetate is the food-substance preferred. These micro-organisms belong to three series of flagellatæ, rather removed from each other systematically, namely, Phytomonades, Cryptomonades and Euglenomonades (see table). The first two deposit starch, the last one the similar polysaccharide 'paramylum'.

	PHYTOMONADES						CRYPTOMONADES			EUGLENOMONADES		
	Polytoma uvella	*Polytoma ocellatum* (1)	*Polytoma ocellatum* (2)	*Polytomella caeca*	*Chlorogonium euchlorum*	*Hyalogonium Klebsii*	*Chilomonas oblonga* (1)	*Chilomonas oblonga* (2)	*Chilomonas paramecium*	*Euglena gracilis*	*Astasia quartana*	*Astasia (Chattonii) longa*
Acidic acid	+	+	+	+	+	+	+	+	+	+	+	+
Propionic acid	−	−	+	+	−	−	+	−	−	+	+	+
n-Butyric acid	+	+	−	+	−	−	+	−	−	+	+	+
n-Valerianic acid	−	+	−	+	−	−	+	−	−	+	−	−
n-Capronic acid	−	−	−	−	−	−	−	−	−	+	−	−
i-Butyric acid	−	+	+	+	−	−	+	−	−	−	−	+
Ethyl acetate	+	+	+	+	+	+	+	+	+	+	+	+
Ethylal	−	−	−	+	−	−	−	+	+	+	−	+
Malic acid	−	+	−	−	−	−	−	−	−	+	−	+
Lactic acid	+	+	−	+	−	−	−	−	+	−	−	−
Pyruvic acid	−	−	−	−	−	−	+	−	−	−	−	−
Succinic acid	+	+	−	+	+	+	+	+	−	+	+	+
Glycerine aldehyde	−	−	−	−	−	−	−	+	−	−	−	+
Dioxyacetone	−	+	+	+	−	−	+	−	+	−	−	−

Up to date, I have results for twelve forms, to which *Peptone de viande Vaillant* in the presence of about twenty different organic substances was offered in solution. With peptone alone as well as with formic, oxalic and lævulinic acid, with glycol, glycolic acid, glycerine, pentoses and hexoses in case of small inoculation only a very small or no development at all was observed. With the other substances, the micro-organisms behaved in very different ways. Only acetate was favourable in all cases, and so too ethyl acetate. The homologues of acetic acid are not so generally accepted: the longer the carbon-chain the more rarely the fatty acids are assimilated.

Special importance is attached, therefore, to newer results with succinic acid. The trioses are, contrary to the hexoses, assimilated by some species, and also such substances as ethylal, malic, lactic and pyruvic acids, but not so often as succinic acid. In a similar way to that in which acetic acid is formed from glycine, succinic acid is formed from asparaginic acid in the putrification of proteins by reduction and splitting off of ammonia. Also, the dehydration of acetic acid with condensation of two molecules may be considered as a source for succinic acid. This appears to me important to the conditions of life in the natural environment of the pigment-free flagellatæ. Here, succinic acid may be formed in putrifying mud, rise into the oxygen-containing water layer and there be used by the flagellates. Probably this acid plays, in general, a more important role in nutrition than at present known.

Especially strong was the growth of a *Chilomonas* species with succinic acid salts, here even as great as with acetate. In the course of many nutrition experiments, more rapid and abundant growth has not been observed. Succinic acid may consequently be regarded as the specific nutrient for this organism, from which it builds up its body and forms a considerable quantity of starch in pure cultures.

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der Deutschen Universitat,
Prag.
Dec. 16.

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[1] *Ber. deutsche botan. Ges.*, 38, (8) (1920); *Beitr. allgem. Botanik*, 2, 88 (1921).

[2] *Naturwiss.*, 23, 110 (1935).

Adrenal Degeneration in a Pure Strain of Mice subject to Mammary Cancer

WE have observed as a regular occurrence spontaneous degenerative changes in the adrenals of both males and females of a genetically pure strain of mice. The strain is the *R* III strain obtained by Mme. Dobrovolskaia-Zawadskaia of the Institut du Radium in Paris as the result of brother and sister mating and maintained in our laboratory in this way for the last three years. The degenerative changes in the adrenals are progressive, and when fully developed at the age of about one year are massive and involve both cortex and medulla. The degenerative changes are of a specific kind and have never been seen by us to occur spontaneously in the adrenals of mice of mixed strains up to one year of age, of which we have examined more than a thousand.

The following considerations add to the interest which these findings may have from the point of view of genetics: (1) The genetically pure strain *R* III in which these degenerative changes occur has a high incidence of spontaneous mammary cancer in the females. (2) In the males of this strain, which never develop mammary cancer spontaneously, a high incidence of mammary cancer can be induced by the continued administration of œstrin. (3) The degenerative changes in the adrenals, which set in spontaneously in the mice of the *R* III strain, are identical with the degenerative changes in the adrenals which we have recorded[1] as developing regularly in male and female mice of mixed strains after the continued application of œstrin.

A detailed account of these observations will be published soon.

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E. S. HORNING.

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Jan. 8.

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[1] *The Lancet*, i, 247 (1936).

Wing Abnormality in *Locustana pardalina*

I ENCLOSE photographs (Fig. 1) of two locusts with the following history: The eggs were hatched and the young reared inside, in glass, so that the only sunlight that could reach them was screened through two layers of glass; other conditions were identical with such as produced perfectly normal flyers. They remind one strongly of similarly localized (and similarly produced?) abnormalities in *Drosophila*, and we may legitimately assume that the abnormality will be hereditary.

Most of the young were used for experimental purposes, but eleven remained over by the time that they were ready to undergo the final moult. Of these, three died immediately after the moult, the wings remaining small and crinkled. Four survived the moult but with wings as in the photographs, and four were apparently perfectly normal.

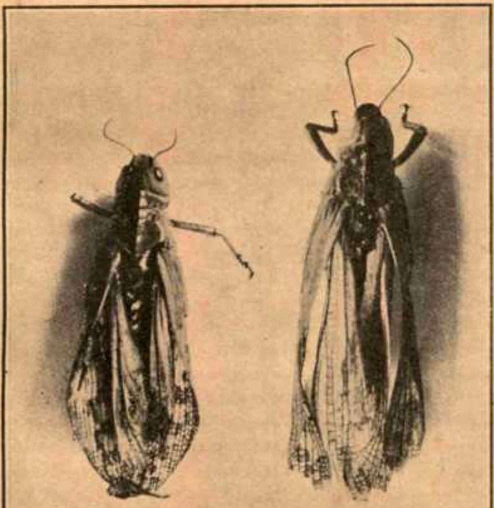

Fig. 1.

LOCUST WITH ABNORMAL WINGS. THE LEGS OF BOTH SPECIMENS WERE BROKEN OFF AFTER DEATH.

About a fortnight after the moult, the eight locusts were sprayed with a suspension of a *Micrococcus* sp. in the form of a fine mist: all four abnormal locusts died (the first two, the last nineteen days after infection); the four normal ones are still alive. The course of infection is the same in all—the fæcal pellets, 24 hours after infection, were in the mornings red, jelly-like and swarming with *Micrococcus*; after feeding, the pellets become more or less normal with only a light infection. The live ones are still (nearly a month after infection) passing such pellets. In those that died, the rectal matter suddenly became a very acid, brown, slimy liquid with a massive *Micrococcus* infection.

The abnormal wing character is thus associated with a loss of constitutional vigour, the latter being revealed by non-survival of the last moult and by decreased resistance to bacterial attack. This is, of course, no new phenomenon; idiocy in man is almost constantly associated with small bodily size, a short expectation of life and an increased susceptibility to disease.

Cases such as these add force to the objections that have been raised against the mechanistic preformationalism of modern genetics; they indicate in no uncertain way that the injuries concerned are of a constitutional character—injuries of the organism as a whole—which may be expressed as definitely localized abnormalities, perhaps particularly in the latest ontogenetic developments; they seem to indicate that genetics deals not with primary and independent but with secondary phenomena, dependent on, or modifying, 'holistic' changes.

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Dec. 8.

McCormick and the Reaping Machine

IN NATURE of December 26, p. 1088, a note appears referring to twelve notable American inventions. Among these is included a practical reaping machine by Cyrus McCormick. Cyrus McCormick was not the inventor of the first practical reaping machine. No doubt the American firms concerned with the manufacture of reaping machines have loudly and persistently claimed McCormick as the inventor of the reaping machine, and some British writers, who should have known better, have accepted this claim, but it has been repeatedly disproved that McCormick has any claim to be considered the maker of the first practical reaping machine.

Early in the nineteenth century there were many attempts to make reaping machines, and some of these attempts attracted considerable attention. The first really practical machine which was able to cut a harvest and continue to do so year after year was made by the Rev. Patrick Bell, in 1828, when he was a divinity student at the University of St. Andrews. A full account of this machine was published in 1828 in the *Quarterly Journal of Agriculture*. The original machine, which Bell made with his own hands with the assistance of the local blacksmith, is now in the Science Museum at South Kensington. This machine was used on the farm of Bell's father and afterwards on the farm of his brother for many years.

The earliest year in which it is claimed that McCormick produced a reaper is 1831, but no proof can be produced to show that he made any machines until several years later. By that time several of Bell's machines had found their way to America.

It is claimed on behalf of McCormick that Bell never patented anything whereas McCormick took out his first patents in 1834, and further patents in 1845 and 1847. Bell's reasons for not patenting anything have been given to us by himself and were of the highest and most honourable kind. He considered it to be his duty to present his invention freely to the agricultural public and not to add to its cost by any royalties or profits accruing to himself. He tells us that "The late Lord Panmure, knowing the low state of my finances, offered to be at the expenses of the patent if I would accept one. For the reasons above stated, I declined his lordship's offer". In later life, Bell admitted that it was probably a mistake that he did not patent his invention. As he gave it freely to the public, many imitations were turned out. He himself says, "Had I patented the machine at the time, all this bungling in machine-making would have been avoided; and the issue perhaps proves that, for the public benefit even, this was the prudent course to have been adopted".

Bell's machine embodied all the main features of the modern reaping machine though in a somewhat crude form. All these features were also included in the earliest known machines which could be ascribed to McCormick, but before McCormick's machines were made several of Bell's machines were already in America. McCormick's patents were disputed in his own country and prolonged law suits took place with regard to them.

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Gesture Language

A PARAGRAPH in the Research Items in NATURE of December 5, entitled "Origins of Speech and the Orang-Utan", refers to Dr. Cornelius J. Connolly's important studies of the brains of various primates. The note stated that it is believed by neurologists that the associative process, with the power of making articulate sounds, constitute the essential elements in human speech, and that the association between sound and objects makes symbolism possible.

May I point out that human power of symbolism is not primarily dependent on association between *sound* and objects, but rather on the ability (which apparently is peculiar to man) of analysing events—whether sensed or imagined—and expressing the separated elements by a series of separate bodily gestures.

The association between sound and objects (except in the comparatively rare onomatopœic symbolism of objects or events which are naturally associated with a characteristic and imitatable sound) came later; it probably arose—as I have previously pointed out—from the natural sympathy of movement between man's hands and his mouth which Charles Darwin described in "The Expression of the Emotions".

It is not generally known that the natural pantomime of uneducated deaf mutes, by which the born deaf of all nations can communicate with one another, is not built up of separate signs equivalent to words. It does not analyse events into separate parts equivalent to parts of speech; it cannot define. It would appear that man's advance was primarily due to his development of this power of symbolism —which made new syntheses possible.

The original pantomimic expression of primitive man was doubtless accompanied by an emotional gabble—due to the Darwinian association of hand and mouth, and to the corresponding association of facial gesture and muscular movements of the larynx and pharynx which was assumed by E. B. Tylor[1] and which I have personally observed.

This 'gabble' can scarcely have been understandable by ear, for if the hand gestures were not standardized, the associated sounds could have no constant meaning. It was only when man had learnt to use a particular gesture to symbolize a definite object, action, quality, etc., that true speech began.

The chimpanzee fails in two respects: he cannot apparently symbolize, and his tongue does not move in sympathy with his hands. Thus, Madame Kohts[2] points out that whereas the young child feels with his hands and his tongue, the young chimpanzee feels with his hands and his lips.

In attempting to locate the areas of the brain responsible for the development of speech, the physical anthropologist should, I suggest, study especially those areas which control bodily gesture on one hand, and those which give the power of analysis on the other.

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[1] E. B. Tylor, "Primitive Culture", vol. 1, chap. v.

[2] "Infant Ape and Human Child", Darwinianum, Moscow, 1935.

Neutrino Theory of Light

PROF. V. FOCK[1] has pointed out an apparent inconsistency in the neutrino theory of light. He shows that the operator of Jordan

$$\sqrt{|\nu|}\,b(\nu) = \sum_{\alpha=-\infty}^{\alpha=+\infty} \gamma^{+}(\alpha)\gamma(\alpha+\nu) \qquad (1)$$

commutes with his adjoint operator $b^{+}(\nu) = b(-\nu)$, while according to Jordan the relation

$$b^{+}(\nu)b(\nu) - b(\nu)b^{+}(\nu) = -1 \text{ for } \nu > 0 \qquad (2)$$

should hold. In configuration space the operator takes the form $\sqrt{|\nu|}\,b(\nu) = \sum_{k=1}^{k=n} b(\nu,x_k)$. k denotes the co-ordinate of the kth particle. Fock identifies the operators $b(\nu,x^k)$ with $e^{i\nu xk}$. Therefore all the $b(\nu)$ and $b^{+}(\nu)$ commute in contradiction with (2). However, a configuration space representation of a problem is only possible *if the number of neutrinos n is finite*. As we need the interpretation of Dirac with respect to the filled up negative energy states ($\alpha < 0$), we are concerned with an *infinite number of particles*.

If we assume *the number of possible states finite*, a configuration space description of $b(\nu)$ is possible, because the number of neutrinos is *a fortiori* finite. Let therefore $u_a(x)$ be the wave function of a state α. α takes all integral values between $-A$ and $+A$, where A is a finite positive integer, which tends towards infinity. The operator $b(\nu,x_k) = b^{+}(-\nu,x_k)$ is defined by

$$b(\nu,x_k)u_a(x_k) = \begin{cases} u_{a-\nu}(x_k), \text{ if } -A \leqslant \alpha - \nu \leqslant A \\ \quad 0\ , \text{ for all other values of } \alpha - \nu \end{cases} \qquad (3)$$

Let

$$\psi(\alpha_1, \ldots \alpha_k \ldots) = \sum_P \delta(P) u_{a_1}(x_1) u_{a_2}(x_2) \ldots u_{a_k}(x_k) \ldots u_{a_n}(x_n),$$

with $\delta(P) = \pm 1$ an antisymmetric wave function. The sum is to be extended over all permutations P. An easy calculation leads to the identity

$$\nu\{b^{+}(\nu)b(\nu) - b(\nu)b^{+}(\nu)\}\psi = \psi\left\{\sum_{a=A-(\nu-1)}^{a=A} N_a - \sum_{a=-A}^{a=(\nu-1)-A} N_a\right\} \text{ for } \nu > 0 \qquad (4)$$

$N_a = 1$ or 0 according to whether the particular α occurs or does not occur in $\psi(\alpha_1 \ldots \alpha_n)$. If the number of states tends to infinity and the total energy of the system remains finite, the Dirac interpretation demands that all states whose energy is smaller than a finite negative energy $-B$ are occupied ($N_\alpha = 1$ for $\alpha < -B$), while all states of positive energy above a certain positive energy B are empty ($N_\alpha = 0$ for $\alpha > B$). If ν is a finite positive integer, and if A tends to ∞, the first sum in the right hand term disappears and the second one equals ν, which is the desired result (2).

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[1] Fock, V., NATURE, 138, 1011 (1936); *C.R. Acad. Sci.*, 4, 229 (1936).

Nigeria and the Sahara

SOME passing remarks in the article entitled "Soil Drift in South Australia" in NATURE of December 19 (p. 1039) may give the casual reader the erroneous impression that the northern part of British Nigeria is threatened by the "encroaching desert". A glance at any adequate map of Africa will show that the northern frontier of Nigeria runs through the western Sudan and that the Sahara lies well to the north in French West Africa. The geological evidence is clear, as I pointed out twenty-five years ago[1], that the desert pulsates, that its margins expand and contract, and that the most recent movement has been one of contraction with the consequent spread of more humid conditions over the country between Lake Chad and the River Niger. There is no evidence that existing climatic conditions are deteriorating.

There may be room for some adjustment of stocking policy, but comparison with the Dominions is to be deplored. It should be remembered that in Nigeria the Africans themselves are the stock farmers, following ancient methods in unfenced communal pastures. They are happy and contented, and problems arise only when the industry is unduly stimulated by ambitious administrators or ardent tax collectors.

J. D. FALCONER.

The Cedars,
Harlington Corner,
Middlesex.
Dec. 21.

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[1] "The Geology and Geography of Northern Nigeria" (Macmillan, 1911).

Points from Foregoing Letters

REFERRING to criticisms by Dr. Broom, the Keeper of Geology in the British Museum (Natural History) defends the removal of matrix and the sectioning of type-specimens in museums, in the interests of morphological research. He quotes Prof. D. M. S. Watson to show that the value of the fossil reptiles referred to by Dr. Broom were in no way impaired, but rather enhanced, after their treatment by Dr. Boonstra.

New experiments on sound 'beats' produced in the inner ear (by means of electrical stimuli, undergoing periodic phase reversal) are considered by C. S. Hallpike and Prof. H. Hartridge to supply additional evidence in support of the Helmholtz hypothesis, which postulates indirect excitation of the nerve elements by a resonance mechanism.

Preliminary results obtained by means of a new technique in utilizing monochromatic X-rays in crystal analysis are described by Dr. I. Fankuchen, and photographs are submitted indicating the spurious nature of the innermost halo observed in ordinary spectrograms of tobacco virus. Crystals of pentaerythritol ground at a suitable angle were found convenient for the purpose of increasing the concentration of the monochromatic X-rays.

An X-ray photograph of a rotating crystal, showing interference phenomena, is submitted by Chr. Finbak and Prof. O. Hassel. The authors consider that the effect is partly due to direct interference of the characteristic radiation emitted by the excited atom, and that a secondary interference of the primary fluorescence radiation also plays a part in the phenomenon.

A table showing the concentration ranges in which 'electron compounds' ('Hume-Rothery' phases) are formed in binary alloys of various metals (zinc, copper, silver, gold, cadmium, aluminium) is supplied by M. Hara. The existence ranges and also the solubility in the α and γ solid phases are considered by the author in relation to the difference in the atomic diameters of the components.

Various non-pigmented one-celled organisms (flagellates) have been grown by Prof. E. G. Pringsheim in peptone medium to which various organic substances (fatty acids, esters, etc.) were added. All organisms investigated thrived on acetic acid and on ethyl acetate but differed in their ability to assimilate other compounds. Succinic acid was also used by a large proportion of the organisms, and malic, lactic and pyruvic acids to a lesser extent.

A pure strain of mice in which degenerative changes in the adrenal glands develop spontaneously before the animals are one year old have been found by Dr. W. Cramer and E. S. Horning to be likewise very susceptible to cancer. The females have a higher rate of spontaneous mammary cancer, and in the males mammary cancer can be induced by administration of the sex hormone, œstrin.

Photographs of two locusts with abnormal wings, reared under glass in conditions which usually produce normal flyers, are submitted by Prof. T. F. Dreyer. The abnormal individuals also show lower resistance to micrococcus infection, indicating that wing abnormality is associated with changes in the organism as a whole. This, the author claims, supports the 'holistic' view of genetics.

Referring to the early history of the reaping machine, Prof. James Hendrick states that the Rev. Patrick Bell of St. Andrews built a practical reaping machine in 1828, several years before McCormick took out his patents in the United States.

Sir Richard Paget writes that the symbolism of human speech is not primarily dependent on association between sound and objects, but arose after man had succeeded in analysing events and expressing the various components by separate bodily gestures.

Referring to recent criticism by Prof. V. Fock of the neutrino theory of light, Prof. E. G. C. Stueckelberg states that, while a configuration space representation of operators is impossible, if the number of particles concerned is infinite, there exists a configuration space method for a finite number of particles, which leads in the limit to Prof. Jordan's result.

Research Items

Submerged Archæological Sites on the Essex Coast

A SUB-COMMITTEE of the Fenland Research Committee, of which Mr. S. H. Warren has acted as chairman, has been engaged on the investigation of the submerged land-surface of the Essex coast and has presented a report (*Proc. Prehistoric Soc.*, 2, 1) dealing with the character of the land-surface, the archæological sites, pollen analysis, pottery, and flint implements, and discussing the relation of this area to the East Anglian fenland, where broadly the same sequence of events—a period of land elevation followed by one of subsidence—has been established. The main archæological sites, three in number, are situated at Lion Point, Clacton (now Jaywick Sands), Mill Bay, Dovercourt, and Stone Point, Walton-on-Naze. They consist of surface settlements, or camp sites, pit dwellings, cooking holes and hearth sites. The old land surface can be seen at various levels below high-tide, and extends below the lowest level of spring-tides. It belongs, therefore, to a period of relative land elevation. The earliest trace of human habitation belongs to the Mesolithic III culture Windmill Hill pottery, leaf arrow-heads and flint and stone celts, belong to a Neolithic *A* people, who settled on this surface and were responsible for cooking-holes, pit-dwellings and hearths. They were followed by a Neolithic *B* people ; but judging from the relative scarcity of their pottery, they were in small numbers. The latest dateable material from the old land surface consists of a few beaker *B* sherds ; but no *A* beakers and no Bronze Age cord-impressed ware has been recorded. The human occupation of the land-surface seems to have come to an end with the onset of salt-marsh conditions. Over a peat bed, rich in pollen of Chenopodiaceæ, a layer of *Scrobicularia* clay indicates submergence. At Lion Point, Clacton, quantities of grooved ware, showing affinities with two types of Dutch megalithic ware, were found, and are now recognized for the first time to occur over extensive areas in south-eastern Britain.

Effect of Tissue Extracts on Tumour Growth

DR. J. B. MURPHY, of the Rockefeller Institute for Medical Research, summarizes his results on the inhibition of malignant growths by extracts from normal tissue in a paper in the "Reports of the Second International Congress of the Campaign against Cancer" (Brussels, 1936). Extracts of placenta, embryo skin and prelactating mammary gland inhibit the growth of transplanted mouse cancer when the graft is treated with the extract. The prelactating mammary gland, which appears to be the best source of the inhibiting agent, also contains a stimulating factor which is ether-soluble, while the inhibiting agent is water-soluble. In another paper in the same volume, Prof. T. Maisin and Dr. Y. Pourbaix describe the effects of feeding different animal organs on the growth of tumours induced in mice with benzpyrene. These organs contained both activating and inhibiting factors in different proportions. Whole liver had an activating action while whole brain was inhibitory. These factors, however, are probably different from those of Dr. Murphy, as the inhibiting factor was ether-soluble and the stimulating factor was water-soluble. The work described in the two papers indicates how complex is the control of tissue growth in both normal and malignant tissues in the living animal.

An Interesting Larval Bivalve

THE embryonic and larval stages of a Japanese species of *Sphærium* have been described by Dr. Katsuhiro Okada ("Some Notes on *Sphærium japonicum biwaense* Mori, a Freshwater Bivalve. (4) Gastrula and Fetal Larva". *Sci. Rep. Tôhoku Imp. Univ.*, Fourth Series (Biology), Sendai, Japan, 11, No. 1 ; 1936). There is no free-swimming stage, the whole of the embryonic and larval period being passed in the marsupial sac of the mother. The new term 'fetal larva' is given to the larval stage after the complete closure of the blastopore up to the formation of the rudimentary shell. This is quite different from a 'veliger', for the larva continues to develop until the small but adult form is reached without any sign of metamorphosis. This 'fetal larva' is, however, regarded by the author as a vestigial veliger. Most lamellibranchs develop as free-swimming veligers and pass through the larval stage with a simple velum and bivalve shell ; but there are several instances of the veliger stage being suppressed, especially in freshwater forms with viviparous habit. Compared with other lamellibranchs, the present species indicates signs of secondary direct development in which the metamorphosis is indistinct, merely the earlier development of the foot and the vestigial signs of the head region having been shown.

New Varieties of Potato

AN important application of Vavilov's geographical method in the study of economic crops has recently been made by Russian plant breeders with regard to the potato. The results of their work have been published mainly in Russian, and the bulletin issued by the Imperial Bureau of Plant Genetics (School of Agriculture, Cambridge, price 3*s.* 6*d.*), on "The South American Potatoes and their Breeding Value" can be considered as the first comprehensive account in English of one of the most remarkable discoveries in plant breeding. It describes the material collected on expeditions made to South and Central America, the original home of the potato, where more than twelve cultivated, and thirty wild species were found in place of the single cultivated species previously known. The properties exhibited by these forms have already provided a great stimulus to potato-breeding and, among other developments, should result in the crop being grown over a much wider geographical range than has been possible up to the present, for at least one species has been found which forms tubers under sub-tropical conditions, while others occur that can withstand frost. Disease resistance, short dormancy and high protein content are further valuable properties exhibited by these newly discovered forms, that will provide the breeder with new and valuable possibilities.

Sand Devils

THERE is not much detailed information in books on climatology or meteorology about the small pillar-like whirlwinds known as sand devils. It is common knowledge that they develop in deserts when the sun is strongly heating the ground, that is to say, especially in the summer, and then most often during the hottest hours of the day. Observers at the chain of meteorological stations of the Air Ministry that extends from Egypt to Iraq and the Sudan have had them under observation, however, since 1927, and a note entitled "Sand Devils", by W. D. Flower (Professional Note No. 71 of the Meteorological Office, Air Ministry), tells us what they saw and ends with a theory of their structure and formation that takes into account the instability of the lower atmosphere under intense solar radiation. The observed facts are briefly as follows: No marked preference for either clockwise or counter clockwise rotation was found. The way that they favoured the hottest part of the day was very marked, although observers are not prone to be abroad at that time and tend to miss many of those that develop then. Some observations of the linear speed of rotation at the outer edge were made and showed a range from 10 to 40 miles per hour. In size they varied from less than 5 feet to more than 2,000 feet in height, and from less than 5 feet to more than 200 feet in diameter. One might instance a diameter of 30 feet and a height of 200 feet as being the size of a typical sand devil, and less than one minute as its duration, although several lasted for ten or fifteen minutes. A super-adiabatic lapse-rate in the lower atmosphere appears to be usually, if not invariably, present. The sand devil of necessity travels with the general wind in its neighbourhood and demonstrates the normal increase of wind with height by leaning forwards in the direction towards which the wind is blowing.

Centimetre Radio Waves

A NOTE in the *Physical Review* of December 1 (50, 1091) by Messrs. C. E. Cleeton and N. H. Williams, of the University of Michigan, describes an investigation undertaken to determine the practical short-wave limit for electrical oscillations produced by valves. Three valves of the split-anode magnetron type were designed to operate at wave-lengths less than 2 cm. The smallest of these was provided with an anode of 0·038 cm. diameter, while the outside diameter of the glass envelope was 0·45 cm. At an anode voltage of 1,200 and with a magnetic field strength of 24,000 oersteds, oscillations were obtained at a wave-length of 0·64 cm., as measured with an echellette grating spectrometer previously described by the authors (*Phys. Rev.*, 45, 234–237; 1934). The resulting radiation was detected with a crystal detector placed at the focus of a receiving mirror at a distance of 15 metres from the valve. The other two valves produced oscillations of wave-lengths 1·2 cm. and 1·9 cm. at lower intensities of magnetic field. It is concluded that continuous electric waves may be produced at wave-lengths less than 1 cm., the waves being of sufficient intensity for many research purposes. According to a note recently received from Science Service, these minute radio waves are being used for the study of the molecular structure of gases, including water vapour. While such substances as black paper, ebonite and wood are transparent to the waves, it appears that their absorption by the water vapour in the atmosphere is such as to render their application to radio communication somewhat difficult.

Lightning and Overhead Transmission Lines

AT a meeting of the Institution of Electrical Engineers on January 7, a paper on "Lightning" was read by Mr. B. L. Goodlet. The first part of this paper dealt with lightning as a physical phenomenon and reviewed present knowledge and hypotheses on the formation of thunderclouds and the mechanism of the lightning flash. It was pointed out that a complete flash usually consists of a sequence of double strokes separated by time intervals of the order of one hundredth of a second. These double strokes comprise a preliminary or 'leader' from cloud to ground followed by a powerful 'return' stroke from ground to cloud. The distribution of flashes to earth under a storm centre is influenced by the distribution of space charge above the ground and by discontinuities of conductivity in the ground itself. The second part of the paper dealt with the theory of the effects of lightning strokes on overhead transmission lines. It is concluded that direct strokes to overhead conductors are certain to cause flash-over; but interruption of the supply may be minimized either by fitting devices, such as special choke coils or protective gaps, or by the installation of overhead earth wires, which will prevent any strokes falling on the line conductors. Emphasis was laid in the paper on the fact that in order to protect an insulated line from flash-over, when either a tower or the earth wire is struck it is necessary to ensure that the effective resistance of the earth connexion of the tower is reduced to a low value For example, it is deduced that no flash-over will occur on a line insulated with chains of nine standard cap-and-pin units, if the tower footing resistances are less than 10 ohms. It may not, however, always be possible to secure a sufficiently low value of this resistance to avoid flash-over.

Observation of Orionids, Leonids and Geminids in 1936

KÔZIRÔ KOMAKI, of Kanaya, Aritagun, Wakayama-ken, Japan, has sent the results of his observations of these three showers. The Orionids were very numerous, and he states that he has not observed such a rich display for ten years. On the night of October 21 the rate was more than 33 an hour—a very high rate for this shower. The eastward shift in the radiant from night to night was very obvious. Thus on October $20{\cdot}72^{\mathrm{d}}$ U.T. the position of the radiant was 93·5°+13°, and on October $27{\cdot}77^{\mathrm{d}}$ it was 99·5°+6·5°. A number of other observers in different parts of Japan obtained results similar to those of Mr. Komaki. Mr. K. Yasii at Takehara attempted to photograph meteors during the period of the Orionids, and succeeded in obtaining 10, of which 4 were Orionids. On November 12–16 watch was kept for the Leonids, but the apparition was very poor, only 5 being observed hourly on November 17, when the maximum was attained. Several Andromedids were observed on November 21 by Mr. Sanekata, but nothing is said about the radiant. The Geminids were seen on December 10–16, the maximum being attained on December 13–14, when the frequency was about 40 hourly. This is similar to the rate in previous years. The radiant showed the eastward movement usually observed with this shower. On December $12{\cdot}76^{\mathrm{d}}$ U.T. it was at 113°+32·5° and on December $15{\cdot}65^{\mathrm{d}}$ at 115°+32·5°.

American Association for the Advancement of Science

ATLANTIC CITY MEETING

THE ninety-ninth meeting of the Association was held in Atlantic City, N.J., on December 28–January 2, where one meeting had been held previously, namely, in 1932. This was to many of the members a strange setting for a great scientific assembly with the wide board-walk winding along close by the breakers of the Atlantic, and lined on the other side by shops in endless variety over which tower the great hotels, the comforts and service of which have made Atlantic City famous. One found no great university buildings, no richly stored museums, no famous research laboratories such as usually shelter the sessions and stimulate the activities of Association meetings. But all pronounced the meeting a success; the weather was mild, the sea beautiful, the attendance good, and the facilities adequate to serve well all needs of the occasion.

The splendid Municipal Auditorium, with numerous audience rooms of varied capacity, and the well-planned meeting-places in the big hotels brought closer together than ever before the sessions of the fifteen sections and some forty associated societies and conferences included in the programme. Time spent in reaching distant meetings was saved, conferences were easily arranged, and personal contacts more frequent. Important as are the formal papers, one must rate of even higher value the discussions between and after meetings when new ideas are subjected to the keenest criticism. All conditions at Atlantic City contributed to further interchange of views and to strengthen the unity of the Association

The opening general session on December 28 was devoted primarily to the address of the retiring president, Dr. Karl T. Compton, on "The Electron: Its Intellectual and Social Significance". Dr. Compton used the discovery of the electron, which apparently had no practical use when first found and measured, as the example of how pure research turns into valuable practical application. He enumerated industries made possible by electronic devices which have a total business of hundreds of millions of dollars each year, and added that the application of the discovery of the electron has brought intangible values in improved health, safety and convenience. Taking a swift audit of the electron's money contribution to civilization, Dr. Compton pointed out that it is responsible for a growing industry in electronic devices which now amounts to a total business of 50,000,000 dollars a year in America alone.

The Sigma Xi address on December 29 was given by Dr. Henry G. Knight, chief of the U.S. Bureau of Chemistry and Soils, on "Selenium and Its Relation to Soil, Plants, Animals, and Public Health". The Phi Beta Kappa address on December 30 was delivered by President James R. Angell, of Yale University; his subject was "The Scholar and the Specialist".

Special afternoon general lectures were given on December 28 by Dr. E. O. Hulbert, of the Naval Research Laboratory, on "The Optics of the Surface of the Sea", on December 29 by Mr. David Dietz, science editor of the Scripps-Howard newspapers, on "Science and the American Press", and on December 30 by Dr. P. W. Zimmerman, of the Boyce Thompson Institute for Plant Research, on "Response of Plants to Hormone-like Growth Substances". The last mentioned item was a formal presentation before the Association of the subject awarded the Association Prize at St. Louis last year.

The Section on Medical Sciences devoted four days to a continuing symposium on cancer, covering in series of invited papers by leaders in cancer research the position of various aspects of present-day investigation. The morning of December 29 was devoted to various types of radiation and their effects, and the afternoon to heredity and constitutional factors; the following morning and afternoon to induction, stimulation and inhibition of tumorous growths; and the morning of December 31 to the metabolism of cancerous tissue. On the afternoon of December 30, Dr. C. C. Little, director of the Jackson Memorial Laboratory, gave the afternoon general lecture on the subject "The Social Significance of Cancer". A general lecture was given on January 1 by Dr. Walter Schiller, of the University of Vienna, on "Changes and Modifications in the Conception of Carcinoma". All told, this series constituted the most complete presentation of the cancer problem and the results of research in this field yet organized in the United States. The sessions were largely attended and the discussions prolonged.

Some new features were introduced into the programme at Atlantic City. Friday, January 1, was designated Association Day and devoted to general purposes. The morning was utilized for meetings of sectional committees, scientific boards and the Secretaries' Conference of the Association. In the afternoon was held a demonstration symposium on "The Moving Picture in the Service of Science". In one large auditorium Dr. William Beebe showed his reels on "Bathosphere Embryonic Eels", made under the auspices of the New York Zoological Society. Following this, Mr. Perry Burgess, president of the Leonard Wood Memorial, presented a sound movie of dramatic interest, "Miracles in the South Sea", portraying life in the leper colony in Culion, P.I. At the same time in a separate auditorium Prof. E. M. K. Geiling, of the University of Chicago, and Mr. L. L. Robbins illustrated "Whaling for Science" in a film showing habits of the cetacean and search for the hypophysis. "High Speed Motion Pictures of the Flight of Birds and of Bullets", a series of great interest, was shown by Dr. H. E. Edgerton, of the Massachusetts Institute of Technology. A colour film entitled "A Health Educator with a Cine-Kodak in the Orient" was exhibited and described by Dr. C. E. Turner, of the Massachusetts Institute of Technology; he presented vividly the mode of life, problems of population and sanitation in those regions.

The closing event in Atlantic City was a special showing on Friday evening (January 1) of "The Human Adventure", an eight-reel talking picture sketching man's rise from savagery to civilization. The late Dr. James Henry Breasted, director of the Oriental Institute at the University of Chicago, had supervised personally the production of this film and the sound record was partly in his own voice.

On January 2 the Association moved to Philadelphia on invitation of the American Philosophical Society, and in its famous hall heard a programme on viruses and virus diseases. The first paper, by Dr. W. M. Stanley, included a survey of the work granted the Association Prize. After the luncheon, visiting members were taken to the Franklin Institute and the Academy of Natural Sciences, where scientific programmes had been arranged.

The newly elected president of the Association, Dr. George D. Birkhoff, recently made Dean of the Graduate School of Arts and Sciences at Harvard, where he has been professor of mathematics since 1919, presented before the mathematicians an important paper entitled "A Conceptual Theory of Atomic Structure". This paper, which gives physicists a clearer comprehension of the composition of matter, presents anew to modern thought fundamental ideas first advanced by the illustrious James Clerk Maxwell. It is interesting to recall that in 1926 Dr. Birkhoff was awarded the Association Prize of the Philadelphia meeting for his paper demonstrating that Schrödinger's fundamental wave equation, then recently published, could be reached on the basis of a conceptual theory of matter and electricity.

The Association prize for an outstanding contribution to science in the Atlantic City programme was given to Dr. W. M. Stanley, of the Rockefeller Institute for Medical Research, for his paper entitled "Crystalline Tobacco-Mosaic Virus Protein". After reporting his experiments and analysing their significance with thoroughness, he concluded his paper as follows:

"In view of the properties which this protein possesses, the borderline between the living and the non-living tends to become non-existent, for, although it possesses properties which have been regarded as characteristic of living things, such as specificity of host range and the ability to reproduce and to mutate, it is nevertheless a protein molecule and as such may be regarded as non-living. It is possible that by virtue of its size, it is enabled to possess sufficient organization within the molecule to endow it with such properties. As such, it would represent a link between the type of organization within the atom or molecule with which chemists have concerned themselves and the type of organization within the cell with which biologists have been concerned."

The attendance at Atlantic City was large, being variously estimated from four to five thousand, of which 2,400 were officially registered. At the various sessions fourteen hundred papers were presented. Despite the variety of these offerings, the audience rooms were filled to capacity. The scientific exhibition was especially well visited and its numerous exhibits attracted favourable comment. Special mention may be made the remarkable research exhibit of Dr. Irving Langmuir, the Nobel laureate in chemistry, who has produced the world's thinnest films.

The addresses of the retiring vice-presidents, given at various times, included the following:

Mathematics: Prof. T. H. Hildebrandt, of the University of Michigan, on "Recent Developments in the Theory of Integration"; *Physics:* Prof. John T. Tate, of the University of Minnesota, on "Electron Impacts in Gases"; *Chemistry:* Prof. Moses Bomberg, of the University of Michigan, on "Free Radicals"; *Astronomy:* Dr. H. R. Morgan, of the United States Naval Observatory, on "Some Problems in Fundamental Astronomy"; *Zoology:* Dr. Ross G. Harrison, of Yale University, on "Embryology and Its Relations"; *Botany:* Prof. E. W. Sinnott, of Columbia University, on "Morphology as a Dynamic Science"; *Anthropology:* N. C. Nelson, of the American Museum of Natural History, on "Prehistoric Archæology, Past, Present, and Future"; *Psychology:* Dr. Robert M. Ogden, of Cornell University, on "The Psychology of Art: Naive Geometry"; *Education:* Prof. F. B. Knight, of the University of Iowa, on "Data Related to Classroom Learning"; *Social and Economic Sciences:* Dr. Shelby Harrison, of the Russell Sage Foundation, on "Winning Social Advance Through the Process of Accretion"; *Historical and Philological Sciences:* Dr. George Sarton, of Harvard University, on "The Study of the History of 20th Century Science"; *Agriculture:* Prof. H. K. Hayes, of the University of Minnesota, on "Agricultural Research in China".

The following officers were elected for the terms indicated in parenthesis:

President (1937): George D. Birkhoff, of Harvard University;

Permanent Secretary (1937–40): Forrest R. Moulton, formerly professor of astronomy, University of Chicago;

General Secretary (1937–40): Otis W. Caldwell, of Boyce Thompson Institute for Plant Research;

Treasurer (1937–40): John L. Wirt;

Elected Council Members (1937–40): Vincent du Vigneaud, of George Washington University Medical School, and Sam F. Trelease, of Columbia University;

Members of the Executive Committee (1937–40): Edwin G. Conklin, of Princeton University, and Henry B. Ward, professor emeritus of the University of Illinois;

Member of the Board of Trustees of Science Service (1937–39): J. McKeen Cattell, editor of *Science;*

Members of the Finance Committee (1937–40): Arthur Keith, of the United States Geological Survey, and (1937–38) Charles S. Baker, Munsey Building, Washington, D.C.;

Members of the Committee on Grants (1937–40): A. T. Poffenberger, of Columbia University, and Jacob G. Lipman, of the New Jersey Agricultural Experiment Station;

Vice-Presidents of the Sections (1937):

W. D. Cairns, Oberlin College (Mathematics);
Harvey Fletcher, the Bell Telephone Laboratories (Physics);
Farrington Daniels, the University of Wisconsin (Chemistry);
Philip Fox, the Adler Planetarium and Astronomical Museum (Astronomy);
Kirtley F. Mather, Harvard University (Geology and Geography);
Ralph S. Lillie, the University of Chicago (Zoological Sciences);
F. E. Denny, the Boyce Thompson Institute for Plant Research (Botanical Sciences);
John R. Swanton, the United States Bureau of American Ethnology (Anthropology);
A. T. Poffenberger, Columbia University (Psychology);
Stuart Rice, United States Central Statistical Board (Social and Economic Sciences);
R. C. Archibald, Brown University (Historical and Philological Sciences);

J. W. Barker, Columbia University (Engineering);
Esmond R. Long, the University of Pennsylvania (Medical Sciences);
E. C. Auchter, the United States Bureau of Plant Industry (Agriculture);
Ralph Tyler, Ohio State University (Education).

Secretaries of the Sections (1937–40):
E. R. Hedrick, the University of California at Los Angeles (Mathematics);
H. A. Barton, the American Institute of Physics (Physics);
Neil E. Gordon, of Johns Hopkins University (Chemistry).
Harlan T. Stetson, the Massachusetts Institute of Technology (Astronomy);
Howard Meyerhoff, Smith College (Geology and Geography);
George A. Baitsell, Yale University (Zoological Sciences);
J. T. Buchholz, the University of Illinois (Botanical Sciences);
W. M. Krogman, Western Reserve University (Anthropology);
Leonard Carmichael, the University of Rochester (Psychology);
E. P. Hutchinson, 11 Centre Street, Cambridge, Mass. (Social and Economic Sciences);
Joseph Mayer, Library of Congress (Historical and Philological Sciences);
F. M. Feiker, the American Engineering Council (Engineering);
Malcolm Soule, the University of Michigan (Medical Sciences);
M. F. Morgan, the Connecticut Agricultural Experiment Station (Agriculture);
P. M. Symonds, Columbia University Teachers College (Education).

HENRY B. WARD.

The Wellcome Trust

SIR HENRY WELLCOME, who died on July 25, 1936, at the age of eighty-two years, was known as the creator of a great manufacturing business and also for the active interest he took in archæological and geographical exploration, the social welfare of native races and the promotion of fundamental research in sciences on which the progress of medicine depends. Beginning so long ago as 1894, he founded in that year the Wellcome Physiological Research Laboratories, and two years later a corresponding centre for chemical research. In 1899, he established the Wellcome Tropical Research Laboratories at Khartoum, where the late Sir Andrew Balfour worked as director for twelve years, doing notable work on the control of malaria and the investigation of other tropical diseases. In 1913 the Wellcome Bureau of Scientific Research was brought into being to control the various research laboratories already operating, and then followed the Historical Medical Museum, the Museum of Medical Science and the Entomological Field Laboratory. All these institutions, with the exception of the physiological and entomological laboratories, are now housed in the magnificent Wellcome Research Institution in Euston Road, London. This was Sir Henry's crowning gift; the corner-stone was laid in 1931 by the late Lord Moynihan, who said that the ceremony might well be regarded as referring to the corner-stone of a long life's work.

By his will, Sir Henry provided for the continuance of the Wellcome Research Institution, the trustees appointed to administer the estate being Sir Henry Dale, F.R.S., director of the National Institute for Medical Research; Prof. T. R. Elliott, C.B.E., F.R.S., professor of medicine in the University of London; Messrs. G. Hudson Lyall and L. C. Bullock, members of a London firm of solicitors; and Mr. Martin Price, chartered accountant.

The accompanying statement has now been issued by the five trustees:

As the trustees appointed by the will of the late Sir Henry Wellcome, we ask you to be good enough to publish this letter in order to clear up any misconception which may have arisen with regard to the effects of the will. We are led to make this statement by the number of appeals for contributions to various research undertakings which have already reached us. For reasons mentioned below the trustees will not be able to consider any such applications in the immediate future.

In January 1924 the Wellcome Foundation Limited was formed for the purpose of taking over the whole of the business activities of Burroughs Wellcome and Co., and the various scientific research institutions and museums established by the late Sir Henry Wellcome, who held the whole of the share capital.

By the terms of the will the shares of the Wellcome Foundation are now vested in us as trustees, and the activities of the Foundation throughout the world will be carried on, in collaboration with the trustees, by a Board of Directors of which the present Governing Director is Mr. George E. Pearson, who has been closely associated with the late Sir Henry Wellcome for more than forty years.

It will be realized that owing to the magnitude of the testator's estate, a very large sum has to be found for death duties. Provision has also to be made for:

(*a*) A welfare fund for the benefit of employees of the Wellcome Foundation Ltd., and its associated companies.

(*b*) The payment of certain specified annuities to relatives and others personally connected with the testator.

(*c*) The erection and maintenance of a building in Minnesota to be dedicated as a memorial to the testator's parents.

Subject to these prior charges, the remainder of the divisible profits will be utilized in accordance with the testator's instructions in the following manner:

(i) For the maintenance of "The Research Undertaking Charity", which is a fund for the advancement of medical and scientific research work in any part of the world conducive to the improvement of the physical conditions of mankind, and in particular for the discovery, invention and improvement of medicinal agents and methods for the prevention and cure of disorders, and the control or extermination of insect and other pests which afflict human beings and animal and plant life, and also for the organization, equipment and expenses of special research expeditions and commissions.

(ii) For the maintenance of "The Museum and Library Charity", which is a fund for the establishment or endowment of research museums or libraries in any part of the world and for the collection of information of every kind connected with the history of medicine, surgery, chemistry, bacteriology, pharmacy and allied sciences, which in the opinion of the trustees may be desirable.

This statement of the position has been somewhat delayed by the fact that the testator imposed upon all his trustees the obligation, before undertaking the trust, to enter into a covenant not to be engaged in or in any way to assist in any concern which carried on a business in competition with Burroughs Wellcome and Co. Three of the trustees had no difficulty in entering into this covenant immediately after the testator's death, but the two medical and scientific trustees felt that certain words in the covenant might be held to restrict them unduly in the performance of their official and general duties to medical science, and to imply their particular concern with the business interests of the Foundation. The matter has now been considered by the High Court of Justice, which has made an order allowing them to enter into a covenant in a form removing any such unacceptable implication and enabling effect to be given to what was known to have been the testator's intention.

No trustee, director, or any other person holds for himself or in his own right any shares in the Wellcome Foundation, and all the divisible profits in each year will be devoted to the various purposes named in the will and indicated above.

We believe this to be the first example, in Great Britain at least, of a testamentary disposition by which the whole of the profits from a great manufacturing and trading organization, after certain personal and memorial bequests have been fulfilled, are permanently dedicated to the advancement of knowledge for the general benefit of mankind.

G. HUDSON LYALL,
H. H. DALE,
L. C. BULLOCK,
MARTIN PRICE,
T. R. ELLIOTT.

The proviso which, by order of the Court, may be added by a trustee to the covenant required of all the trustees under the will of Sir Henry Wellcome, reads as follows:

"PROVIDED that nothing in this Covenant shall be held to prevent me in the exercise of my proper function in any appointment held by me in the public service or under any publicly or privately endowed organisation for the promotion of medical research or under any University in Great Britain from giving advice on scientific matters to any person or persons solely for the purpose of rendering scientific discovery available for the general use and without pecuniary reward or other personal advantage to myself."

Prize Awards for 1936 of the Paris Academy of Sciences*

THE LOUTREUIL FOUNDATION

Researches on Fixed Problems.—Pierre Auger (3,000 francs), for his researches on cosmic physics requiring a stay at the Jungfraujoch Laboratory; Abel Brion (3,000 francs), for his researches on the pathological physiology of the kidney in animals; Raymond Cahen (2,000 francs), for his researches on tolerance to morphine in the rat and rabbit; Claude Charmetant (3,000 francs), for his researches on the electrolysis of chlorides, bromides and iodides in aqueous alcoholic solutions; H. Girard (1,000 francs), for the study of blood groups and the transfusion of blood in animals; Henri Laugier (3,000 francs), for his researches on circulation reactions during emotion; Gustave Lesbouyries and Maurice Berthelon (2,000 francs), for their researches on the genital hormones of animals; Paul Marsais (2,000 francs), for the continuation of his studies on the diseases of the vine, especially mildew and its treatment; Louis Nattan-Larrier (6,000 francs), for helping him continue his work on the serological condition of the development of normal tissues and cancers; Paul Nottin (3,000 francs), for his researches on the action of the impurities of sulphuric acid due to the Glover tower on alcoholic fermentation; the Besançon Observatory (5,000 francs), for the organization of a French office of isostatic reduction; Maurice Pierre (3,000 francs), for the study of Hering's nerve in domestic animals; Antoine Poidebard (5,000 francs), for his researches on submarine photography at Tyre; Emile Roubaud (5,000 francs), for his researches on the locust; Henri Simonnet (2,000 francs), for his chemical and physiological researches on the fate of morphine in the animal organism; Charles Alluaud (4,000 francs), for his zoological researches in the Sahara; Jean Gruvel (5,000 francs), as a contribution to an expedition to Indo-China for the study of the ichthyological fauna.

Purchase of Laboratory Material.—Emile André (3,000 francs), for the purchase of a polarimeter for the determination of rotatory power as a function of the wave-length; Henri Lafuma (3,500 francs), for the purchase of a testing machine for refractory products; Marcel Véron (3,500 francs), for the purchase of a spectrobolometer.

Publications.—Comité de Physique du Globe des Colonies (8,000 francs), for the publication of the "Annales de Physique du Globe de la France d'outre-mer"; Fédération française des Sociétés de Sciences naturelles (5,000 francs), for the publication of the "Faune de France"; André Guillaumin, for assisting in the publication of a new guide to the collection of living plants in the Jardin des plantes; Louise Nouvel (3,000 francs), for the publication of a work on the biology of the Natantia crustaceans.

Grants to Libraries.—Ecole nationale vétérinaire d'Alfort (5,000 francs), for preparing a card index and completing its foreign periodicals; Ecole national vétérinaire de Toulouse (6,000 francs), for completing its collections; Ecole polytechnique (6,000 francs), for the purchase of scientific publications; Institut national agronomique (6,000 francs), for the completion of its collection of foreign periodicals.

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* *Continued from p. 162.*

MME. VICTOR-NOURY FOUNDATION

René Bourret (2,500 francs), for his work on the snakes of Indo-China; Elisabeth Jérémine (2,500 francs), for researches in petrography; Robert Didier and Paul Rode (2,000 francs), for their work on the mammals of France; Jules Guart (2,000 francs), for his book on the parasitic cestodes obtained during the voyages of Prince Albert of Monaco, 1886-1913; Jacques Pochon (2,000 francs), for his work on the role of a cellulolytic bacterium of the paunch in the digestion of cellulose in ruminants; Henri Stehlé (2,000 francs), for starting his work on the flora of Guadeloupe; André Thomas (2,000 francs), for work in experimental cytology; Voldemar Vilter (2,000 francs), for his work on the formation of the feather and its histological mechanism; Elisabeth Sylvain-David (2,000 francs), for the publication of a memoir on the Foraminifera.

GENERAL FOUNDATIONS

The Pierre Lafitte Foundation to Robert Bureau, for his researches on the origin of atmospherics in wireless telegraphy and on the use of electro-magnetic waves for recording observations made in captive balloons; the Millet-Ronssin Foundation between René Herpin (4,000 francs), for fitting up his laboratory of marine zoology, Fernand Obaton (3,000 francs), for his cinematographic studies of the movements of plants and the organization of a research centre of this nature at the Sorbonne, and Nicholas Théobald (3,000 francs), for his work on fossil insects.

THE VILLEMOT FOUNDATION

Aimé Cotton (40,000 francs), for his researches at Bellevue with the large electro-magnet of the Academy; Pierre Augustin Dangeard (10,000 francs), for his botanical studies; Roger Heim (12,000 francs), for the study of the cryptogam material collected by him in Madagascar and the publication of the results; Gaston Julia (5,000 francs), for the mathematical circle which meets at the Henri Poincaré Institute for the study of current mathematical questions; Laboratoire central d'électricité (10,000 francs), for the purchase of apparatus for researches on the determination of the ohm in absolute measure with high precision; Raoul Lecoq (10,000 francs), for his work on the study of vitamins in unbalanced food regimes; Père Lejay (10,000 francs), for work on solar phenomena at the Zi-Ka-Wei Observatory; Pierre Lesage (6,000 francs), for his researches on heredity in plants of the acquired physiological character, precocity; Berbard Lyot (30,000 francs), for his studies on the solar corona; Charles Mauguin (20,000 francs), for acquiring apparatus designed for the analysis of the crystalline structures of minerals; Jean Piveteau (10,000 francs), for resuming excavations in the celebrated Perrier deposit of Tertiary mammals; Hyacinthe Vincent (12,000 francs), for work relating to the etiology and pathogeny of certain infectious diseases.

The Charles Frémont Foundation to Jean Feytaud, for his researches on noxious insects and the organization of defensive measures against these enemies.

SPECIAL FOUNDATIONS

The Lannelongue Foundation to Mme. Gabriel Cusco; the Hélène Helbronner-Fould Prize to Mme. Marie Phisalix, for her work on snake poisons; the Girbal-Baral Foundation to Mlle. Yvette Cauchois (10,000 francs), for her studies on the spectrography of the X-rays, and Roger Gautheret 10,000 francs), for his studies on the culture of plant tissues.

Air Resistance of Passenger Trains

IN a paper read before the Institution of Mechanical Engineers on November 27, Mr. F. C. Johansen describes the results of experiments on the air resistance of passenger trains produced by modifying the shape and the smoothness of their surfaces, originally of L.M.S. pattern, in two different ways. In the first way, there was no general change in the external form of the coaches, but in the second way all coaches have smoothed bodies and faired under-carriages. The modifications introduced involved no marked alteration from the conventional appearance except for fairings on the engine, tender and the tail end of the last coach, the object being to show what reductions in air resistance could be achieved without any radical degree of stream-lining.

In the first way, the reduction of the longitudinal force was of the order of 20 per cent and decreases with the increase of the length of the train, since the reduction is mainly due to the locomotive and the first coach. In the second way, the reduction of the longitudinal force was much larger, being of the order of 50 per cent, the more effective lining being due to the all-smooth coaches. In the ideal train the corresponding reduction of the force would be about 75 per cent. The experimental results lead to the following recommendations and conclusions.

The air resistance of a train of conventional British type is equivalent to about 0·0016 V^2 lb. per ton of train weight, where V is the speed in still air in miles per hour. The air resistance can be reduced by 50 per cent without drastic departure from conventional design and by 75 per cent by ideal stream-lining With speeds of 100 m.p.h., the corresponding fuel economy would be about £1 per hour.

It was found that the air resistance was augmented by side winds, this effect being mainly due to frontal pressure on exposed surfaces. Curiously enough, the worst natural wind is not directly ahead but ranges from 30° to 60° on either side of this direction. Stream-lining measures are more effective in side winds than in direct winds. The gaps between the coach bodies of an ordinary train account for very little of the total air resistance. A surprisingly large proportion of the air resistance of a coach is contributed by the bogies and under-carriage structure. A fair shape at the tail end of a train reduces air resistance to an extent which is more marked the more complete the stream-lining.

The full benefit of measures to reduce air resistance can be realized only if the locomotive and the coaches are all stream-lined. The final conclusion the author arrives at is that the ideal stream-lined train is a continuous cylindrical body with well-rounded ends, having a polished surface free from external fittings and irregularities. A tubular surface, incorporating a stressed skin of sheet metal, would be very suitable.

Science News a Century Ago

The Polarization of Heat

WHEN Whewell was publishing his "History of the Inductive Sciences", Forbes wrote to him on January 31, 1837: "I feel gratified by the prominent place you have given to my experiments as bearing upon the theory of Heat. . . . But I must mention for yourself, if not for your book, that the discovery of the polarization of heat was not the necessary consequence of applying the thermo-multiplier to the investigation, which would have been a poor achievement, seeing it was another man's invention; but that Melloni had first applied the instrument to the tourmaline question, and answered in the negative (*Ann. de Chemie*, vol. 55); then Nobili, the inventor, attempted to repeat Berard's experiment with the most approved piles, and with results quite null (*Bib. Universelle*). So that I conclude that, when I published my experiments, the question of polarization was negatively answered by persons operating with every advantage which I possessed, and indeed seemed to be set at rest. My discovery was the application of mica as a polarizing substance, first by transmission, then by reflection; and I have shown that repeating Nobili's experiment—the same as Berard's and Powell's—the quantity of heat reflected from glass is so excessively minute that the errors might well equal the total effect. I think you have not mentioned total reflection and circular polarization.

"As to simple reflection, Melloni should be mentioned alone, but I claim double refraction."

The Zoological Society

AT a meeting of the Zoological Society held on February 2, 1837, the Rev. John Barlow being in the chair, it was stated that the receipts for the preceding month had been £2,146 12*s*. 2*d*. and the expenditure £1,019 6*s*. 3*d*. The number of visitors to the menagerie was 1,666, from whom £42 14*s*. was received, and the number of visitors to the museum 219, from whom £4 1*s*. was received. It was also stated that Mr. Yarrell had agreed to act as secretary without emolument, provided an assistant secretary was appointed, which the council had taken steps to do. The number of mammalia in the menagerie was 294, the number of birds 693 and the number of reptiles 27.

Dr. John Latham (1740-1837)

DR. JOHN LATHAM, an eminent ornithologist and archæologist, and one of the many celebrated truants of medicine, who died on February 4, 1837, was born in 1740 at Eltham in Kent, the son of a surgeon. He was educated at Merchant Taylors School and studied medicine under John Hunter. He practised for many years at Dartford, where he acquired a considerable fortune which enabled him to retire in 1796 to Romsey and devote all his energies to the study of archæology and ornithology. He was elected F.S.A. on December 15, 1774, and F.R.S. on May 25, 1775, and took a leading part in the foundation of the Linnean Society in 1788. He was the author of a "Synopsis of Birds" published in 1785, to which he added supplements in 1787 and 1802, and in 1790 brought out an abstract of this work entitled "Index Ornithologicus". Owing to financial losses, he was compelled to sell a great part of his library and museum, but with a rare courage, at the age of eighty-one years, he attempted to restore his fortune by an enlarged edition of his "Synopsis" entitled "A General History of Birds" which appeared between 1821 and 1828 in eleven volumes at Winchester, to which he had moved in 1820. He also took part in the revision of the second edition of Pennant's "Indian Zoology" published in 1793, and contributed several papers to the *Philosophical Transactions*, *Transactions of the Linnean Society* and *Archæologia*.

The subject of this note must not be confused, as was done in his obituary notice in the *Gentleman's Magazine* of July 1837, with another Dr. John Latham, Harveian orator in 1794 and president of the Royal College of Physicians in 1813–20.

Baron Desgenettes (1762-1837)

FEBRUARY 3 marks the centenary of the death of one of the most eminent medical men in Napoleon's army, Baron Réné Nicolas Dufriche Desgenettes. He was born at Alençon on February 23, 1762, and after studying medicine at Montpellier and Paris, he qualified at Montpellier in 1789 with a Latin thesis on the lymphatics. The next two years he spent at Montpellier, and then returned to Paris, where he enjoyed the society of some of the most illustrious savants of the time, such as Pelletan, Tenon, Sabatier, Condorcet, Vicq D'Azyr and Louis. On the advice of the last two, he joined the army, where in 1794 he first made the acquaintance of Napoleon. Two years later he was appointed physician and lecturer to the recently established Val-de-Grâce Military Hospital and Medical School, where he published several works on education and the treatment of war diseases, and took an active part in the foundation of two medical societies.

The next step in Desgenettes' career was his appointment by Napoleon as principal medical officer in the Egyptian and Syrian campaigns, in which he distinguished himself by his heroism and devotion to the sick and wounded. In 1802 he was made head of the Val-de-Grâce Hospital and shortly afterwards Inspector General of the Health Service of the French army. In 1805 he was sent to Spain to study the epidemic which was ravaging Cadiz, Malaga and Alicante. After taking part in the campaign in Prussia and Poland, he was made prisoner by the Russians, but was released by the Czar in gratitude for his care of the Russian wounded. At the battle of Waterloo he served as chief medical officer of the army and of the Imperial Guard. In 1822, owing to the sweeping changes made by the Frassinous régime, he was ousted from the chair of hygiene to which he had been appointed by the Directory, but was restored to it in 1830.

Desgenettes belonged to several learned societies, including the Paris Academy of Sciences, and was one of the first members of the Paris Academy of Medicine founded in 1820. He was a copious writer, his chief works being "Notes on the History of the Army in Italy" (1797), "The Medical History of the Army in the East (1802) and "Essays on Medical Biography and Bibliography" (1825).

University Events

CAMBRIDGE.—At Queens' College, Dr. G. P. McCullagh has been elected to a reserved fellowship. Dr. McCullagh is a former scholar of the Queen's University, Belfast, where he took his M.D. in 1931 and was Riddel demonstrator in pathology from 1932 until 1935. In 1935 he was appointed a University demonstrator in pathology at Cambridge.

GLASGOW.—The curators of patronage have appointed Dr. John W. S. Blacklock, lecturer on the pathology of diseases of infancy and childhood at the Royal Hospital for Sick Children, to the St. Mungo (Notman) chair of pathology at the Royal Infirmary. Prof. Blacklock will be, *ex officio*, pathologist to the Royal Infirmary.

A gift of £10,000 has been promised by Imperial Chemical Industries, Ltd., towards the cost of erecting the new Chemistry Institute at Gilmorehill. The cost is estimated at £200,000, and £118,000 has been assured by the Carnegie Trustees for the Scottish Universities.

Prof. E. B. Bailey has resigned from the chair of geology on his appointment to the directorship of the Geological Survey. His resignation will take effect from March 31, 1937.

LONDON.—The title of professor of geology (oil technology) in the University has been conferred on Mr. V. C. Illing, in respect of the post held by him at the Imperial College—Royal School of Mines; that of reader in physiology in the University on Dr. W. H. Newton, in respect of the post held by him at University College, and that of emeritus professor of education in the University on Sir T. Percy Nunn, on his retirement from the University professorship of education at the Institute of Education.

The degree of D.Sc. in horticulture has been conferred on Mr. H. V. Taylor, of the Imperial College—Royal College of Science; and that of D.Sc. in hygiene on Mr. Thomas Bedford, an external student.

OXFORD.—In Convocation on January 21 the honorary degree of D.Sc. was conferred on Dr. John D. Pollock, chairman of Metal Industries Limited, and of the British Oxygen Company, a Carnegie Trustee and benefactor to the Engineering and Physics Departments of the University.

Societies and Academies

Paris

Academy of Sciences, January 4 (*C.R.*, 204, 1–76).

LÉON LECORNU: The suppression of friction.

CHARLES ACHARD and MAURICE PIETTRE: Researches on the blood serum and muscular plasma in the fœtus.

LOUIS LÉGER and MLLE. MARCELLE GAUTHIER: *Graminella bulbosa*, a new genus of parasite entophyte of the larvæ of Ephemerids of genus *Bætis*.

CARLOS BIGGERI: The singularities of analytical functions defined by potential series.

GEORGES VALIRON: The variations of the modulus of integral or meromorph functions.

JEAN ROUBAUD-VALETTE: The use of hypercomplex numbers for establishing the equations of a relativist wave mechanics.

C. DAUZÈRE: The electrical conductivity of the air in a potash mine in Catalonia. From the experiments described it would not appear that potassium has any marked effect in increasing the ionization of the air above granite rocks.

FÉLIX EHRENHAFT: An experimental method for finding the errors of determination of the size of an object by the microscope.

RENÉ FREYMANN: The absorption spectra in the near infra-red of solutions of alcohols in ether or dioxan: oxonium formation. The disappearance of the (OH) band from the infra-red spectrum of alcohols in certain solvents (ether, dioxan, acetone) is interpreted as being due to the formation of an oxonium compound.

WILFRIED HELLER: An attempt at a classification of syneresis.

MLLE. SUZANNE ESTRADÈRE: Relations between indices of shock, cracking, the oxidation of hydrocarbons and its thermal effects.

ALBERT PORTEVIN and DIRAN SÉFÉRIAN: The influence of elements added to steel on the nitrogen absorption on fusion in the arc. The addition of carbon, manganese and silicon tends to reduce the absorption of nitrogen: special elements (except titanium) increase the absorption.

HENRI MOUREU and GEORGES WETROFF: The existence and the stability of the phosphonitril radical, PN, and the synthesis of phosphorus dichloronitride. Attention is directed to the analogy between the groups CN and PN. The paranitride $(PN)_n$, treated at about 500° C. with chlorine, does not give nitrogen and PCl_5 as might be expected, but an addition compound, $(PNCl_2)_3$.

GUSTAVE VAVON and ISRAËL CHILOUET: The bornylamines.

HENRI LONGCHAMBON: The characteristics of the palygorskites. The examination of a considerable number of specimens proves the close analogy between palygorskites and sepiolites, and confirms the hypothesis of Fersmann, that palygorskites are derived from sepiolites by the isomorphic replacement of magnesium by aluminium.

GILBERT MATHIEU: The two large tectonic units of Vendée.

HENRI V. VALLOIS: The duration of life in fossil man. The character utilized for the determination of the age was the synosteosis of the cranial sutures. Out of 173 subjects, only three appear to have survived more than fifty years. It is probable that in Palæolithic and Mesolithic times death coincided with the decline of the physical powers.

ROBERT KÜHNER: The nuclei and their divisions in the carpophore, especially in *Mycena*.

PIERRE P. GRASSÉ: Hemaphrorrhea, reflex reject of blood and air by the phymateid Acridians. When *Dictyophorus oberthuri* is handled, bubbles of froth appear at various points of the body, and this froth was found to be composed of blood and air.

GEORGES TEISSIER: The biometrical comparison of two species of the genus *Maia*.

JEAN ROCHE and RENÉ COMBETTE: The physical state of globin and molecular weight of the methæmoglobin obtained by the combination of protohæmatin with globin.

MLLE. CAMILLE CHATAGNON: The urinary elimination of bromine after ingestion of sodium bromide.

Yves Raoul: A new synthesis of hordenine. Tyramine is prepared by heating tyrosine under reduced pressure at 250° C., and this is methylated by means of formaldehyde in the presence of formic acid. At the boiling point, a 50 per cent yield of hordenine is obtained: at the ordinary temperature after a month, a 16 per cent yield is obtained.

Amsterdam

Royal Academy (Proc., 39, No. 10, Dec. 1936).

A. Kappers: The spread of primitive humanity and its links with the more differentiated races, as revealed by cephalic and cranial index curves.

L. S. Ornstein: Scattering of neutrons in matter (4).

J. Clay and H. F. Jongen: The absolute intensity of cosmic radiation at sea-level.

E. Cohen and A. K. W. A. van Lieshout: The influence of mechanical deformation on the velocity of transformation of polymorphous metals (3). The influence of metallic admixtures (2).

E. Dubois: Racial identity of *Homo soloensis* Oppenoorth (including *Homo modjokertensis* von Kœnigswald) and *Sinanthropus pekinensis* Davidson Black.

H. Brinkman: A continuously acting cloud-chamber.

E. Gorter, L. Maaskant and G. J. van Lookeren Campagne: The spreading of fibrinogen.

I. Lifschitz: Dissymmetrical synthesis in the case of complex metallic salts (2).

J. Westerveld: The granites of the Malayan tin-belt compared with tin-granites from other regions.

S. T. Bok: The branching of dendrites in the cerebral cortex.

T. Reichstein, E. Laqueur, I. E. Uyldert, P. de Fremery and R. W. Spanhoff: An active crystalline substance from the cortex of the suprarenal gland—corticosterone (see also Nature, Jan. 2, p. 26).

Geneva

Society of Physics and Natural History, November 5.

P. Rossier: (1) Observations of the comet 1936*a*. Photographs taken on July 23 and 29, 1936. The spectrum is of the normal cometary type, with carbon and cyanogen bands. (2) Relations between the colour index and effective wave-length of a star. Starting with an approximate expression for the index, the author shows that the colour index is a linear function of the effective wave-length, the coefficients of which bear a simple relation to the sensibility constants of the receivers considered.

Don Zimmet and Dubois-Ferrière: Vitamin C in human saliva, and paradentoses.

November 19.

P. Rossier: (1) Determination of the sensibility constants of receivers of radiant energy by means of scales of colour indices and of effective wave-lengths. The application of the theory of first approximation of the author to a particular case gives constants of the same order of magnitude as those determined by other methods. (2) Apparent character of a variation of a photographic extinction with atmospheric humidity. The variation of the sensibility of photographic plates with the humidity explains an extinction which the author had thought could be attributed to atmospheric absorption. (3) The star *BD* 4114 = *HD* 193092. Photographic observations of this star now suspected to be variable.

L. Meyer: Visual observations of Nova Lacertæ 1936.

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 621–672, November 15).

Edwin Hubble: Effects of red shifts on the distribution of nebulæ. A discussion of five surveys providing homogeneous counts of nebulæ leads to two opposed views. Assuming the displacements towards the red in the spectra of nebulæ are velocity shifts, the universe is closed, very small, packed with matter to the threshold of perception, and the rate of expansion has been slowing down. If the displacements are not velocity shifts, then the universe approximates to a homogeneous expanding model in which spatial curvature and rate of expansion are inappreciable. Presumably the 200-in. reflector will provide definitive tests between these models.

Felix G. Gustafson: Inducement of fruit development by growth-promoting chemicals. Such substances as indole-propionic, -acetic, and -butyric acids and phenylacetic acid, when applied in lanoline to the cut style of an ovary, cause growth resembling that resulting from fertilization, but no seeds were ever found. Mature fruits without seeds were produced in tomato, petunia, *Salpiglossus* and pepper.

William J. Robbins, Virginia B. White, J. E. McClary and Mary Bartly: Importance of ash elements in the cultivation of excised root tips. The addition to a nutrient solution of agar or filter paper, or water-extracts or the ash of either, even for a limited period (24–48 hours) increases the average growth of root tips 5–6 times. It is suggested that, since root tips have little store of ash elements, they should be useful for the study of mineral elements essential for growth in higher plants.

C. B. Davenport and William Drager: Growth curve of infants. It resembles that of a monomolecular autocatalytic reaction, but is modified by a period of accelerated growth at 6–8 months, and a period of retarded growth at 16–18 months. The growth curve is not controlled, even early in life, by any single reaction.

Donald F. Jones: Mutation rate in somatic cells of maize. While such mutations are an important factor in aberrant development, they are much less frequent than changes produced by somatic segregation.

Curt Stern and Dorothy Doan: A cytogenetic demonstration of crossing-over between *X*- and *Y*-chromosomes in the male of *Drosophila melanogaster*.

G. A. Miller: Number of the Abelian groups of a given order.

Chester Stock: Titanotheres from the Titus Canyon formation, California. This formation is of Oligocene age and occurs in the Death Valley region. Two specimens, one forming a new genus and species, are described and illustrated.

E. Wigner: Saturation of exchange forces.

A. van Harreveld and C. A. G. Wiersma: The triple innervation of the crayfish muscle. Two of the fibres identified appear to give contraction and the third inhibits it.

S. S. Stevens and E. B. Newman: The nature of aural harmonics. The aural harmonics were observed directly by analysing the electrical potential generated in the cochleas of animals by means of an oscillograph and a wave-analyser.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, January 30

British Mycological Society, at 11.—(at University College, Gower Street, London, W.C.1).—Symposium on "Antagonism of Micro-organisms" to be opened by Prof. W. Brown, discussion to be opened by G. Samuel.

Monday, February 1

Society of Engineers (at Geological Society), at 6.—A. S. E. Ackermann: "Scientific Paradoxes and Problems".

Armstrong College, Newcastle-upon-Tyne, at 6.30.—Prof. M. Polanyi: "The Transition State in Chemical Reactions" (Thirty-sixth Bedson Lecture).

Wednesday, February 3

Institution of Mining Engineers, at 11.15.—Annual General Meeting to be held in the rooms of the Geological Society, Burlington House, Piccadilly, London, W.1.

Queen Mary College, at 4.—Prof. F. E. Fritsch, F.R.S.: "Special Aspects of Algal Ecology" (succeeding lectures on February 10, 17, 24 and March 3).*

Thursday, February 4

Chemical Society, at 5.—Discussion on "The Transition State in Reaction Kinetics" to be opened by Prof. M. Polanyi.

Friday, February 5

Society of Chemical Industry (Glasgow Section).—Dr. J. T. Dunn: "The Service of Science to Industry" (Jubilee Memorial Lecture).

Royal Institution, at 9.—Dr. Stanley Kemp, F.R.S.: "Animal Life in the Antarctic".

Saturday, February 6

School Nature Study Union, at 3.—Thirty-third Annual Conference to be held at University College, Gower Street, London, W.C.1.

Prof. Walter Garstang: "The Songs of Birds".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Head of the Merton Central Evening Institute, Merton Park, S.W.19—The Registrar (January 30).

Assistant Tobacco Officer in the Department of Agriculture and Lands, Southern Rhodesia—The Official Secretary, High Commissioner for Southern Rhodesia, Rhodesia House, 429 Strand, W.C.2 (January 30).

Forestry Assistant (Grade III) in the Forest Products Research Laboratory, Princes Risborough—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (February 3).

Assistant Lecturer in Science and Mathematics in the Liverpool City Technical College—The Director of Education, Education Offices, 14 Sir Thomas Street, Liverpool, 1 (February 5).

University Lecturer in Anatomy in the University of Cambridge—Dr. F. J. W. Roughton, Department of Physiology (February 6).

Lecturer in Industrial Chemistry in the Cardiff Technical College—The Director of Education, City Hall, Cardiff (February 6).

Instructor Lieutenants (honours degree in mathematics, physics, chemistry or engineering) in the Royal Navy—Director, Education Department, Admiralty, 5 Millbank, London, S.W.1 (February 8).

Mechanical and Electrical Engineers (temporary) in the Directorate of Works and Buildings, Air Ministry—Secretary (W.B.9), Air Ministry, Adastral House, Kingsway, W.C.2, by postcard (February 8).

Senior Mechanical Assistants and Senior Electrical Assistants (temporary) in the Air Ministry—Secretary (W.B 9), Air Ministry, Adastral House, Kingsway, W.C 2, by postcard (February 8).

A Physicist in the Aeronautical Inspection Directorate, Test House, Kidbrooke, London, S.E.3 (non-metallic materials section)—Secretary, Air Ministry (S.2.D), Adastral House, Kingsway, W.C.2 (February 8).

Assistant Executive Engineer in the Public Works Department of the Federated Shan States, Burma—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2, by postcard (February 11).

Assistants (Grade II and III) at the Royal Aircraft Establishment, South Farnborough, Hants; *Ref.* 336*A*, for the writing of technical and descriptive matter; *Ref.* 327*A*, to assist in bench and flight testing, *Ref.* 314*A*, for structural strength and aerodynamic calculations—Chief Superintendent, Royal Aircraft Establishment, South Farnborough, stating appropriate reference number (February 12).

Director of the Fitzwilliam Museum in the University of Cambridge—The Vice-Chancellor (February 23).

Lecturer in Physics and Mathematics at the Croydon Polytechnic—Education Officer, Education Office, Katharine Street, Croydon (February 27).

Director of the Laboratory of the Freshwater Biological Association of the British Empire—Prof. P. A. Buxton, London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1 (February 28).

Stevenson Lecturer in Citizenship in the University of Glasgow—Secretary (February 28).

Senior Lecturer in Social Anthropology in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (March 31).

Teacher of Mathematics and Science in the Junior Technical School of the Northampton Polytechnic, St. John Street, London, E C.1—The Secretary.

University Lecturer in Anatomy in the University of Cambridge—The Professor of Anatomy.

Assistant Civil Engineers in the Civil Engineer-in-Chief's Department, Admiralty—Civil Engineer-in-Chief, Admiralty, S.W.1 (mark envelopes "A C.E Decr.").

Civil Engineering Assistants in the Drawing Office, Admiralty, Civil Engineer-in-Chief's Department—Civil Engineer-in-Chief, Admiralty, S.W.1, marked D O.X.

Official Publications Received

Great Britain and Ireland

Check-Lists of the Forest Trees and Shrubs of the British Empire. No. 2: Nyasaland Protectorate. Edited by Dr J. Burtt Davy and A. C. Hoyle. Pp. 111. (Oxford: Imperial Forestry Institute.) [121

Saorstát Éireann: Roinn Talmhaíochta (Department of Agriculture): Brainse Iascaigh (Fisheries Branch). Report on the Sea and Inland Fisheries for the Year 1935. (P. No. 2357.) Pp 32. (Dublin: Government Publications Sales Office.) 9*d*. [121

Ministry of Health. Midwives Acts, 1902 to 1926. Report on the Work of the Central Midwives Board for the Year ended 31st March 1936. Pp. 12. (London. H.M. Stationery Office) 2*d*. net [131

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 44: Fertilization and Proembryo Formation in *Sequoia*. By W. J. Looby and J. Doyle. Pp. 457–476+plates 13–14. 2*s*. 6*d*. Vol. 21 (N.S.), No 45: The Convection of Heat and Materials in the Stem of a Tree. By Prof. H. H. Dixon. Pp. 477–486. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd) [141

Other Countries

U.S. Department of the Interior: Geological Survey. Bulletin 847–B: The Rosebud Coal Field, Rosebud and Custer Counties, Montana. By W G Pierce. (Contributions to Economic Geology, 1934–36) Pp. v+43–120+plates 5–21. 1 25 dollars Bulletin 864–C: Mineral Deposits of the Ruby–Kuskokwim Region, Alaska. By J. B. Mertie, Jr (Mineral Resources of Alaska, 1933.) Pp. v+115–245+plates 2–7. 25 cents. Bulletin 870: Geology and Ore Deposits of the Bayard Area, Central Mining District, New Mexico. By Samuel G. Lasky. Pp. vi+144+17 plates. 80 cents. Bulletin 871: Mineral Resources of the Region around Boulder Dam By D. F. Hewett, Eugene Callaghan, B. N. Moore, T. B. Nolan, W. W Rubey and W. T. Schaller. Pp. vi+197+14 plates. 45 cents. (Washington, D.C.: Government Printing Office.) [41

Skrifter utgitt av det Norske Videnskaps-Akademi i Oslo. 1. Mat.-Naturv. Klasse, 1936, No. 7: Land-Locked Waters; Hydrography and Bottom Deposits in Badly-Ventilated Norwegian Fjords, with Remarks upon Sedimentation under Anaerobic Conditions. By Kaare Munster Strøm. Pp. 85+9 plates. (Oslo. Jacob Dybwad.) 9.50 kr. [81

U S. Department of Agriculture. Circular No. 408: Wireworm Infestation Trends accompanying certain Crop Rotations in the Pacific Northwest By F. H. Shirck and H P. Lanchester. Pp. 10. (Washington, D.C.: Government Printing Office.) 5 cents. [81

Indian Forest Records (New Series). Vol. 2, No. 1: A Survey of the Damage to Teak Timber by the Beehole Borer (*Xyleutes ceramica* Wlk.) throughout the Main Teak-bearing Forests of Burma (Lepidoptera–Cossidæ). By D. J. Atkinson. Pp. 98+12 plates. (Delhi: Manager of Publications.) 4.10 rupees; 7*s*. 9*d*. [111

The Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1935, togethre with the Twenty-ninth Annual Report of the Central Committee of the Association for the Year ending 31st March 1936. Pp. 89. (Coonoor: Pasteur Institute.) [111

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Location of Industries

THE attention which, in the recent reports of the Commissioners for the Special Areas, has been directed to the attraction to, and the stimulation of, industry within those areas is only a particular example of the increasing interest which is being taken in the location of industry in Great Britain. The importance of rehabilitating the depressed areas of the country, whether those specially scheduled in the Special Areas Act or those other 'black spots' of the country such as the weaving and coal-mining areas of Lancashire, where unemployment is at least as great as in some of the Special Areas, and the signs of revival even less, is only one of many considerations bringing this matter to the front.

In his third report, the Commissioner of the Special Areas in England and Wales, while repudiating the idea of direct State control of the location of industry, advocated some measure of indirect control in the proscription of the location of industry in the London area, except for very definite and special reasons. Although this suggestion was intended to benefit the Special Areas, the argument rested at least as much on the relative vulnerability of London and the home counties, and the latter factor is obviously one of which increasing account must be taken unless we succeed in evolving a much more promising international order.

At the same time, the location of industry, like the planning of cities and towns, assumes greater importance from the increasing danger of destroying by indiscriminate building the amenities and beauty of our countryside. Ribbon-building has already done irreparable damage on both highways and coast, and unless effective control is exercised in these matters, as in questions of atmospheric or riparian pollution, little may be left to us of the rich heritage of rural England which was ours at the commencement of this century. Finally, transport considerations themselves are enforcing the consideration of the location of industry, so as to avoid the economic and social wastefulness and strain upon health involved in carrying immense numbers of tired people long distances to and from their work in overcrowded vehicles occupied only for a small fraction of the day.

Town planning, the location of industry, national health and defence, and the preservation of rural England, are in fact essentially different facets of one problem calling for long-range statesmanship and resolute scientific investigation. The strong criticism which the Government proposal to build an aircraft factory at White Waltham, near Maidenhead, received in the House of Commons, and the indignation which it aroused elsewhere, was due as much to the Government's countenancing Departmental violation of this principle as to the threat to the amenities of the Thames valley and the disregard of the claims of the Special Areas and the Commissioner's recommendations. Happily, the volume of protest, from all parties, was such that on January 26 Mr. Baldwin announced that the scheme had been abandoned, and that a new site will be sought in Lancashire.

It is not the least of the services performed by Mr. Malcolm Stewart, until recently Commissioner for the Special Areas, that he has so repeatedly emphasized the necessity for considering these areas as a problem of economic and social redevelopment on a very wide basis, calling for a definite national policy. The point is further stressed in an admirable broadsheet entitled "The

Location of Industry" which has just been issued by Political and Economic Planning (P E P) It is not merely that we are tending to consider the wider economic and social costs of different industrial policies and to realize the heavy offset to prosperity in the Midlands and South represented by wretched and paralysed groups of communities in Wales and the North. Increasingly we are coming to appreciate that there are definite opportunities of reconstruction and re-planning in the present situation, which, if wisely used, may involve almost as great benefit to the whole community as to any special section for whose benefit they are immediately initiated.

The Government itself has repeatedly emphasized the experimental character of the Special Areas Act. From the experience of the selected areas was to be crystallized all those methods which could be adopted in other areas suffering from heavy unemployment. The Special Areas were essentially a large-scale social experiment. On this point the valuable study "Re-adjustment in Lancashire"*, prepared by members of the Economics Research Section of the University of Manchester, bases one of its most powerful arguments for inclusion of the weaving districts of Lancashire within the Act. The present limits of the Act are arbitrary and convenient, rather than based rationally on economic or geographical facts, but can be justified for the purpose of an experiment so long as the experiment is representative. "Re-adjustment in Lancashire", however, seizes upon the point that the four areas so far selected are not representative of conditions in the weaving districts, because, unlike all the Special Areas, the rate of unemployment there is higher for women than for men.

The main importance of this most recent survey by the University of Manchester lies in the analysis and exposure of conditions in the weaving district. The case for including this area to obtain data for conditions not yet covered by districts already scheduled is presented with all the thoroughness, lucidity and impartiality which we have learnt to associate with the work of this Economics Research Section. There are, however, other matters bearing on the location of industry in Lancashire to which the investigation also directs attention. One of its principal suggestions is in regard to the establishment of a trading estate and the provision of capital at low rates to provide a favourable environment for local industrial enterprise, particularly with the view of attracting industries employing women. Special attention is directed to the possibility of the district becoming a large and growing centre for the clothing trades.

Former strictures upon blind-alley work, casual employment and the exploitation of young persons as well as of the unemployed in Lancashire generally are repeated, and the social evils which flow from an industry continually discarding its workers as they become older are still far from receiving the attention they demand. The possibilities and limitations of road construction in the area in regard to unemployment, of cleaning up the face of the country by demolishing derelict mills and similar measures are also considered, and the investigation makes it clear how little the re-armament programme can contribute to the solution of Lancashire's most intractable problems. This sober but impressive marshalling of the facts should at least assist to secure fair consideration for an area much greater in size than one or two of the Special Areas, and no less deserving.

If the investigation we have just discussed reveals the limitations of the present Special Areas Act, and the necessity for fresh schedules or for the rapid extension of the experience gained to other 'black spots' of unemployment, the need is emphasized for a national policy and above all for the consideration of the location of industry by creative minds free from prejudice and competent to take into account all the many aspects of national and social policy and well-being involved. The case for a national policy is the more imperative since its realization in practice depends upon the utilization of the opportunities of reconstruction and development afforded not merely in the Special Areas but also in special emergencies.

The most cursory glance at this problem should indicate how interlocked is this whole question of the location of industry and national reconstruction, and the importance of a central authority powerful and unbiased enough to secure action on behalf of the national and not sectional interests. The comparison cited in the P E P Broadsheet between the treatment of the Special Areas and the subsidizing of the sugar beet industry alone illustrates how disproportionate is our present policy, and the need for some wider co-ordination and vision. The wisdom of subsidizing the sugar beet industry has been attacked on scientific grounds, but however great the intrinsic merits of the sugar beet subsidy, it is difficult to defend the subsidizing in this way of a population of about half a million, in comparison with the treatment of a population more than eight times as great in the Special Areas and in considerably more desperate straits. Drift from the depressed areas will only be checked as it is made worth while for a sufficient proportion of the natural leaders who are thrown up in each area to stay in it happily, doing constructive work instead of becoming narrowed and embittered, and quitting it in favour of somewhere more attractive.

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* Re-adjustment in Lancashire. By Members of the Economics Research Section, University of Manchester. Pp vii+137. (Manchester: Manchester University Press, 1936.) 4s. 6d. net.

The Special Areas are merely a particularly acute and painful example of the growing disequilibrium and sapping of vitality created by the excessive expansion of the metropolis. Moreover, years of mismanagement and neglect rather than sudden and unforeseeable misfortune are responsible for tragedies such as those of the coal-mining, cotton, fishing and sections of the agricultural industries, together with the areas mainly dependent upon them. The conclusion is inescapable that in future all major adjustments of policy should be examined not only with reference to their effects on the industry or other activity concerned but also with reference to their effects on the balance of national development. A constructively-minded Government, ready at the first signs of trouble to invest money in development work such as trading estates and new or improved communications, to bring in fresh industries or marketing measures and research to stimulate backward industries, could probably have salvaged many million pounds of expenditure in the last dozen years which has led the industry or area concerned no nearer a permanent self-supporting basis. "Re-adjustment in Lancashire" and the P E P Broadsheet are yet further reminders of the part which scientific investigation must play in the development of economic, social and industrial policy, and of the dire peril which attends neglect or failure to secure a more balanced national development and reconstruction in which internal strains between different areas and industries are minimized and a reasonable measure of social justice maintained.

The Science of English History

Roman Britain and the English Settlements
By Prof. R. G. Collingwood and J. N. L. Myres. (The Oxford History of England.) Pp. xxvi+515. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) *12s. 6d.* net.

THIS volume on Roman Britain and the English settlements is the first (though not the first to be published) in a series of fourteen covering the history of England, edited by Prof. G. N. Clark. The full-dress treatment of the theme commences with Cæsar's invasion, but this is preceded by a thirty-page introduction in which the geographical background and the prehistory of Britain are sketched in. Prof. Collingwood's contribution carries us through the Roman period into the fifth century; there Mr. J. N. L. Myres picks up the story, discussing that same century from the Anglo-Saxon point of view, and then the general problems of the English Settlement.

In 1910 Sir Charles Oman produced his very successful "History of England before the Norman Conquest". Though the new History is on a slightly larger scale, the two works are closely comparable, and it is interesting to see how they differ. Confining ourselves for the moment to the Roman period, Oman's survey is mainly military and political, based on documentary evidence (including coins and inscriptions). Collingwood, on the other hand, devotes more than one third of his pages to economic history and cognate studies. It is archæology that has made this possible in a period in many ways so ill-documented. The remarkable progress made by the science of the spade in recent years, and especially since the Great War, is familiar to all; a single contrast will bring it home. Some seventeen years work at Silchester, completed in 1906, laid bare the plan of a Romano-British town, but nothing else; on the other hand, three years work at Verulamium in 1932–34 revealed the history of an experiment in urbanization extending over nearly half a millennium, its growth, changes, vicissitudes and decay. On the military side, again, the post-War labours of field archæologists on the Roman Wall, at Richborough, Caerleon, Segontium and many other sites have given a new vitality and precision to the history of the army. The vigour of the development of archæology is also shown by the extent to which the natural sciences are drawn into the orbit of its research, and by the success with which novel techniques such as air photography are being exploited. All such aspects of field work are reflected in this volume, and help to mould its character.

Prof. Collingwood for many years has been one of the leaders of Roman studies in Great Britain, and speaks in this book with authority; he writes with that feeling for style which fortunately has never deserted the English historian. Special attention is due to his study of the interplay of life in town, in villa and in hamlet, and his exposition of the two agricultural methods employed in Roman Britain. The shift of the economic centre of gravity from town to countryside in the third century A.D. is seen to be a fact of prime importance.

Mr. Myres reverts to J. R. Green's method of approach, laying emphasis on the topography of Britain in relation to the English settlement. Recent studies in place-names and the history of institutions, and the attention now being devoted to Anglo-Saxon antiquities in their stylistic and distributional aspects, provide him with a range of data far wider than Green controlled. But the unresolved differences of opinion among contemporary scholars on many important aspects of his theme, the publication of Mr. R. H. Hodgkin's "History of the Anglo-Saxons" while his own was in progress, and the insufficiency of the available evidence, direct or indirect, combine to render his contribution less assured than that of his colleague. Nevertheless, it is an independent and acute study, embodying original research into the problems of a peculiarly difficult period; the section on the "Character of the Conquest" may be selected for special commendation.

To treat archæological material in the traditional historical manner, that is, with maps but without illustrations, offers a difficulty not hitherto surmounted. It was attempted for the "Cambridge Ancient History", but failed; for supplementary volumes of plates were issued at a later date. In this History, Prof. Collingwood's challenging thesis on Celtic and Roman art loses much from the lack of pictures; Mr. Myres, despairing of indicating verbally the quality of Anglo-Saxon art, "reluctantly omits" a review of the subject.

We have mentioned maps as essential to a history; and it is regrettable that the chief map in this book—that of Roman Britain—should be inadequate. The methods of symbolism adopted fail to bring out clearly the limits of the highland and the lowland zones of Britain, the importance of which is emphasized throughout the book; while the areas of naturally open country in the former zone (which it must be presumed the white areas on the map are meant to indicate) can scarcely be accepted as probable by anyone familiar with the geology and topography of, for example, Wales and the south-western peninsula.

CYRIL FOX.

Reactions in Uganda

Africa Answers Back
By H.H. Prince Akiki K. Nyabongo. Pp. x+278. (London: George Routledge and Sons, Ltd., 1936.) 7*s*. 6*d*. net.

As the work of a prince of the blood-royal of Uganda, who has been educated at Yale and Oxford, "Africa Answers Back", although in form a fictional biography, is a work which deserves more than casual consideration. It is significant as the mental reaction of an educated African to his contacts with European civilization.

In outline, the story runs: A son is born to an important chief, who has three hundred and seventy-five wives. The boy is educated in a missionary, and later in a private venture, school. His father dies in an epidemic of smallpox, which is stamped out by wholesale vaccination performed by a German doctor from Kiziba, Tanganyika, and doctors summoned hurriedly by drum from Mombasa and Zanzibar. The son is elected chief and introduces reforms, but is compelled to revert in part to traditional ways.

This thread of the story will indicate its limitations. The point of view is aristocratic. No attention is given to the social and economic problems of the people, which indeed in some ways are less insistent in Uganda than elsewhere in African administration. However, as a picture of the functioning of a great polygamous household and of the duties and ceremonial of its individual members, the book is more illuminating, even if less comprehensive, than most formal treatises.

Three contrasted points of view are presented with no little skill. First there is that of tradition, represented by the old chief, who, though open-minded up to a point towards the innovations Christianity would wish to introduce, is baffled by its inconsistencies, and convinced by his own line of argument that customary ways such as, for example, polygamy and birth control, are best for his generation, whatever a later generation may decide to do. Secondly, there is the missionary point of view, presented in a form rather out of date now, and, of course, as seen through native eyes. Thirdly, there is the point of view of the educated native, seen as it develops from the tribal attitude of the immature boy into the sophisticated and superficially acute outlook of the young man, who accepts the science of Western civilization as in most, but not all, respects superior to his own system, but is incapable of taking up the attitude of faith of that civilization.

The closing note is pessimistic. The missionary retires defeated. The hero, as a reformer, is regarded askance by his people, and as a monogamist, his single wife proving a shrew, is forced at her insistence to marry three or four more wives for the sake of peace in which to work out his plans.

Music in Films

Film Music:
a Summary of the Characteristic Features of its History, Aesthetics, Technique; and possible Developments. By Kurt London. Translated by Eric S. Bensinger. Pp. 280 +28 plates. (London: Faber and Faber, Ltd., 1936.) 12*s.* 6*d.* net.

IT is characteristic of our times that, while the abstract and practical aspects of transient political trends are over-documented in book form, the corresponding aspects of such permanently revolutionary factors in everyday life as broadcasting and the sound film are, on the whole, treated only in an ephemeral literature of specialized circles.

The attempt to make a balanced estimate of the inseparable technical and æsthetic problems of the sound film has not yet been made with any considerable measure of success. In the volume under notice, Dr. Kurt London succeeds in making us realize the profundity of the problems, but does not attain balance. He is described as a thinker, a musician and a technician; but his thinking stops short of the need for compelling the technician to be the slave of the musician. His error of outlook is shared by many distinguished musicians; it is implicit in Mr. Constant Lambert's introduction to this book, in which he says—apparently with some surprise and disappointment—that "Wireless has not so far compensated the composer by providing him with a new art form".

The book is in six parts, dealing in turn with "Origins of Film Music", "Music with the Silent Film", "Mechanical Interlude", "The Sound Film", "Training the Rising Generation" ("On the Establishment of a Microphone Academy") and "The Future of the Sound Film". On the technical side, the good description of the musical instruments in the sound film orchestra, and the good account of the limitations in reproduction imposed by the microphone and the rest of the recording and reproducing equipment, are in strong contrast with the poor exposition of the physics of recording. The author's brief treatment of the comparatively new electro-musical instruments, the *Ondium Martenot*, the trautonium and the Neo-Bechstein piano, is also good.

Dr. London's æsthetic judgment is sound, within its limitations. But he accepts far too easily the shackles of the average acoustic plumbing of the moment, and he neglects some of the most significant technical work of the decade. His imagination is misapplied in trimming the musician's mind and methods to fit the defects of the commercially available technique. He forgets that when babies and cradles do not fit, it is better to operate on the cradle. From this point of view, his interesting account of "microphone instruments", that is, "those constructed with a view to the special requirements of the microphone", is deplorable, as putting over-emphasis on this submission to the treason of the plumbers.

There is no valid ground for the assertion that an extension beyond 15,000 cycles per second of the frequency range reproduced would be of revolutionary æsthetic importance; the attention devoted to the sham 'stereoscopic' tone treatment of the French school is the more disproportionate because the conclusive experiments of the Bell Laboratories on binaural listening are not mentioned at all. It is firmly established by these experiments that true 'stereoscopic' listening, even with a very limited frequency range, is more satisfying than single-channel listening with a virtually complete frequency range. This omission emphasizes, too, the singular absence from the book of any reference to Stokowski, who has collaborated so fruitfully with the Bell Laboratories, not only on binaural listening but also on the utilization of the new powers which electrical reproduction puts at the disposal of the musician, in part-compensation for the disservices which it does him in other respects. Of all these disservices the greatest, in everyday practice, is the simple amplitude distortion which is not inherent in present technique, which is not mentioned by Dr. London, but makes a visit to any single cinema theatre definitely painful to a musicianly or acoustico-physical ear.

The author and the translator are responsible for some offences to the King's and the physicist's English; he uses the words "resonance", "tone" and "dynamic" inaccurately, as many people will.

It is perhaps too late to hope that the "recordist" may join the mortician, but it is not too late to kill the adjective "microgenic". The translator comes near distortion, for the ordinary reader, when he renders "Plastik" as "plastic", and goes beyond it for the ordinary viewer when he talks of a film called "President Vanisher".

The author's philosophy of film æsthetic is somewhat superficial, a fair recognition of the validity of expressionism in the music being marred by over-insistence on representationalism in the picture. To talk of the hand-written sound-track, with its vast possibilities, at some length is wise and discriminating ; to talk of it as "quite unreal sound", "a magic realm created out of nothing" is nonsense. The Beethoven symphonies were "quite unreal sound", "a magic realm created out of nothing", in exactly the same sense ; the orthodox score, the photographed sound track, and the hand-written track are all of them arbitrary notations containing, for the initiated, the prescription for producing real sound out of unreal sound.

Dr. London's book is the more welcome in giving so much enjoyable ground for disagreement ; it is attractive, suggestive and educative. No one who recognizes the power of the sound film in modifying the taste of the citizens of to-day and to-morrow can afford to neglect it. Its attractions are enhanced by the many facsimile reproductions from film-music scores.

Science in Recent Years

The March of Science : a First Quinquennial Review, 1931–1935. By Various Authors. Issued under the authority of the Council of the British Association for the Advancement of Science. Pp. viii +215. (London : Sir Isaac Pitman and Sons, Ltd., 1937.) 3*s*. 6*d*. net.

THIS book is the first of a new series of volumes wherein, it is intended, the advances made in the chief branches of pure science over a period of five years will be described in plain language by experts. These books are intended both for ordinary readers of scientific tastes and for those workers in any one branch of science who would like to learn with a minimum of trouble what is new and important in other branches. The style and difficulty is, in consequence, somewhere between those of the illustrated popular expositions and the learned reports for the specialist in his own science. Editors and publishers have attempted this kind of books in the past, sometimes with success, but it is good news that the Council of the British Association with its wide knowledge of the right contributors has now begun this work. The chief difficulty of such enterprises is, of course, in getting the best men to take the peculiar trouble which semi-popular exposition demands.

The present volume deserves a warm welcome from readers. It is rare that a permanent work, so homely in appearance, has such distinguished contributors. There are no illustrations. The price is modest. There are sixteen chapters or sections (varying from 2,500 to 6,000 words in length) by different writers, each of whom is distinguished in his own subject. Nearly all of these have done the journeyman work of compiling and writing satisfactorily, and some have done it very well. On the whole, the more eminent authorities have done their tasks better than the less. The sections on cosmical physics (Sir James Jeans), economic science (Sir Josiah Stamp), biochemistry (Sir F. Gowland Hopkins), and science and industry (Sir Frank Smith) are models of the thing required—apposite, informed, fair, well-expressed, neither too technical nor too popular for the readers envisaged. The important discoveries or developments in these subjects in the past five years are singled out and well described. The reader who has, perhaps, heard vaguely of some of these in talk can now know where the main interests of a diversity of subjects lie, what has been proved, what is still speculation, whither progress is tending and how good are prospects. Good also, although less distinguished, are the sections on geology (P. G. H. Boswell), geography (G. R. Crone), educational science (A. Gray Jones), agricultural science (J. A. S. Watson) and physiology (L. E. Bayliss).

It is chiefly in the sections on physics and physical chemistry that a bareness of treatment is revealed. Chemistry has sections on 'physical' and 'organic'. The former, however, should more properly have been called 'general'. The section is good as that, but it contains little of the advances in subjects like gas reactions, photochemistry, solution, catalysis. The writer on physics had a peculiarly hard task within his limits of difficulty and space. (Two sections might well have been allotted to this large field.) Unfortunately, however, he opened with an account of nineteenth-century physics, excellent in itself but largely irrelevant there, and so left himself too little space for some of the important revelations of the past five years. Dr. de Beer, on the other hand, has perhaps erred by excess of zeal. Compared with the other sections, his on zoology is too full, too well documented. But it cannot be criticized on other grounds.

A. S. R.

Preparation of Scientific and Technical Papers

By Prof. Sam F. Trelease and Emma Sarepta Yule. Third edition. Pp. 125. (Baltimore, Md.: Williams and Wilkins Co; London: Baillière, Tindall and Cox, 1936.) 7*s*.

MANY useful hints on the composition of scientific papers, and methods of presenting observations and results logically and precisely, are given in this small volume. Much practice, combined with a sense of literary values, are required for the production of a scientific paper to satisfy all the canons of style which writers are expected to acknowledge. There are, however, many typographical and other conventions which every author should know; and it is particularly in guidance as to the use of these that this book will be helpful.

We note that in the list of abbreviations of common weights and measures, and elsewhere in the book, "cc" is given for cubic centimetre; but, as actually two words are abbreviated, "c.c." is the correct form. The classified titles of a number of scientific periodicals are given in another list, but we miss several British publications of greater importance than some others included. Under anthropology, *Africa* is included but not the *Journal of the Royal Anthropological Institute*; and among other omissions are: the *Quarterly Journal of Microscopical Science*, the *Journal of the Chemical Society*, and the *Philosophical Magazine*, while *Science Progress* is wrongly described as "Science Progress in the Twentieth Century". It is very difficult to make up a list of this kind, and impossible within the space of about nine pages to give more than a few representative titles of the many thousands of scientific periodicals now published. We suggest, however, that, before the next edition of the book is issued, the lists of journals grouped under headings relating to various branches of science should be submitted to competent authorities in each branch for revision.

The King's England:

a New Domesday Book of 10,000 Towns and Villages. (1) Enchanted Land: Half-a-Million Miles in the King's England. By Arthur Mee. Pp. xviii+291+65 plates. 7*s*. 6*d*. net. (2) Kent: the Gateway of England and its Great Possessions. By Arthur Mee. Pp. xii+506+65 plates. 10*s*. 6*d*. net. (3) Warwickshire: Shakespeare's Country. Edited by Arthur Mee. Pp. xi+308+49 plates. 7*s*. 6*d*. net. (4) Lancashire: Cradle of our Prosperity. Edited by Arthur Mee. Pp. viii+326+49 plates. 7*s*. 6*d*. net. (London: Hodder and Stoughton, Ltd., 1936.)

THESE four volumes are the first instalment of a survey of England by counties, which aims at describing in detail every town and every village in the country which is worthy of interest on account of its present economic or social importance, its past historical or personal associations, or its retention of features of artistic, antiquarian or cultural significance. The author has had the assistance of a body of expert helpers; and some six years have been spent in preparation. The time is not too long, as some ten thousand villages, it is said, have been visited. The collection of the photographs alone, if the illustration of the first four volumes is a fair sample, must have been a stupendous undertaking, especially as it is evident that on the whole a high standard has been attained.

Except in the first volume, which is a generalized epitome or survey of the topics with which the series deals as a whole, the arrangement of the material collected is that of the gazetteer. Each city, town or village visited appears in alphabetical order, the counties being characterized in a brief introduction, in which what is taken as the keynote is particularized, justified and expanded, though not at too great length. Kent, for example, is termed "the gateway of England", Warwickshire, "Shakespeare's country", and Lancashire, "the cradle of England's prosperity".

Yet in none of these volumes is this dominant note allowed to overshadow other interests. In Warwickshire, Birmingham and Coventry are not neglected, nor is Lancashire's industrialism allowed to obscure the relics of its ancient countryside or its interest for the student in Roman Ribchester and the wooden circle of Bleasdale. Mr. Mee is happiest, however, in rural Kent or Warwickshire, or in writing his general volume when he can roam about in the past among obscure villages with their ancient churches and family monuments, as well as their unexpected and their often surprising associations with some of the famous personages of history, social and literary no less than political.

Those of like tastes will roam with Mr. Mee with equal zest. It is a course of very mixed feeding, which will seem reprehensible to the formal historian and educationist. But it is very enjoyable.

School Certificate Chemistry

By A. Holderness and J. Lambert. Pp. x+414. (London: William Heinemann, Ltd., 1936.) 4*s*. 6*d*.

THIS is a pleasing book profusely illustrated by photographs and line drawings, the latter being unusually clear and instructive. The atomic and molecular theories are given careful attention and the authors have succeeded in making clear a section which most pupils often find rather difficult. The metals are treated in a somewhat original manner, the authors using a classification based on the electrochemical series instead of the usual periodic classification. The salts are grouped according to acid radicals instead of metals, the sulphates, for example, being described in the chapter on sulphuric acid.

Each chapter is provided with a set of questions, and there are general questions at the end of the book, preceding a list of atomic weights and a table of logarithms. A useful feature is the final chapter of twenty pages devoted to revision notes and definitions, which contains some good general advice to young pupils about to present themselves for examination. This is certainly a book which pupils and teachers alike will enjoy using. The consistent use of arrows instead of equals signs in equations will not commend itself to teachers, who find that this practice leads to carelessness in balancing equations.

Jan Swammerdam, 1637-80

By Prof. F. J. Cole, F.R.S.

JAN SWAMMERDAM was born at Amsterdam on February 12, 1637, and died there on February 17, 1680. He was the son of a prosperous apothecary, Johan Jacobsz Swammerdam, with whom he is frequently confused, and the grandson of J. Theodorus, who assumed the name of Swammerdam, and was born in the Dutch village of Swammerdam or Swadenburgerdam (now Zwammerdam) on the Old Rhine.

The pseudo-learned atmosphere of his father's private collection of rarities, which included minerals, fossils, plants, animals, manufactured and artistic curiosities and coins, the animal section forming about a sixth of the whole, could scarcely have been responsible for the rigorous scientific attitude towards natural knowledge which was characteristic of Swammerdam himself. His father intended him for the Church, but he embarked upon the study of medicine, only to be diverted from it by his passion for entomological research. Finally, however, he completed his medical course and graduated M.D. at Leyden in 1667. In the meantime, he had become friendly with his famous contemporaries Steno and de Graaf, but later his relations with de Graaf were embittered by a controversy on the structure of the genital organs. Also before graduation he had visited France, where he was befriended by Melchisedec Thévenot, and continued his entomological investigations. It was here that he publicly demonstrated the valves of the lymphatic vessels on June 19, 1664 (published 1667), but in this he was anticipated by another Hollander, Frederik Ruysch, who issued a detailed description of the valves in 1665.

On returning home, Swammerdam participated in the foundation of the private Amsterdam "College" of Medicine. This company of enthusiasts printed small volumes of transactions in 1667 and 1673, which are now exceedingly rare, and to which Swammerdam himself contributed. He was thus for the time committed to human anatomy, and experimented with methods of injection, inflation and preservation. He did not, however, invent *solidifying* coloured injection masses, as is generally stated, but he was responsible for the general adoption of the method by anatomists after his time. His first wax injection was carried out in van Horne's house in Leyden in 1666. It was probably in 1671 that he sent to the Royal Society, accompanied by descriptions and figures (published in 1672), his famous preparation of the human female genitalia. Arteries and veins had been injected with yellow and red wax, which acted as a preservative, and the whole was then dried. The Royal Society's collection was handed over to the British Museum in 1781, and this historic specimen was never again seen. Later, Swammerdam applied the injection method to the smaller invertebrates, and he succeeded in filling the blood vessels of a Lepidopterous larva from the heart by means of a capillary glass tube.

After an illness, Swammerdam abandoned human anatomy, and thenceforward devoted himself entirely to comparative anatomy, chiefly of insects. Such a devotion to science absorbed not only all his time and attention, but also was expensive, and his father penalized the neglect of a profitable profession by cutting off supplies. To mollify his angry parent, Swammerdam wasted much valuable time in cataloguing the family museum, and this catalogue, which was published in 1679, shows that the collection was not comparable with many others which existed in Holland at the time.

In 1673 Swammerdam came under the disturbing influence of Anthoinette Bourignon, and henceforward his interest in science began to decline. It flared up from time to time, but the process of extinction had set in. Finally, he convinced himself that the pursuit of learning was vain and even impious, and he died in an atmosphere darkened by the turmoils of an unbalanced mind. Nevertheless, it was during this period of strife that he completed his classic treatises on the honey-bee and the mayfly, working, as the rhetorical Boerhaave tells us, exposed bareheaded to the scorching heat of the sun and "dissolving into sweat under the irresistible ardours of that powerful luminary".

The early death of Swammerdam was not entirely responsible for the fact that the bulk of his work remained unpublished, for to his own indifference were added the apathy and neglect of his successors. The manuscripts passed first into the hands of Thévenot, who designed to publish them, but he died without discharging this important trust. After some vicissitudes, the papers were acquired by G. Duverney, the celebrated Parisian anatomist, who had already undertaken other charges of a similar nature, but lacked the desire to liquidate any of them. Finally, Boerhaave was moved to intervene, and in the subsequent proceedings he played an important and honourable part. He purchased the documents from Duverney, and published them under his own guarantee as two imposing folio volumes in Dutch and Latin in 1737–38, exactly a century after the birth of their author, but nevertheless not yet out of date ! It is painful to reflect that Swammerdam's own collection of preparations shared the common fate of the museums of his period, and, having failed to attract a purchaser, was dispersed. Unlike his great contemporaries, Malpighi and Leeuwenhoek, Swammerdam was not a fellow of the Royal Society ; but he corresponded with the Society, the archives of which include some material in his autograph. One genus (1826) and some ten species of insects have been named after him.

The picture which the evidence justifies us in forming of the personality of Swammerdam, is that of a man with an introspective and self-torturing mind which found expression sometimes in pompous and scornful criticism of others, but more often in the superfluous distractions of mysticism and spiritual exaltation. Add to this a consuming energy which produced, in some ten years before the age of forty, one of the most remarkable works in natural history which has ever been written, and also an indifferent physique wasted from time to time by fevers, and the result could only be a life which rapidly burnt itself out. His strength in research lay in observation and experiment. In reflection he was dangerous, and apart from the fact that he was a convinced and uncompromising opponent of spontaneous generation, which was incompatible with his belief in preformation, no important generalization can be associated with his name. No portrait of him is known to exist. That reproduced by Michelet and others is a forgery based on one of the lay figures in Rembrandt's "Anatomy Lesson" of 1632, the model of which could not have been Swammerdam.

The methods employed by Swammerdam in his finer work have been partly disclosed by Boerhaave. He used a simple dissecting microscope of his own design, made by Samuel J. van Musschenbroek, and very delicate dissecting instruments sharpened under the microscope. He was one of the first naturalists after Boyle to appreciate the importance of alcohol as a preservative, and was probably the first to make dissections under water, and to clear up an entomological preparation by dissolving out the fatty substances. The modern practice of preparing Lepidopterous larvæ for exhibition by pressing out the viscera and inflating and drying the skin was invented by Swammerdam.

In addition to various Parerga to be found in the works of T. Bartholini, sen., Thévenot, van Horne, Blasius, Boccone, Steno, the *Philosophical Transactions* and the works of the Amsterdam "College", Swammerdam published four major works during his lifetime. The first of these, an inaugural dissertation on respiration, was published in 1667 in Latin, and five other Latin editions appeared later. In 1927 the first edition was re-issued in Holland with a Dutch translation. This little treatise has considerable physiological importance. The discovery of the part played by air in respiration may here be recognized in one of its earliest phases, and the mechanism of mammalian respiration is ingeniously demonstrated by means of a pair of bellows containing the wind-pipe and lungs, in which the action of the bellows on the lungs can be observed through a glass window cut in the side. As pointed out by Patterson, this idea was adopted without acknowledgement by Mayow in 1674. In the interests of priority, it should also be recorded that Swammerdam's experiment had been published for thirteen years before Borelli issued the first volume of his "De Motu Animalium".

Swammerdam was among the earliest to test the effects of injecting the vessels of *living* animals, and his discovery that the mammalian lung sinks in water before it has functioned, but floats afterwards, has important medico-legal bearings in cases of suspected infanticide. Significant observations on clinical and chemical thermometers are also to be found in this remarkable thesis, and even topics foreign to its express purpose, such as the hermaphroditism and reciprocal union and fertilization of snails, are not excluded.

Swammerdam's first entomological publication, which later formed a part of the "Biblia Naturæ", was his "General History of Insects". It appeared in 1669 in the Dutch language, and was followed by five other French and Latin editions. A few years later, in 1672, the work on the uterus was issued, and went through eight editions, all of them in Latin. It includes the polemic against de Graaf, but is important from the point of view of anatomical injections and the preformation doctrine.

The treatise on the mayfly was first published in 1675 in Dutch—six years after Malpighi's treatise on *Bombyx*—but only two other editions, in English and French respectively, appear to have been printed. To Anthoinette Bourignon the mayfly was a "little beast which lives for only a single day, and throughout that time endures many miseries". She gave, however, a grudging consent to the printing of the book, but implored Swammerdam to devote himself in the future to the more serious things of eternity. In this expansive and verbose work Swammerdam followed the lead of Servetus, and undertook the dubious task of establishing an ethical system which united the diverse interests of biology and divinity. In spite of the fact that it had a numerous following, amongst whom may be mentioned Lesser in Germany and Kirby and Spence in England, insecto-theology, as it was called, fell an inevitable victim to its own disruptive elements The biology of the work, however, greatly diluted as it is, shows us Swammerdam at his best. He appears to have started work on the mayfly as early as 1667. The anatomy of the small nymph is beautifully worked out, and in this respect Swammerdam is clearly superior to Malpighi. In addition, the curious life-history, in which the brevity of the adult stage is contrasted with the exceptionally long larval period, is laid bare for the first time. This work is also included in the "Biblia Naturæ".

The posthumous "Bible [not Book] of Nature" owes its name probably to its sponsor Boerhaave, and the detailed and accurate plates are the work of an artist employed by the author. One of the Ephemera plates, however, is signed "Auctor del". In all, eight editions were published, including German, French and English translations. It is impossible in this brief notice to refer to more than a few of the topics which are investigated in this stupendous work. Its plan, based on selected types, is monographic, comparative and experimental, and it is undoubtedly the foundation of our modern knowledge of the structure, metamorphosis and classification of insects. In addition, there are valuable observations on Crustacea, Mollusca and the life-history and anatomy of the frog in both larval and adult stages. Swammerdam spent some five years on the hive-bee, dealing with the anatomy, life-history and general economy of that much investigated animal, and his account of it is the most trustworthy and comprehensive we have had from any one man. It would, in fact, rank high even if judged by modern standards. In 1668 Swammerdam had already discovered by skilful dissection that an insect larva, pupa and imago may *at one stage* of the life-cycle exist simultaneously one within the other like a nest of boxes, and he had also studied experimentally the conditions which induce and regulate moulting and metamorphosis. His consequent assumption that no new parts are formed, and that the perfect insect is there *all the time*, led him to adopt the Preformation doctrine, the long and evil reign of which lies so heavily on his reputation. Swammerdam severely criticizes Harvey's views on metamorphosis, esteeming him at "little less than nothing", and stating that his work on generation contains almost as many errors as words. Harvey's philosophy of generation may have been, as Vallisneri says, "encrusted with Aristotelian pitch and heavy with rust", but it was the deadly blight of Preformation that stopped the clock.

Swammerdam accidentally stumbled upon the mimetic resemblance of certain Diptera to bees, and he found that some Lepidopterous egg masses might give rise to flies instead of caterpillars, which is the earliest record of egg parasites. He observed also in the case of the frog the first cleavage of the ovum, and noted the cellular structure of later stages. He admits, however, that blood corpuscles had been known for "some years" before he saw them, but does not give the source of his information, which could scarcely have been Leeuwenhoek. He certainly found the oval blood corpuscles of the frog before Leeuwenhoek. His ingenious neuro-muscular preparation (1668) by which he studied the relation of muscle and nerve, and the nature of muscle contraction and the nerve impulse, enabled him to refute the current belief that muscular action was due to a material substance reaching the muscle via the nerves, and in his experiments on the contraction of the heart and muscle he invented a form of plethysmograph. These results alone would entitle him to be regarded as one of the founders of experimental biology. But to the discoveries which are to be found in the "Biblia Naturæ" there is almost no end.

Chemical Exploration of the Stratosphere*

By Prof. F. A. Paneth

OUR prospect of finding differences in the chemical composition of the air is, of course, better the higher the sample is obtained in the stratosphere. An important part of the whole research is therefore the collection of air samples from great altitudes. For this purpose, sending up automatic devices in unmanned balloons is the most efficient method. Aeroplanes cannot attain sufficiently high altitudes; even Squadron Leader F. R. D. Swain in his record flight last September reached only 15 km., and the inconveniences of an airtight suit preclude complicated scientific operations. Balloon ascents in closed gondolas, as introduced by A. Piccard in 1931, give more freedom for observations, and can attain greater heights. A year ago, Capt. Stevens and Capt Anderson in a stratosphere flight arranged by the National Geographic Society and the U.S. Army Air Corps reached 22 km.; but it cannot be said that the scientific results of the expedition justified the immense costs. The varying conditions of the atmosphere make numerous observations necessary, and only the cheap flights of sounding

* Continued from p. 182

balloons can be repeated frequently enough; moreover, they can ascend far higher than manned balloons. (Heights of more than 30 km. have been recorded.) Fig. 2 shows the altitudes so far reached by the most successful flights of aeroplanes, manned and unmanned balloons. The flights from which air samples have been brought back are underlined. A number of other air samples collected by sounding balloons are not recorded in the figure; the heights attained can be seen in Table 3.

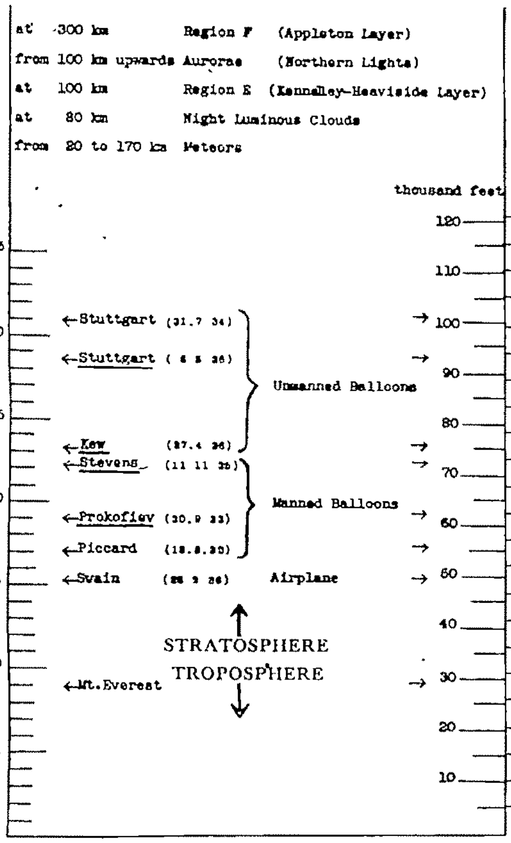

Fig. 2.

Chart of stratosphere flights. Air samples were obtained on those which are underlined.

For the automatic sampling quite a simple device is sufficient. The one used in the joint work of the Meteorological Office of the Air Ministry, and Dr. Glückauf and I working at the Imperial College of Science and Technology, is represented in Fig. 3. A detailed description has been given by Mr. L. H. G. Dines of the Upper Air Section of the Meteorological Office, who launched the balloons from Kew Observatory[1]. The device comes into operation after the sounding balloon has burst at the top of its flight; an extension of an evacuated glass bulb is then broken, and air is sucked in while the vessel, attached to a parachute, begins to fall; after an interval of 10–15 sec. the extension is sealed again. In Fig. 3 on the right-hand side are to be seen the parachute, the bamboo cage and the aluminium cylinders which contain the glass vessel and a Dines barothermograph; on the left side are the glass vessel (volume about 500 c.c.), and the electrical arrangement for breaking the extension and for sealing the bulb again; this latter is effected by means of a heating coil which surrounds the lower part of the glass stem and fuses a particular kind of sealing wax contained inside. If the mechanism functions satisfactorily, the pressure of the air inside the vessel should correspond within certain limits to the highest value of the barographic record.

These flights have been in progress since 1935. From the first results, published a year ago[2], it was concluded that up to 18 km. no definite change in the chemical composition of the stratosphere occurred, but that at a height of 21 km. the relative amount of the light gas helium is already distinctly increased. During the past year, this has been confirmed by further successful flights reaching more than 23 km.[3] Similar investigations have lately been carried out by Prof. E. Regener in Stuttgart[4], using larger balloons; in his samples, one from a height of more than 28 km, he determined the oxygen content and found deficits, in

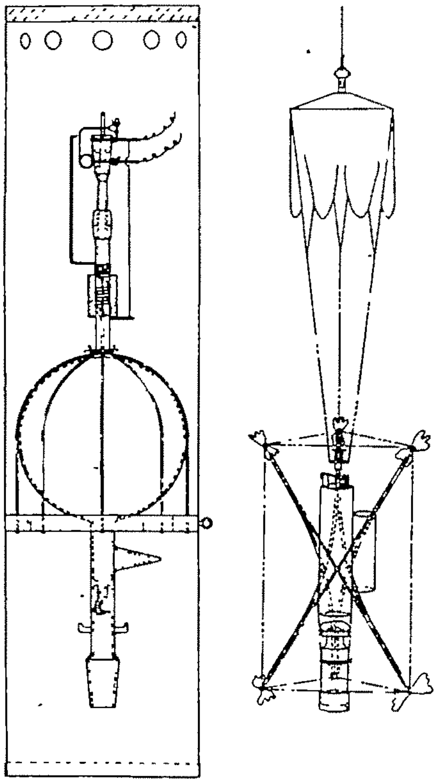

Fig. 3.

Apparatus for sampling stratosphere air.

good agreement with the helium surpluses detected in the London flights. The only two air samples obtained by manned stratosphere balloons also confirm our finding: a sample collected over Russia by Prokofiev in 1933 at a height of 18·5 km., and analysed by A. A. Čerepennikov and by A. B. Moskvin, showed no variation in its composition[5]; but the air brought back by Capt. Stevens from 21·5 km., and analysed with great accuracy by M. Shepherd[6] of the National Bureau of Standards in Washington, revealed a slight oxygen deficit

TABLE 3.

HELIUM AND OXYGEN CONTENT OF THE ATMOSPHERE AT VARIOUS ALTITUDES.

Height in km.	Helium[2,3]		Oxygen	
	Per cent by vol	Variation (per cent He)	Per cent by vol	Variation (per cent O_2)
0	$5·27 \times 10^{-4}$	0	20·945[8]	0
			20·92[4]	0
9–16·8			20·92[7]	0
14·5			20·89[4]	−0·14
16·7	5·30	+0·5		
18·5	5·31	+0·7	20·95[5]	0
			20·84[4]	−0·38
19			20·87[4]	−0·24
21	5·64	+7·0		
21·5			20·895[6]	−0·24
22	5·49	+4·1	20·57[4]	−1·7
	5·53	+5·1		
23·4	5·49	+4·2		
24			20·74[4]	−0·86
28–29			20·39[4]	−2·5

In Table 3 all reliable data about the helium and oxygen content of stratosphere air are brought together. In addition to the results already mentioned, the figure found by Lepape and Colange[7] for the average oxygen content of samples collected between 9 km. and 16·8 km. is also included; they observed no deviation. According to the same authors the helium plus neon content at this height varies considerably (as much as 57 per cent), and on the average is increased by 27 per cent; the method applied was, however, not reliable. Our results show the constancy of the helium, and therefore *a fortiori* the neon, content at these heights within one per cent.

The deviations in the helium and oxygen content of the higher layers of the stratosphere, revealed by the figures in Table 3, from those in the troposphere, are in the direction to be expected if at a height of about 20 km. winds are no longer efficient enough to ensure a complete mixing of the atmospheric gases. The 'light' gas helium is present in a higher, the 'heavy' gas oxygen in a lower, percentage. The difference is more marked in the case of helium; this is in good accord with the greater density difference between helium and the main atmospheric gas, nitrogen (see Table 2).

Here, however, the possibility of generalizations ends. Calculation shows that a height of 1 km. in an undisturbed atmosphere should lead to an increase of the helium value of more than 13 per cent, and to an oxygen deficit of about 1·6 per cent. Now neither the London nor the Stuttgart samples show a gradual change in the composition of the air in proportion to altitude; and the changes found are much smaller than would be expected if from 20 km onwards there were perfect quietude This leads to the conclusion that there is by no means a sudden change in the conditions of the stratosphere at this height, but that the influence of air currents becomes only gradually less, and is dependent on weather conditions. We cannot therefore expect exact correspondence between the helium and oxygen values of air samples, collected on different dates and from different geographical areas; we intend to determine both values for one and the same air sample in order to test whether the changes found are actually due to gravitational separation.

It may be mentioned that air samples from heights of 18·5 km. and from 21·5 km. have been analysed for hydrogen by Čerepennikov, Moskvin and Shepherd Even at these heights none was found. Previously meteorologists, misled by unreliable chemical analyses, took for granted the presence in the troposphere of measurable quantities of hydrogen, and demonstrated by calculations that the upper part of our atmosphere should therefore consist almost entirely of hydrogen. Some even went so far in hypothetical speculations as to postulate the presence there of a still lighter element, christened 'geocoronium' or 'zodiakon'. This, and particularly the 'hydrogen sphere', is still mentioned in many text-books. G. Ch. Lichtenberg, professor of physics in Göttingen a century and a half ago, must have had similar cases in mind when he wrote: "Perhaps Hamlet is right that there are more things in heaven and earth than are dreamt of in our philosophy; but on the other hand it may be said that there are a good many things in our natural philosophy books of which neither in heaven nor on earth any trace can be found."

When we started work two years ago on the helium content of stratosphere air, it was quite unknown whether it would be possible to reach a layer where any variations from the composition of ordinary air occur. The only accurate figure about stratosphere air then available, the oxygen analysis of air from 18·5 km. height, collected and analysed by the Russian investigators, showed not yet the slightest difference from ordinary air. Since last summer, we have been certain that from about 20 km. upwards the composition of air changes to a measurable extent. Much further work will be necessary before we are able to formulate the rules governing these changes. But as the question of stratospheric air movements may be also of some practical importance for weather forecasting and for aeronautics, we hope to continue, and to extend, our researches.

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[1] L. H. G. Dines, *Quart. J. Roy. Meteorol. Soc.*, **62**, 379 (1936).

[2] F. A. Paneth and E. Glückauf, NATURE, **136**, 717 (1935)

[3] Details of the new flights will be published later.

[4] E. Regener, NATURE, **138**, 544 (1936).

[5] Report of the Central Geophysical Observatory U.S.S.R. Short abstract of the Russian publication in NATURE, **133**, 918 (1934).

[6] M. Shepherd, private communication.

[7] A. Lepape and G. Colange, *C.R.*, **200**, 1871 (1935); NATURE, **137**, 459 (1936).

Obituary Notices

Sir John Bland-Sutton, Bt.

SIR JOHN BLAND-SUTTON, BT., president in 1923–25 of the Royal College of Surgeons of England, and consulting surgeon to the Middlesex Hospital, who died on December 20 last, was born in 1855. Since John Hunter, no pathologist-surgeon of equal eminence has arisen in Great Britain, and like his prototype he approached surgery through the study of anatomy and comparative anatomy. Like Hunter, too, he was brought up in the country, and school played a less prominent part in his education than his own sharp eyes and sceptical curiosity. Unlike Hunter, he was not an experimentalist. He was more preoccupied with naked-eye form than with histology or physiology, though he always studied morphology in relation to function and to the evolutionary process.

It was not until he was twenty-three years of age that Bland-Sutton, already a skilled naturalist, first determined to be a surgeon. Poverty in youth teaches a man that independence, the power to help others, free choice, and the avoidance of jarring contacts are unattainable unless one does something that the world needs and is willing to pay for. In surgery Bland-Sutton found a field for his talents and for applying his mastery of anatomy and pathology. He entered as a student of the Middlesex Hospital in 1878, and in the following year was appointed demonstrator of anatomy. As an anatomical teacher he achieved great popularity, and in 1886 he was appointed assistant surgeon, becoming surgeon in 1905 and consulting surgeon in 1920. Throughout life, he remained devoted to the Middlesex Hospital, to which in 1914 he presented the complete pathological institute which bears his name. It was significant of his forward outlook that the space allotted to the museum in the new building was reduced so that more scope could be given to the experimental and histological laboratories.

In 1896, Bland-Sutton was appointed surgeon to the Chelsea Hospital for Women, and it was in gynæcological surgery that he made his name. For years this branch of surgery was practised by physicians—a curious anomaly having its roots far back in history. Spencer Wells and his successors at the Samaritan Hospital had broken through the tradition, and some obstetric physicians were good surgeons, *vixerunt fortes ante Agamemnon*, but the main credit for bringing pelvic surgery up to the level of general surgery unquestionably belongs to Bland-Sutton. He more than any man disestablished the 'couch-invalid' formerly seen in so many families—generally a woman with fibroids, an ovarian tumour, or the sequelæ of pelvic inflammation. Striding into this field where the crop had been ripening through many tedious years of invalidism and inaction, he rapidly acquired a very large and beneficent practice. His operating afternoons at the Chelsea Hospital for Women attracted surgeons from all over the world. At the same time, in his capacity of surgeon to the Middlesex Hospital, the hospital in which he was nurtured and which he always loved, he continued the practice of general surgery.

As an operator, Bland-Sutton was rapid and safe, though some critics considered him lacking in the refinements of technique. His results were excellent. Surgeons, like the clergy, may perhaps be divided into two classes, ritualists and evangelicals. Some love complicated instruments and elaborate technique; Bland-Sutton liked to reduce his instrumental and aseptic outfit to the minimum essential for the job in hand. Moreover, as a pathologist he realized that Nature is the real surgeon, while the surgeon is a kind of 'plumber's mate' to Nature. He never wasted time in doing things that Nature would do better herself. Perhaps in sewing up the abdominal wall with a single layer of sutures he sometimes trusted her too much.

Bland-Sutton had a vigorous common-sense mind which always led him to seize on the essentials of a subject and to press direct to a conclusion which was generally the right one. His mental vigour always seemed to maintain a constant level, so that in the spare quarters of an hour which most men waste, he could add a few lines to any paper he was writing. *Nulla dies sine linea* was a favourite quotation. His mental energy demanded satisfaction in constant work, and needed no whipping up to the task. Few men have done more work in a lifetime, and few have done it better. He said he could only learn by the eye, and noted in himself an entire absence of the mathematical faculty, nor I think did music appeal to him. His letters, always brief and pointed, were written in a clear and unhurried hand, and so far as I know he never employed a secretary, a typewriter or a dictaphone. From his boyhood's intensive Bible lessons, for his aunt intended him for the Church, and from the study of Shakespeare, he derived a distinctive literary style, concise, arresting, and seasoned with an occasional archaism or blunt Anglo-Saxon word. It may have been the foundation of his friendship with Kipling that both men were students of the art of expression.

Bland-Sutton once said to me in reference to a very large text-book : "It is very easy to write a big book and very difficult to write a small one," surely a salutary doctrine for these days. The truth was illustrated in Bland-Sutton's classic book on tumours, which has gone through many editions. In it he brought into small compass and proper interrelation a crowd of unorganized facts, and vivified the subject for generations of students. He would have nothing to do with dull half-tone illustrations, and insisted on wood-cuts. I still remember the interest and relief with which I read this book, so different from some of the woolly and verbose text-books of its day.

Bland-Sutton's mind can also be studied in his earlier book of 1890, "Evolution and Disease", which broke the new ground of comparative pathology. He wished to indicate that "there is a natural history of disease, as well as of plants and animals". "We shall find conditions which we regard as abnormal in man presenting themselves as normal states in other animals." "There has been an evolution of disease *pari passu* with evolution of animal forms." "I quickly saw that the manifestations of disease were regulated by the same laws which govern physiological processes in general." Such are some of his conclusions, illustrated by a wealth of detailed examples derived from his studies as pathologist to the Zoological Society. A subject of special interest to him was the comparative pathology of the reproductive organs in animals, and in 1892 he received the Jacksonian Prize of the Royal College of Surgeons for a study of diseases of the ovaries and uterine appendages, which probably determined the direction of his surgical activities.

For some years Bland-Sutton was an active member of the old Obstetric Society, in which discussion was at that time conducted with gloves of minimum weight. There is much to be said for frank discussion, but the hand of the dominant seniors was heavy upon their juniors. A young man read before the Society a paper explaining a novel condition of which he had found an example in a hospital museum. Patronizing criticism followed until Bland-Sutton got up. He said : "Some years ago I was a member of a committee appointed to consider this specimen. We could come to no conclusion about it and I said that it should be placed in a museum, and that some day light would be thrown upon it. Gentlemen, that light has come." Such generous feeling for his juniors was habitual with Bland-Sutton, as the writer—for some years his assistant surgeon at the Middlesex Hospital—can testify from personal experience.

Though in youth he must have been a great reader, Bland-Sutton's regard for books was not a very high one, and he always strove for first-hand knowledge of any subject which interested him. His library was kept to an absolute minimum, partly by the incineration of intruders as soon as they had been perused. His interest in general literature was not keen, though Egyptian and Persian archæology fascinated him. The Bible, Nature, Shakespeare, the world of men and women (for he was a great traveller), were his educators, and for his strong personality these sufficed. It was not only in his profile, but in himself also that something Napoleonic could be detected. It showed in his intense industry, his coolness in crisis, in his quick grasp of the essentials of a problem, in the rapid translation of decision into action, and in a certain aloofness of personality. His nature was kindly and generous. Fortune allowed him to enjoy the golden age of Victoria and to exercise for years a splendid hospitality in the replica of a hall which a king of Persia had built for himself. In his consulting room was an Egyptian frieze representing the weighing of the soul after death in the courts of Osiris. It was his reminder to himself of his mortality, and of the ethical standards surviving from his Puritan training.

I cannot conclude without a reference to the mutual devotion which for so many years bound Sir John to Lady Bland-Sutton, who survives him.

W. SAMPSON HANDLEY.

Prof. J. A. MacWilliam, F.R.S.

BY the death on January 13, at the age of seventy-nine years, of Prof. J. A. MacWilliam, the University of Aberdeen and the medical sciences have lost one who by devoted service to his Alma Mater and untiring zeal in scientific investigation had become known to many at home and abroad. He had held the regius chair of physiology at Aberdeen for forty-one years, from 1886 until 1927.

Prof. MacWilliam's chief contribution to scientific medicine was the discovery that the peculiar condition known as fibrillar contraction of the heart consisted of a lack of harmony in contraction and relaxation of the minute bundles of muscle fibres of which the walls of the heart are composed. He showed that fibrillation is not due to interference or destruction of some co-ordinating nerve centre; but that it is brought about by what he described as a "rapid succession of inco-ordinated peristaltic contractions". He also showed clearly the relation of the refractory period to this disturbance. It is not without interest to note that the real significance of his work was not fully recognized until comparatively recent times. The work had its inspiration in the famous school of Ludwig at Leipzig, which, in the eighties of last century, was a Mecca for many of the younger physiologists on both sides of the Atlantic. Bowditch of Harvard, Gaskell of Cambridge, MacWilliam and others were at that time actively engaged in demonstrating those peculiar properties of heart muscle upon which cardiac rhythm depends.

For several years, MacWilliam's indifferent health interfered with intensive original research, and it was not until 1913 that a further series of important papers appeared on the measurement of blood pressure in man. These investigations were the subject of a comprehensive discussion which appeared in *Physiological Reviews* in 1925. There are other publications to which reference might be made, but those mentioned indicate the extent of his work and the high estimate which has been placed upon it. In 1916 MacWilliam was elected a fellow of the Royal Society, an honour which brought satisfaction to many of his colleagues and students.

It is perhaps as teacher and lecturer that MacWilliam will best be remembered. Gifted with a clear and lucid style, he could present, with but the slightest reference to notes, the most difficult aspects of his subject. As a lecturer he had few equals; every lecture was excellently arranged, clearly delivered and full of interest and incident. To those who had the privilege of knowing him intimately, Prof. MacWilliam revealed a new depth and richness of character which made one realize the greatness of his personality. The experience of the years—and they were not without their share of sorrow and suffering—had produced a wonderful combination of philosophical insight and critical scientific judgment.

By his personal qualities, always gracious, never unkindly critical, ever sympathetic, Prof. MacWilliam endeared himself to many generations of Aberdeen students. His charm of manner, his constant kindness and courtesy, won for him the affectionate regard of all who knew him intimately. In the world of science his name has an enduring place; in the hearts of his friends his memory will for long be cherished. E. W. H CRUICKSHANK.

Sir Halley Stewart

SIR HALLEY STEWART, whose death at the advanced age of ninety-nine years occurred on January 26, was a generous supporter of scientific research. One of his outstanding benefactions was the founding of the Halley Stewart Laboratories for Physics Research at Hampstead, which now forms a post-graduate school of the Physics Department of King's College, London. These laboratories were in the first instance put at the disposal of the College in 1932 for the special use of Prof. E. V. Appleton, whose radio researches in the college buildings in the Strand had been greatly hampered by the electrical interference caused by adjacent machinery. The premises in Hampstead, which were formally opened by Lord Rutherford, provided a fully equipped electrical research laboratory as well as a residence above, for the professor of physics. During the years 1932–36, Prof. Appleton and his students were able to continue unhampered their exploration of the properties of the higher atmosphere using radio waves emitted from the roof of King's College and received at Hampstead. Since Prof. Appleton's translation last year to Cambridge, the Halley Stewart Laboratories have been directed by the present Wheatstone professor, Dr. C. D. Ellis, whose researches lie mainly in the field of radioactivity.

WE regret to announce the following deaths:

Prof. Stanley R. Benedict, professor of biochemistry in Cornell University Medical College, on December 21, aged fifty-two years.

Prof. Philip E. Browning, formerly associate professor of chemistry in Yale University, an authority on the rare elements, on January 2, aged seventy years.

News and Views

New Year Honours

THE following names of scientific workers and others associated with scientific work appear in the list of New Year honours conferred by the King, which was published on February 1. *Baron:* Sir Harry McGowan, chairman of Imperial Chemical Industries, Ltd. *Order of Merit:* The Right Hon. H. A. L. Fisher, warden of New College, Oxford, in recognition of his eminent position as an historian and of his services to literature. *K.C.B.:* Mr. H. T. Tizard, rector of the Imperial College of Science and Technology. *Baronet:* Mr. P. Malcolm Stewart, late Commissioner for the Special Areas (England and Wales). *K.C.M.G.:* Mr. F. A. Stockdale, agricultural advisor to the Secretary of State for the Colonies. *D.B.E.:* Lady (Juliet Evangeline) Williams, honorary treasurer, Queen Charlotte's Anæsthetic Fund, and honorary secretary of the Joint Council of Midwifery. *Knights Bachelor:* Dr. J. A. Arkwright, member of the Agricultural Research Council; Prof. J. C. G. Ledingham, director of the Lister Institute, London, professor of bacteriology, University of London; Lieut.-Colonel A. G. Lee, Engineer-in-chief, Post Office Engineering Department, General Post Office; Dr. E. K. Le Fleming, chairman of the Council of the British Medical Association, a member of the General Council of Medical Education and Registration of the United Kingdom; Mr. C. G. Trevor, Indian Forest Service, Inspector-General of Forests, and president of the Forest Research Institute and College, Dehra Dun.

C.B.: Dr. L. D. Barnett, lately keeper of Oriental printed books and manuscripts, British Museum; Mr. F. C. Cook, chief engineer, Roads Department, Ministry of Transport; Dr. M. F. Lindley, comptroller general of patents, designs and trade marks and comptroller of the Industrial Property Department, Board of Trade. *C.S.I.:* Mr. F. Anderson, Indian Service of Engineers, chief engineer and joint secretary to the Government of the United Provinces in the Public Works Department, Irrigation Branch, United Provinces; Mr. T. B. Tate, Indian Service of Engineers, chief engineer and secretary to the Government of the Punjab in the Public Works Department, Irrigation Branch, Punjab. *C.M.G.:* Mr. R. Marrs, principal, Ceylon University College. *C.I.E.:* Mr. C. E. L. Gilbert, Indian Forest Service, chief conservator of forests, Bombay Presidency, Bombay; Dr. D. Penman, chief inspector of mines in India, and lately principal, Indian School of Mines, Dhanbad; Rao Bahadur Tiruvadi Sambasivaiyer Venkataraman, Indian Agricultural Service, sugarcane expert, Imperial Cane Breeding Station, Coimbatore; Mr. H. L. O. Garrett, Indian Educational Service (retired), lately principal, Government College, Lahore, Punjab; Dr. G. C. Ramsay, deputy director of the Ross Institute of Tropical Hygiene, London School of Hygiene and Tropical Medicine. *C.B.E.:* Mr. C. Gillman, chief engineer, Railways, Tanganyika Territory; Mr. A. E. Hamp, chief engineer, Kenya and Uganda Railways and Harbours; Mr. G. Jeffrey, member of the Agricultural Bureau, State of South Australia; Mr. D. Mackay, for services in connexion with scientific exploration and survey in the interior of Australia; Mr. H. A. Lewis-Dale, deputy director of Works and Buildings, Air Ministry; Mr. A. G. H. White, lately librarian to the Royal Society.

O.B.E.: Rai Bahadur Mathura Prasad Bhola, lately deputy conservator of forests, United Provinces; Mr. C. Chaffer, principal technical officer, Compass Department, Admiralty; Mr. R. B. Crusher, assistant director of surveys, Palestine; Prof. S. M. Dixon, lately member of the Safety in Mines Research Board; Mr. P. E. L. Gethin, chief surveyor and director of civil aviation, Tanganyika Territory; Mr. B. Hart, honorary consulting radiologist to the Doncaster Royal Infirmary; Mr. E. W. D. Jackson, Indian Service of Engineers, executive engineer (irrigation), Meiktila Division, Burma; Mr. H. S. Kingsford, assistant secretary, Society of Antiquaries of London; Mr. R. H. Locke, superintendent, Horticultural Operations, New Delhi; Dr. G. H. Pethybridge, lately mycologist and assistant director, Plant Pathological Department, Harpenden; Mr. E. A. Smith, chief technical officer for fuel, H.M. Office of Works and Public Buildings; Mr. J. G. Strickland, assistant director of surveys, Uganda Protectorate. *M.B.E.:* Surendra Nath Chakravarti, Indian Service of Engineers, municipal engineer, Delhi; Mr. R. McKintosh, Indian Service of Engineers, executive engineer, Public Works Department, Madras; Mr. C. MacQuarie, agricultural surveyor, Medical Department, Tanganyika Territory; Mr. W. E. Pereira, Bombay Forest Service, personal assistant to the chief conservator of forests, Bombay Presidency, Bombay; Major H. C. Phillips, Indian Medical Department, superintendent of the Punjab Vaccine Institute, Lahore, Punjab; Mr. J. H. Smith, principal, Oaklands Farm Institute, and agricultural organizer for Hertfordshire.

History and Significance of the Electron

DR. KARL T. COMPTON, while professor of physics in Princeton University, performed and inspired a great deal of work on the phenomena of the electric discharge in gases, on the emission of electrons from surfaces and on ionization by electron impact. He is now president of the Massachusetts Institute of Technology. His article on "The Electron: its Intellectual and Social Significance" published as a supplement in this issue (p. 229) contains a survey, written in general terms, of the development of our knowledge of the electron since its discovery at the end of last century. The discovery of the electron, and the application of the electron ideas, first to gas discharges, then to radioactivity, spectroscopy and atomic structure, opened a most rapid advance in physical science, leading up to contemporary views of atomic structure and of chemistry. Applied to technical sciences, particularly in the communication industries, the electron has assumed great commercial and social significance.

Prof. C. N. Hinshelwood, F.R.S.

MR. C. N. HINSHELWOOD, who succeeds Prof. Frederick Soddy as Dr. Lee's professor of inorganic and physical chemistry at Oxford, is a leader of physical chemistry in Great Britain. Still in his thirties, he has made a great reputation by his work on gas reactions. He was formerly fellow of Balliol College and University lecturer in chemical dynamics. He is a fellow of Trinity College, a fellow of the Royal Society, an honorary doctor of science of Dublin and a delegate of the Clarendon Press. He is the head of the Balliol and Trinity Colleges Laboratories, and is the first member of this school of physical chemistry to become professor at Oxford. He is a man of wide interests outside his professional work and, in particular, an expert linguist. At Oxford, professorships are attached to particular colleges. In the ordinary way Prof. Hinshelwood should migrate to, and become a fellow of, Exeter College on his appointment. It has happily been arranged, however, that he remain at Trinity College, and in charge of the laboratories there, until an official University institute of physical chemistry be built in the Parks.

Science in the U.S.S.R.

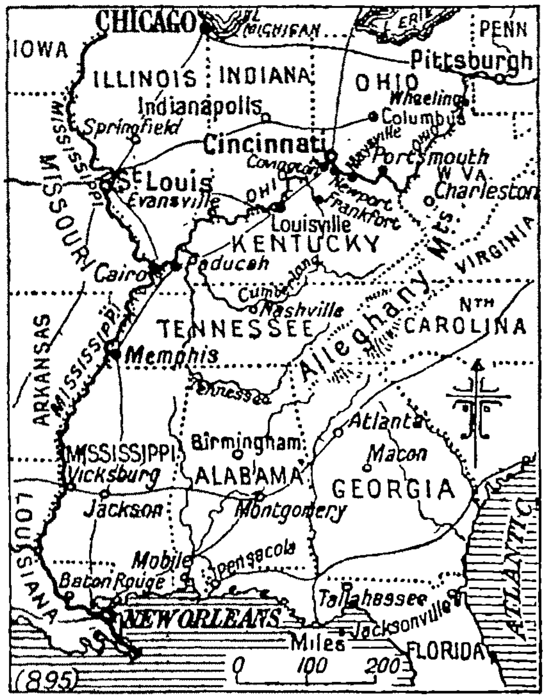
REFERENCES were made in NATURE of January 23 (p. 142), and January 30 (p. 185) to the position with regard to the International Congress of Genetics which was to have been held in Moscow this summer. A request for further information was sent to His Excellency the Russian Ambassador, who has favoured us with a statement on the recent meetings of the Lenin Agricultural Academy (see NATURE, Jan. 30) and on the International Congress of Genetics. Dealing with the latter, the statement is as follows:

"As to the postponement of the Genetics Congress, it is a fact that this was due to requests received by the organisers of the Congress from a number of scientists who wished to have more time for preparation for it. The sole motive for such a postponement was therefore the desire to secure the very best preparation for the Congress and the widest possible participation in its work by scientists of different countries. One thing must be borne in mind in any discussion of the problems of scientific development in the U.S.S.R. The U.S.S.R. is a country of planning. The whole economy of the country, and also the various branches of its cultural and scientific activities are regulated by a definite State plan. Science is planned, not, of course, in the sense that every minute detail of scientific research, etc., is laid down beforehand in a Government Department. That would be ridiculous. But science is planned in the sense that the broad outlines of its development are brought into line with the most urgent requirements of practical life. The prevailing view in the U.S.S.R. is that science must not consider itself a demi-god with the right to choose its own course without any reference to the needs and requirements of the people. On the contrary, the primary object of science is to serve as faithfully as possible the needs of the people, and, indeed, of humanity. Some scientists in foreign countries seem to be inclined to confuse the planning of science, in the above sense, with a lack of scientific freedom. But this is a cardinal error. The planning of science, like planned economy, prevents the waste of human energy and endeavour, and makes it possible to concentrate the greater part of scientific effort on the points of real need of the people and of humanity. The great advantages of such a system are clearly shown by the enormous advance of science in the U.S.S.R. during post-revolutionary years. Indeed, every unbiased observer will testify to the very great prospects for scientific development which exist in the U.S.S.R., such as can be found in scarcely any other country."

The United States Floods

THE catastrophic inundation of the valley of the River Ohio, which was referred to in NATURE of January 30 (p. 185), has since assumed even more alarming proportions and threatens to overwhelm in a comprehensive deluge the whole of the Mississippi Valley from the town of Cairo (Illinois) at the junction with the Ohio River right down to the Gulf of Mexico. The flood waters from the latter river are moving onwards, unchecked and uncontrolled, at the rate of 80–90 miles per twenty-four hours. The extent of country involved can be seen from the accompanying map. At the moment of writing, Cairo is just commencing to receive the crest of the wave, which is expected to culminate in a level of 62 ft. Thence it will pass on through Memphis (Tennessee), Vicksburg and Natchez (Mississippi) to Baton Rouge and New Orleans (Louisiana). In the Ohio Valley there has been left a track of widespread ruin and desolation, with the water still standing 12 ft. deep in the streets of Evansville, just below Louisville. Surveying the disaster at the week-end, the American Red Cross reported 400 people dead, 800,000 homes flooded, more than a million people still homeless and more than a quarter of a million marooned in the upper floors and roofs of their houses or other refuges. The chairman stated with every justification that the American nation is faced with the gravest emergency since the Great War. The material damage is estimated at 400 million dollars (£80,000,000). Not less important is the denudation of the valley, from which some 3,000,000 tons of fertile soil have been swept down-stream by the force of the current.

ORDERS have been issued from Washington to the Army to prepare plans for the evacuation of the entire civilian population within an area extending fifty miles on each side of the Mississippi, in case of a collapse of the levees with which the river banks are topped. Already 60,000 people have moved to higher ground in Arkansas and 30,000 have left their homes in Missouri. Disease and privation have followed on the heels of the flood. A state of quarantine has been declared in Louisville, where typhoid is prevalent, and 200,000 persons have been inoculated. An explanation put forward to account for the magnitude of the disaster is that the Ohio has received as much run-off from rainfall within a fortnight as it usually receives in six months, by reason of the mildness of the season, which has allowed mountain streams to run freely instead of the flow being retarded by the formation of ice and snow, which normally melts slowly during the spring months. Meanwhile, though it is reported that rain has continued to fall heavily in the afflicted area, it is hoped that the worst is past, and that the serious forebodings hitherto entertained will not be realized.



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Recent Solar Activity and Radio Fadings

AMONG the recent solar phenomena, now betokening a considerably disturbed sun, may be noted two large groups of sunspots and a smaller one of special interest. Particulars of these groups are as follows:

	Date on Disk	Central Meridian Passage	Latitude	Maximum Area
(1)	January 17–30	January 24·2	19° S.	1500
(2)	January 19–Feb. 1	January 26·1	20° N.	600
(3)	January 24–Feb. 6	January 31·2	11° S.	1500

Areas are expressed in millionths of the sun's visible hemisphere.

Group (1), although of considerable size on January 19, declined rapidly after a few days and by January 27 had shrunk to less than 200 millionths in area. In association with group (2) an extensive bright $H\alpha$ eruption occurred on January 27 between 10^{h} and 12^{h}. This eruption was recorded on hydrogen spectroheliograms taken by Mr. Evershed at his private observatory at Ewhurst, Surrey; at Greenwich it was cloudy at the time. The first spectroheliograms, taken at $10^{h}\,36^{m}$ and $10^{h}\,46^{m}$ U.T. respectively, show a patch of strong $H\alpha$ emission at a position 22° N. and 23° W. of the sun's central meridian; at $10^{h}\,55^{m}$ the eruption was still present, but at $12^{h}\,7^{m}$ when the last spectroheliogram was taken the eruption had almost faded from view. The beginning of the eruption, normally very sudden, may therefore be placed at some minutes earlier than $10^{h}\,36^{m}$, and the ending, usually much less definite, at about $12^{h}\,10^{m}$.

IT is interesting to record that a radio fading on short-wave wireless transmission was reported to have occurred at the same time on January 27 from $10^{h}\,25^{m}$ to $11^{h}\,50^{m}$. A passing comment may be made on the fact that bright solar eruptions, associated with fadings of short-wave radio transmission over daylight channels, occurred at 27-day intervals on December 30 and December 3 last (see NATURE, Dec. 12, p. 1017 and Jan. 9, p. 61). Furthermore, this apparent 27-day sequence is carried back still further by the recorded radio fadings on November 6 and October 9. The requisite international solar data are not yet published to see whether bright solar eruptions were observed at the time of the radio fadings on the last two dates. At the time of going to press, it is reported from the Royal Observatory, Greenwich, that the third group of the above list has increased greatly in size, and on January 31 it was about 2500 millionths of the sun's hemisphere in area. The group is likely to be the largest recorded since 1928.

Recent Crystallography

IN his Friday evening discourse at the Royal Institution on January 29, Sir William Bragg discussed recent work in crystallography. When X-rays were first applied to the determination of crystal structure, the forms examined were naturally those of simple design. As the technique improved, and as insight was gained into the modes of construction of which Nature made the most use, it became possible to attack more difficult examples with success. Quite recently, the X-ray methods have been able to give material assistance in the examination of the complicated bodies which play the leading part in the living organism, such as the proteins. X-rays have the special power of discerning regularities in the arrangement of the atoms and molecules of which substances are built. Until they were applied to this purpose, no one had suspected how usual and fundamental such regularities were. Nature's structures are generally based on the repetition of some unit of pattern. Even a very small crystal is formed of the orderly repetition of some atomic design repeated billions of times: and the minute but ubiquitous proteins of all living organisms possess this ordered arrangement though they are far too small to be seen in the microscope.

THE proteins all have the same basic composition. This again is an instance of the remarkable limitation to a few fundamental and elemental designs which is characteristic of the natural world. Every protein is composed, in the first instance, of a long chain in which two atoms of carbon and one atom of nitrogen form a pattern of three links, repeated throughout the whole length. Pendants of several varieties are attached to this chain, and one protein differs from another in the nature and variety of its pendants. The work of Astbury and others has shown the details of the construction of the proteins which make up the fibre of wool and hair and horn. It appears that in some substances, such as the uncooked white of an egg, the protein chain is coiled up into the form of a ball. Quite recently, Stanley, of the Rockefeller Institute, has been successful in isolating what is almost certainly the virus of the tobacco plant disease, and showing that it is a protein. This is most remarkable since the virus, by some means or other, is capable of multiplying itself. Bernal and his collaborators have shown that it is crystalline, and have used the X-rays to measure the regularities of its construction. It is of enormous size, relatively to the usual molecular dimensions, having a molecular weight of about twenty millions. It is needle-like in form. It has the optical properties of a crystal. This remarkable combination of properties is probably to be found in other forms of disease-producing virus, and the new discovery may well prove to be of the greatest importance.

Germany and the Nobel Prizes

DURING Herr Hitler's speech to the Reichstag in the Kroll Opera House, Berlin, on January 30, it was announced that he had issued a decree forbidding Germans to accept any Nobel Prize in future. This decree has been issued to avoid repetition of "shameful events of the past", which presumably refers to the award of the Nobel Peace Prize last year to Herr von Ossietzky, the German pacifist. The decree has been received with resentment in Sweden; but the Swedish Nobel Committee looks upon it as Germany's loss, for, since 1901 (when the first prize was awarded), nearly one quarter of all the Nobel prizes have been awarded to German citizens, and during the past ten years twelve out of the forty-one

(*Continued on p.* 241.)

NATURE

SUPPLEMENT

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THE ELECTRON:
ITS INTELLECTUAL AND SOCIAL SIGNIFICANCE*

By Dr. Karl T. Compton,
President of the Massachusetts Institute of Technology

WITHIN the past five years, centenaries, bicentenaries and tercentenaries have been much in vogue. Every town or institution or event which has claim to distinction has sought the excuse of the calendar to remind the world of its claims to greatness. Thus we have recently celebrated the centenary of Faraday's discovery of the principles of electromagnetism and the bicentenary of Watt's invention of the steam engine—discoveries which have introduced the eras of electricity and of mechanical power. The city of Chicago has sought to tell us that the progress of mankind really began with the founding of that community, and has led us to spend millions of dollars to gain the impression that there is really some causal relationship between Chicago and world progress. In my part of the country, the city of Boston and its suburbs staged a succession of tercentenary celebrations, as proud of their past as Chicago is of its present. Greatest of all was last summer's tercentenary celebration of Harvard University, signalizing the firm basis of intellectual freedom and leadership which is the prime requisite for a free people in a democracy.

Encouraged by the success of the Chicago Century of Progress and the Harvard Tercentenary, I venture to feature my address as signalizing an anniversary of the discovery of the electron. To be sure, it is only one generation old, and a generation is a sufficiently vague unit of time for my purposes. Yet, in spite of its youth, it bids fair to rival Chicago in its contributions to economic progress, and Harvard University in its contributions to the understanding of this world in which we live. So I venture to assert that no institution or community which has used one of these milestones to take stock of its achievements and plot its future course has stronger claims to intellectual significance and practical utility than I will claim for the electron.

The history of science abounds with instances when a new concept or discovery has led to tremendous advances into vast new fields of knowledge and art the very existence of which had hitherto been unsuspected. The discoveries of Galileo, Faraday and Pasteur are such instances. But, to my notion, no such instance has been so dramatic as the discovery of the electron, the tiniest thing in the universe, which within one generation has transformed a stagnant science of physics, a descriptive science of chemistry and a sterile science of astronomy into dynamically developing sciences fraught with intellectual adventure, interrelating interpretations and practical values.

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* Address of the retiring president of the American Association for the Advancement of Science, delivered at Atlantic City on December 28, 1936.

I take particular pleasure in mentioning these practical values, for even the most unimaginative and short-sighted, hard-headed, 'practical' business man is forced to admit the justification for the pure research—of no preconceived practical use whatsoever in the minds of those who led in its prosecution, and of all degrees of success and significance—which has been directed at the electron. For out of this research have come the following things which all can understand and appreciate : a growing business in manufacture of electronic devices which now amounts to fifty million dollars a year in America alone ; a total business of some hundreds of millions of dollars a year which is made possible by these electronic devices ; innumerable aids to health, safety and convenience ; and an immense advance in our knowledge of the universe in which we live.

THE BACKGROUND

In science, as in human affairs, great events do not occur without a background of development. The electron had an ancestry which can be traced back through the centuries. Its immediate progenitors were the electromagnetic theory of light, spectroscopy and the leakage of electricity through gases. First cousins were X-rays and radioactivity and quantum theory, for, out of a background of long investigation of bewildering and apparently unrelated phenomena, there burst upon the scientific world the X-ray in 1895, radioactivity in 1896 and the electron in 1897—all while investigators in the older fields of heat radiation and thermodynamics were finding those bothersome inconsistencies in these hitherto respectable subjects which led to that unexpected extension of Newtonian mechanics now called quantum mechanics. The concept of the electron, behaving according to the laws of quantum mechanics, is now the basis of most of our interpretation of all that falls under the good old name of natural philosophy.

That only the pioneers of the scientific world were prepared for these discoveries, however, is witnessed by the fact that a standard text-book of chemistry widely used in my student days in 1904 stated that, "Atoms are the indivisible constituents of molecules", and so late as 1911 a prominent physicist warned his colleagues not to be too hasty in accepting these new-fangled ideas.

The existence of electrons had been foreshadowed for a century by the facts of electrolysis, which led Davy and Berzelius to conclude that chemical forces were electrical in nature, and Faraday to conclude that electric charges exist only in multiples of some fundamental unit. For chemical acids and salts, dissolved in water, tend to split up into ions, that is, atoms or groups of atoms which move in an electric field in such directions as to indicate that they carry either positive or negative electric charges. Furthermore, it is found that the amounts of these ions which carry equal amounts of electricity are exactly proportional to the chemical combining weights of the ions. Faraday saw that this fact would be simply explained by assuming that every ion carries a charge proportional to its chemical valency, that is, the valency times a fundamental unit charge. But Faraday could not, from these facts, deduce the size of this unit of charge ; he could only state the ratio of this charge to the mass of the chemical substance with which the charge was associated. Hydrogen, being the lightest of all ions, had of all known substances therefore the largest value of this ratio of charge to mass.

The first real evidence of particles of larger ratio of charge to mass than hydrogen ions came from the field of optics. Ever since Maxwell's equations of electromagnetism had predicted the existence of electromagnetic waves with the velocity of light, and Hertz, seventeen years later, had discovered them experimentally, physicists had felt sure that light must be caused by some sort of oscillations of electricity within atoms. But only the vaguest and most unsatisfactory speculations, such as whirling vortices or pulsating spheres of electricity, had been suggested.

In 1896, however, Zeeman tried the experiment of examining the spectrum of a light source placed in a strong magnetic field, and discovered that the spectrum lines thus became split into components of slightly differing wave-length, and that these components of the light showed characteristic types of polarization depending on the direction in which the light emerged from the magnetic field. Almost at once, in January 1897, Lorentz showed that this experiment proved that light is caused by the oscillation of electric charges, the motions of which are affected by the magnetic field in the manner required to explain Zeeman's experiments. This much was not unexpected, but what was startling was Lorentz's proof that the Zeeman effect could only have been produced by electrified particles whose ratio of charge to mass is nearly two thousand times larger than that of a hydrogen ion, and whose mass is therefore presumably nearly two thousand times lighter than hydrogen.

Almost at once this conclusion was confirmed in a more dramatic and understandable way by J. J. Thomson, the then youthful director of the Cavendish Laboratory. But let me first pick up this thread of the story a little farther back.

DISCOVERY OF THE ELECTRON

All through the eighteen-eighties and early eighteen-nineties a series of most striking and unexpected discoveries followed from investigations of electric arcs, sparks and especially the glowing discharges of electricity at high voltages through glass tubes containing various gases at pressures far below atmospheric pressure. The striking colour effects, mysterious luminous streamers and entirely bizarre behaviour of these discharges made them the most popular, yet most elusive, subject of laboratory research of those days.

It was these phenomena which led Crookes to postulate the existence of a mysterious "fourth state of matter", different from the solid, liquid or gaseous states. (Of course, we now know that Crookes's fourth state is simply the ionized state of matter.) Once, while attempting to photograph the appearance of a discharge at very low gas pressure, Crookes was bothered by the fact that all the photographic plates in the room with his apparatus became fogged, as if light-struck in spite of their opaque wrapping. He avoided the trouble afterwards, however, by keeping his new supply of plates in another room until, one at a time, they were wanted for use. Thus he solved an experimental difficulty, and missed making a great discovery.[2]

At about the same time Röntgen, in Germany, was trying the same experiment, and he too was troubled by the fogging of his photographic plates. But, as the story goes, his laboratory assistant directed his attention to the peculiar fact that these fogged plates, when developed, showed the image of a bunch of keys which had accidentally been lying on top of the box of plates while the electric discharge experiments were in operation. Röntgen immediately looked into this and discovered that the fogging was due to penetrating radiations produced in the discharge tube where the cathode rays struck the target or anode. Thus by accident were X-rays discovered—that type of accident not uncommon in science when an observant experimenter is at work.

While on the subject of accidents, I might digress to tell of another accident which did not happen, also in connexion with X-rays. For more than fifteen years after their discovery, disputes raged as to whether X-rays were radiations, like light but of very short wave-length, or electrically neutral particles of small mass and high speed. It was evident that they were not electrically charged, since their paths were unaffected by electric or magnetic fields. The leading advocate of the neutral particle theory was W. H. Bragg. In 1912, at Princeton, O. W. Richardson tried an experiment to see if X-rays could be refracted by a prism. A positive result would support the wave theory of X-rays. People had tried this with X-rays through glass prisms without success, but Richardson had an idea that an iron prism might be more effective. So he passed X-rays for hours and days through the tapering edge of a Gillette safety razor blade, but without finding any refraction. If he had happened to try the edge of a crystal instead of the edge of the razor blade, he would undoubtedly have discovered the peculiar diffraction of X-rays in passing through crystals, discovered a couple of years later by Laue, Friederich and Knipping and developed by father and son, W. H. and W. L. Bragg, which proved both the wave nature of X-rays and the atomic lattice structure of crystals. If Röntgen's discovery of X-rays was an accident, then I suppose Richardson's failure to discover diffraction of X-rays was a negative accident. I often wonder how many important negative accidents slip past us week by week!

But to get back on the subject of the electron: it was the cathode rays, which produce the X-rays, which finally turned out to be electrons travelling at high speeds. These cathode rays had been observed to shoot out in straight lines from the surfaces of cathodes in rarefied gases through which electric currents were forced by high voltage. Objects which they struck became luminous with fluorescent light, and objects in their paths cast shadows. But their true nature was disclosed when a magnet was placed near the discharge tube, for then their paths were curved in a direction showing that cathode rays were negatively charged. By measuring this curvature produced by a magnetic field of known strength, and making a pretty sure assumption that the kinetic energy of these rays was determined by the voltage applied to the tube, J. J. Thomson in 1897 first showed that cathode rays are negatively charged particles with a ratio of charge to mass nearly two thousand times that of hydrogen. He furthermore showed that these particles are of the same type, as regards ratio of charge to mass, from whatever gas or cathode material they are produced. He therefore announced these particles, which he called 'corpuscles', to be universal constituents of all substances. Thus was the electron discovered.

MASS AND CHARGE OF THE ELECTRON

Quick and fast came experiments of ingenious design to study the electrons more accurately. They were pulled this way and that by electric and magnetic fields. They were caught in miniature metal fly-traps, called Faraday cages, to measure their charge and kinetic energy. They were detected in their paths electrically, or by photographic plates or by fluorescence. Continually refined from that day to this, we now know that an electron has a ratio of charge to mass which is about 1,842 times the similar ratio for a hydrogen atomic ion.

It was also very desirable to know separately the charge and the mass of an electron, and not just the ratio between these quantities. So an even more interesting lot of experiments has been carried on to measure the electron's charge. They were begun in about 1900 by J. J. Thomson and his colleagues, Townsend, H. A. Wilson and C. T. R. Wilson. I think a brief résumé of attempts to measure the electron's charge will throw an interesting sidelight on the versatility of scientific attack on a difficult problem.

The first attempts were by Townsend, by measurements on the motion and electrification of fog produced when electrolytic gas was bubbled into a region of air which was slightly supersaturated with water vapour, but too many uncertainties were involved to make this work convincing. The first accepted results were by J. J. Thomson, who, after an earlier attempt, employed a technique of producing fog under controlled conditions, developed by his colleague, C. T. R. Wilson, whose method was refined further by his pupil, H. A. Wilson.

It had long been known that water droplets of fog do not form in air which is somewhat supersaturated with water vapour unless there are nuclei, like specks of dust, on which the moisture can condense. Later, Townsend found that fog will also condense on ions, and more readily on negative than on positive ions. C. T. R. Wilson designed an apparatus in which dust-free air could be supersaturated with moisture sufficiently to permit condensation of fog droplets on negative but not on positive ions, which were produced by some convenient ionizing agent. So a fog was formed, in which each droplet of water was condensed on a negative ion. Thomson employed this apparatus in the following manner.

Of course, this fog gradually settled downward under the pull of gravity—slowly because the drops were small compared with the viscous resistance of the air through which they fell. It was like the slow settling of dust on the furniture and floor of a room. But the theory of the rate at which spheres move when a force drives them through a viscous medium was already well known, due to Stokes's law. From this law, measurement of the rate of fall of the fog in centimetres per second as measured by a little telescope focused on the top edge of the fog, combined with knowledge of the force of gravity and the viscosity of air, enabled Thomson to calculate the size of the individual fog droplets. Dividing the total amount of water in the fog by the amount in one drop gave him the total number of fog droplets, and therefore the total number of negative ions. H. A. Wilson added the refinement of superposing an electric field on the gravitational field which pulled the drops through the air. Then, as the fog settled to the bottom of the apparatus, it deposited its electric charge, which, altogether, was large enough to be measured with an electrometer. So, dividing this total charge by the number of ions composing it gave, as the charge of one ion, $3{\cdot}4 \times 10^{-10}$ electrostatic units. This was the first real measurement of the charge of an electron, and was the value quoted in the tables of physical constants when I became a graduate student in 1910.

About that time Millikan, who has always had a flair for picking strategically important subjects to which to devote his investigative talents, undertook with his students a revaluation of the electronic charge. Sources of error in the fog method were well recognized: fog droplets were not all the same size, though measurements could only be made on those smallest ones which fell most slowly; also droplets did not remain of constant size, smaller ones tending to evaporate and larger ones to grow; also there were unavoidable convection currents in the air which modified the rate of fall of the fog; and some droplets might contain more than one ion.

Millikan cleverly avoided or minimized these difficulties by using only a single droplet of some relatively non-volatile liquid like oil or mercury. By ionizing the surrounding air in an electric field he could put various electric charges on the drop. Illuminating it by a powerful light and viewing it like a star through a measuring telescope, he could measure its rate of fall under gravity and its rate of rise when pulled upward against gravity by an electric field, and keep repeating these observations for hours. These measurements were so precise that, to keep pace with them, he had to measure the viscosity of air with hitherto unequalled accuracy. When all this was done, he had proved conclusively that all electric charges are integral multiples of a fundamental unit charge, the electron, the value of which he set as $4 \cdot 774 \times 10^{-10}$ electrostatic units—about 40 per cent larger than the earlier estimates and believed by Millikan to be correct within one part in a thousand.

Within the past half-dozen years, however, doubt has been thrown on the estimated accuracy of this value from quite a different direction, in work with X-rays. Originally, X-ray diffraction experiments in crystals proved the geometric arrangement of atoms in the crystals, but did not establish the scale of distances between atoms or the X-ray wave-length. These distances, once the arrangement of atoms was known, were calculated from absolute values of the weights of the atoms, which in turn were derived from electrochemical equivalents and the value of the electronic charge. Thus X-ray wave-lengths, masses of atoms and distances between atoms in crystals all had values dependent on knowledge of the charge of the electron.

Recently, however, A. H. Compton, Bearden and others have succeeded in making measurements of X-ray wave-lengths by diffracting X-rays from a grating ruled with 15,000–30,000 parallel fine lines to the inch, and operating near the angle of grazing incidence. These measurements involve only knowledge of the number of lines per inch on the grating, and the angles of incidence and diffraction of the X-rays—both depending only on measurements of length and capable of high precision. X-ray wave-lengths thus measured were a little different from the earlier accepted values, and this cast doubt on the accuracy of the electron charge value which had been used in the earlier X-ray estimates. The difference was not large, only about one part in two hundred, but it meant either that experiments had not been as accurate as believed or that there was some unrecognized complicating factor.

So Millikan's work has been repeated in various laboratories with refinements, such as the use of a remarkably non-volatile oil for the drop. But the chief error was found to lie in the measurements of the viscosity of air. During the past year Kelletrop, of Uppsala, has thus published a revised 'oil-drop' determination of electronic charge as $4 \cdot 800 \times 10^{-10}$ E.S.U., which is in excellent agreement with the 'X-ray' determinations. Bearden has just presented his own confirmation of this agreement before the American Physical Society.

It is an interesting coincidence that this best value of the charge of the electron is exactly the same as the figure given by Rutherford thirty years ago, though then determined with so much less precision that not much confidence was placed in it, except as to order of magnitude. It was then known that the alpha rays from radium are helium atoms which have lost two electrons and are therefore doubly positively charged. Rutherford caught a lot of these alpha rays in a metal trap, measuring their aggregate electric charge with an electroscope, and counting them by the scintillations which they produced on striking a fluorescent screen or otherwise. Dividing the total charge by the number gave him double the electronic charge, which he thus calculated to be $4 \cdot 8 \times 10^{-10}$ E.S.U. Already knowing the ratio of charge to mass with high precision, this value of the charge enables us to fix the electron's mass as $9 \cdot 051 \times 10^{-28}$ grams.

ELECTROMAGNETIC MASS

When we speak of the mass of an electron, however, we enter a whole new field of ideas. Some years before the discovery of electrons, J. J. Thomson had pointed out that an electrified particle will possess inertia, that is, mass, simply in virtue of its charge alone, irrespective of whether or not it has any mass of the gravitational type which we have been accustomed to think of. This 'electromagnetic' mass comes about from the fact that any mechanical energy which is expended in accelerating an electric charge is transformed into the energy of the magnetic field surrounding the electrified particle in virtue of its motion. In fact, the kinetic energy of a moving electric charge is found to be simply the energy of its magnetic field and depends only on the square of the velocity of the charge, the amount of charge and the geometrical shape of the charge.

Making the simplest possible assumptions about the shape of an electron, such as a solid sphere or a hollow spherical shell of electricity, and assuming all its mass to be of electromagnetic origin, the diameter of an electron was calculated to be of the order of 10^{-13} cm. It must be emphasized, however, that this estimate of size is not, like the charge and mass, a definite measurement, but is simply an estimate based on assumptions, at least one of which is quite uncertain. For while we have both logic and experiment to back up the assumption that all the mass of the electron is of this electromagnetic origin, we must confess to utter ignorance regarding the shape of the electron. Indeed, some facts suggest that it may have different sizes and shapes in different environments, as in the free state or in an orbit of an atom or in the nucleus of an atom. So our estimate of 10^{-13} cm. for the size of an electron is, at best, very crude.

The idea of electromagnetic mass was strongly supported by the fact that measurements of the mass of very fast moving electrons, through measurements of the ratio of charge to mass of beta rays from radium or cathode rays in high-voltage discharge tubes, showed that their mass is not really a constant thing but increases with the speed of the electron. The value of electron mass given above applies, strictly speaking, only to an electron at rest. Practically, however, it is accurate enough for practical purposes for electron speeds below about one tenth the speed of light. At this speed the electron's mass is about half of one per cent larger than if it were at rest. At still higher speeds, the mass increases more and more rapidly, approaching infinite mass as the speed of light is approached.

These facts, experimentally determined, were shown by Abraham to be of the type expected if the entire mass of an electron is of electromagnetic origin, due entirely to its electric charge. It was this argument, which has since received confirmation from other directions, which was the basis of the theory that all mass, that is, all matter, is electrical. However, the simple electromagnetic concepts were not quite adequate to give an accurate quantitative interpretation of these experiments, and it required the additional introduction by Lorentz of the concepts of the special theory of relativity to bring about complete interpretation of the experiments.

THE ELECTRON AND QUANTUM THEORY

Just two things more do we know accurately about the properties of electrons, in addition to their charge and mass. We know that they are also tiny magnets of strength equal to the basic unit of magnetic moment generally called the Bohr magneton. Once the electron had been discovered, it became natural to seek in it also the explanation of magnetic phenomena, since it was only necessary to assume that the electricity of an electron is whirling about an axis, and the electron becomes endowed with the properties of a tiny magnet. Parsons, Webster and others examined the possibilities inherent in various assumed configurations, with interesting results. But it was only with the introduction of the quantum theory for the interpretation of atomic structure and spectra that the magnetic character of the electron has, within the last dozen years, been put on a well-established basis.

The other thing we know is perhaps the most unexpected of all the electron's properties—it behaves like a wave when it collides with other objects. Davisson and Germer discovered this in the Bell Laboratories, while examining the way in which a beam of electrons, incident on a solid surface, was scattered or reflected by it. They found, if the surface were crystalline, that the electrons were scattered just like diffracted X-rays, but that, unlike X-rays, the wave-length of an electron is not fixed but varies inversely as its speed. J. J. Thomson's son, G. P. Thomson, has made very illuminating studies of this phenomenon, which is the inverse of the Compton effect; together they have given physicists two mottoes: "Particles behave like waves and waves behave like particles" and "Here's to the electron: long may she wave". One of the triumphs of the new wave-mechanics (a brand of quantum mechanics) is that it offers a medium of explanation of these strange phenomena. But my subject of the electron is too long to let me attempt a digression on wave mechanics.

SIGNIFICANCE OF THE ELECTRON CONCEPT

With this sketch of the electron itself before us, let us turn to some of the more important directions in which the electron has given us an interpretation of the physical universe generally. Immediately were explained the phenomena of electrolysis and of ionization generally, for ions were simply atoms or groups of atoms which had gained or lost one or more electrons. Primary chemical forces were explained as the electrostatic attraction between atomic groups which, respectively, contained an excess or a deficiency of electrons. (The more refined interpretation of chemical forces within the past half-dozen years, by Pauling and Slater, has been based upon the quantum theory of atomic structure.)

The three types of rays from radioactive substances were interpreted: alpha rays as helium atoms which had lost two electrons; beta rays as electrons; and gamma rays as X-ray-like radiations. In fact, Becquerel showed the magnetic deflection of beta rays in the same year, 1897, that Thomson showed the magnetic deflection of cathode rays and interpreted them as electrons.

For many years two unexplained phenomena had been studied in metals. When highly heated or when illuminated by ultra-violet light, metals had been shown to emit negative electricity. It was the work of but a year, after the discovery of the electron, for J. J. Thomson and his pupils to show that both these phenomena consist in the emission of electrons. But by what mechanisms are they thus emitted? That was a question the study of which has led to most important theoretical and practical consequences.

Richardson, first as a pupil of Thomson and then as a professor at Princeton in the early nineteen hundreds, developed the theory of thermionic emission of electrons, according to which the electrons are evaporated from the surface of a metal at high temperatures by a process very analogous to evaporation of molecules. The electrons are assumed to have the same distribution of kinetic energies that molecules possess at the same temperature in accordance with the principles of kinetic theory. They escape from the surface, if they reach it, with enough energy to take them away in spite of the attraction tending to pull the electron back into the metal. This attraction is expressed in terms of the now famous 'work-function', a sort of latent heat of evaporation of electrons, which is the work that must be done to get an electron clear of the surface. With these simple assumptions, an equation was derived for the rate of emission of electricity as a function of temperature which has stood the test of perhaps as wide a range of experimentation as any other equation of physics, a range of values of more than a million-million fold in current without any detectable departure from the theory, if this is properly applied.

Richardson's measurements of the 'work-functions' of various metals showed that these values run closely parallel with one of the longest known but least understood properties of metals, namely, their contact potential properties. By contact difference of potential is meant the voltage difference between the surfaces of two metals when they are placed in contact. Richardson found that the difference between the 'work-function' of two metals was, within the limits of accuracy of the data, the same as their contact difference of potential. He therefore proposed the theory that the contact potential property of a metal is determined simply by the work necessary to remove an electron from its surface.

As a beginning graduate student under Richardson in 1910, I was given the job of undertaking a test of this theory through experiments on the other electron-emitting phenomenon, the photoelectric effect. Einstein a few years before had proposed his famous photoelectric equation, which was a contribution to physical theory certainly comparable in importance and thus far more useful in its applications than his more impressive and wider publicized general theory of relativity. According to it, an electron in a metal may receive from the incident light an amount of energy proportional to the frequency of the light—to be exact, an energy equal to Planck's constant h times the frequency ν. If it escapes from the metal, it must do an amount of work w to get away, so that its kinetic energy after escape from the metal would be the difference $h\nu - w$. Obviously, by measuring these kinetic energies of electrons liberated from various metals by light of various frequencies, it should be possible to find out if the 'work-functions' w of different metals are indeed related to their contact differences of potential in the manner predicted by Richardson's theory.

In two papers, by me in 1911 and jointly with Richardson in 1912, it was concluded first that the contact differences of potential are related to the 'work-functions' as Richardson had predicted, and secondly that Einstein's photoelectric equation, rather than a rival theory then under discussion, properly described the facts. Practically simultaneously with this second paper, there appeared the report of a similar verification of Einstein's equation by A. L. Hughes, then in England, though lacking the quantitative connexion with contact differences of potential.

This early work was not very accurate, partly because of lack of good vacuum technique for maintaining untarnished surfaces in a vacuum, partly through lack of constant sources of ultraviolet light and partly because the ultra-violet spectrographs used to isolate the various wavelengths of light gave a certain spectral impurity of scattered light of other wave-lengths. These sources of error were recognized but not overcome when Millikan, in 1916, made a striking advance by using doubly purified light or otherwise correcting for the effects of impurity, and secured a verification of Einstein's equation which was far more accurate than the earlier work as regards the value of Planck's constant h. In fact, Millikan's work remains to this day as one of the best determinations of this important constant. In regard to the 'work-function', however, this work of Millikan's was not so successful, for, after having apparently discovered facts at variance with Richardson's interpretation of the equation and its relation to contact potentials, these differences were ultimately found to reside in faults of experimental procedure or interpretation, so that Richardson's interpretation of Einstein's equation still holds.

In both thermionic and photoelectric effects, theoretical refinements have been introduced by the recent quantum mechanics, and great advances made in experimental technique. However, it is fair to say that their interpretations on the electron theory have been among the major achievements of this theory.

CONDUCTION OF METALS

While we are on the subject of electricity in metals, what constitutes the phenomenon of easy flow of electricity that is the distinguishing feature of metals ? J. J. Thomson at once suggested that this must be due to the existence in metals of electrons free from their parent atoms, moving freely, except for collisions, whenever an electric field was applied in the metal. The theory thus worked out was attractive, but it encountered inconsistencies. There was not even any real evidence that electricity in metals was conducted by electrons.

Then along came Tolman with one of his brilliant ideas, skilfully followed by experiment. It had earlier been suggested that, whatever are the carriers of electric current in metals, it should be possible to centrifuge them toward the periphery of a disk if this were rotated very rapidly about its axis. To be more specific, if electrons are free to move in metals and if a wire connects the centre and the periphery of the rotating disk through lightly pressing brush contacts, electrons should be thrown out of the disk at its periphery and pass back into the centre of the disk through the wire. It would be rather analogous to a current of water driven by a centrifugal pump through a pipe circuit. But all attempts to detect such currents proved futile, because the currents produced by the friction of the contact against the periphery were far larger than the currents to be expected from the centrifuging of electrons.

But Tolman devised two methods of giving powerful accelerations to metal conductors in such manner that he was able to measure the feeble electric currents that were produced as the carriers of electricity in the metal were shaken back and forth, and his calculations showed that these currents were indeed of the size to be expected if the current is carried by electrons. This is our direct evidence that electrons carry the electric current in metals. The mechanism by which they do this is now beginning to be disclosed by Slater, on the basis of an application of quantum mechanics and spectroscopic ideas to metals, and again is an example of the refining power of the quantum theory to succeed where older classical theory was gropingly suggestive, but inadequate.

STRUCTURE OF THE ATOM

Now that I come to the most basic of all the phenomena which the electron has been called upon to interpret, I almost lose courage, for the subject is too vast and complex for anything but encyclopædic treatment. I refer to the structure of atoms. Previous to the discovery of the electron, literally nothing was known of the internal structure or composition of atoms. With this discovery, however, it immediately became evident that all atoms contain electrons and an equivalent amount of positive electricity in some form. It was again J. J. Thomson's genius which began the investigation of the inner atom. This was only about twenty-five years ago.

Thomson reasoned that, if X-rays were made to fall on any substance, the electrons in the atoms of the substance would be forced to vibrate back and forth by the powerful alternating electric forces in the X-ray waves. But, in thus vibrating back and forth, these electrons would re-radiate secondary X-rays in all directions. He calculated just what fraction of the original X-ray energy ought to be thus re-radiated by each electron, and then set his pupils to measure just what this fraction was in specific cases. From the experimental results he was thus able to calculate the number of electrons which performed the re-radiation in each case. These results indicated that the number of such acting electrons in each atom was about half the value of the chemical atomic weight of the atom. Thus first were counted the electrons in an atom.

Rutherford and his pupils, aided by the mathematical analysis of Darwin, tackled the problem from a different point of view. They studied the distribution of deflection of alpha particles, shot out of radioactive materials, as these alpha particles traversed thin sheets of solid materials. They found that this distribution was quantitatively what would be expected if the deflections were produced by ordinary electrostatic forces, varying as the square of the distance, between the alpha particle and a very small object containing most of the mass in each atom. They were thus able to show that this small object is not more than one ten-thousandth of the diameter of the atom, that it contained substantially all the mass of the atom and that it carried a positive electric charge equal, in electronic units, to about half the chemical atomic weight of the atom.

Thus arose the concept that the atom is composed of a positive nucleus of small dimensions, surrounded by electrons to the number of about half the atomic weight.

This had scarcely become established when it was brilliantly refined and extended by Moseley, just before he went to his untimely death in the Great War in 1914. Moseley had made a most ingenious study of the spectra of X-rays of a large number of the chemical elements, using a modification of the X-ray spectroscopy technique developed by the Braggs. He found that the square roots of the frequencies of the characteristic X-ray lines were numerically very simply related to the number which gave the place of the element in the periodic table of the elements, so useful to chemists but so entirely without explanation. Thus this number acquired a definite physical significance and is now well known as the 'atomic number'.

For all the elements heavier than hydrogen, this atomic number is about half the atomic weight and, to make a long story short, this atomic number turns out to be exactly the number of electronic units of charge on an atomic nucleus, or the number of electrons in the atom outside the nucleus. At the same time, Moseley's work proved to be one of the greatest advances ever made in the basic interpretive side of chemistry.

Now that the number of electrons in each atom was known, the next step was to wonder how they were arranged, what held them in place and what they were doing in their spare time. Suggestions were not slow in coming. In fact, even before Moseley's work, two rival theories had appeared, one devised by chemist Lewis and extended by Langmuir to explain the directional symmetries of atoms as indicated by their molecular combining forms, and the other devised by physicist Bohr to account for spectra. Gradually the Bohr theory has been developed to include the symmetries of the Lewis-Langmuir theory, so that both may be said to be merged, with many major additions too numerous to mention.

It was Bohr's bold genius to cast off some of the fetters of classical mechanics, which had been fairly well proved inadequate to meet the situation, and to devise a new mechanics frankly to meet the simplest known facts of atomic structure and spectroscopy—the hydrogen atom and the atomic hydrogen spectrum. In doing so, he at one stroke brought into the same picture the quantum theory of radiation, the electronic structure of the atom and the facts of spectroscopy. He had his electron moving in a circular orbit around the nucleus under the regular laws of electrostatic attraction and centrifugal force. But he stipulated that only such orbits were possible in which the angular momentum of the electron was an integral multiple of Planck's constant h divided by 2π. He also stipulated that the electrons should not radiate energy while revolving in their orbits, but only when they jumped from one orbit to another. In this case the frequency of light radiated was equal to the change of energy of the electron between the two orbits, divided by Planck's constant h. With these assumptions, the spectra of hydrogen and of ionized helium were quantitatively explained in their main features, but not in their finer details.

Then came the Great War, and we heard little of atomic structure in the United States. But in Germany, Sommerfeld was extending Bohr's ideas in most interesting ways. He showed that, by considering elliptic as well as circular orbits, and taking account of the variation of the electron's mass with speed, the fine details as well as the main features in the spectra of hydrogen and ionized helium were accurately explained. He also showed how the theory could be extended to deal with atoms where there were many electrons moving in orbits. He showed that these additional concepts were in the right direction to explain the more complicated spectra both in the visible and in the X-ray regions.

SPECTRAL LINES

When this new work first was known in America, it started the most feverish and earnest scientific activity that the country has ever known, which is still in progress with undiminished zeal and with increasing productive effectiveness. I well remember when the first copy of Sommerfeld's "Atombau und Spectrallinen" came to America in the possession of Prof. P. W. Bridgman. Until later copies arrived, he knew no peace and enjoyed no privacy, for he was besieged by friends wanting to read the book—which he would not allow to go out of his possession. I recall, too, the sudden popularity of the only two or three men in America who knew what a spectral series was. Heretofore, practically our only interest in spectra had been in the culinary variety of spectroscopy used by chemists in identifying chemical elements. No interpretive quality to speak of had hitherto been attached to the peculiar numerical regularities which had been discovered in the vibration frequencies of groups of spectrum lines.

I recall, too, the dismay with which we found only a handful of mathematical physicists versed in the analytical dynamics underlying the new atomic structure theories. In the summer of 1921, having been taught by one of these few mathematical physicists, I went to the University of Michigan to lecture on Sommerfeld's theory, and found there also F. A. Saunders, invited to impart his knowledge of spectrum series. In the winter of 1926, Born and Jordan having just announced a new development in quantum mechanics, I found more than twenty Americans in Göttingen at this fount of quantum wisdom. A year later they were at Zurich, with Schrödinger. A couple of years later, Heisenberg at Leipzig and then Dirac at Cambridge held the Elijah mantle of quantum theory. In America, contributions are coming rapidly, particularly in the fields of application to chemical interpretations, metals and other complex situations.

From all this has come the situation which permitted Dirac, a few years ago, to write: "The underlying physical laws necessary for the mathematical theory of a large part of physics and the whole of chemistry are thus completely known, and the difficulty is only that the exact application of these laws leads to equations much too complicated to be soluble". But if any ambitious young scientist be discouraged lest there be little left to do, let him consider the unexplored atomic nucleus, or the fact that every attempt to apply these laws, which look so satisfactory to us now, discloses new realms of knowledge still unexplored.

Time forbids mention of the most interesting work which was done to check and extend the theories of atomic structure, through direct measurement of the energy states of atoms and molecules by carefully controlled bombardment of these molecules by electrons. Begun by Franck and Hertz in Germany, much of this work was done in America by Foote and Mohler at the Bureau of Standards, by my students at Princeton and by Tate's group at Minnesota, all since 1920.

Before leaving the interpretive triumphs of the electron, however, I cannot refrain from jumping from the atom to the universe, to the interpretation of conditions on the stars. Spectra of stars had long been known, and these were interpreted as indicating that some stars consist principally of hydrogen, others of helium and others of many chemical elements like our sun. But in 1922, a young Indian physicist, Meghnad Saha, first applied atomic structure theory and knowledge of ionizing potentials to the sun and stars. He considered ionization in the hot vapours of the stars to be like a chemical dissociation produced by heat, in which the products of dissociation are electrons and the positive ionic residues of the atoms, and in which the heats of dissociation are given by the ionizing potentials of the atoms. In this way was developed a rational quantitative interpretation of stellar spectra which has thrown enormous light on the problem of conditions of temperature, pressure and condition of the chemical elements in stars. Russell in America and Milne in England have ably applied and extended this theory.

The Electron in Industry

Finally, I come to the last phase of my subject, the social significance of the electron. By this I mean, of course, its useful applications. The first of these was Edison's invention of a thermionic rectifier, based on his discovery that negative electricity would flow across a vacuum from a hot filament to an adjacent electrode, but would not flow in the opposite direction. This was some years before the electron was discovered as the responsible agent in this phenomenon. But within a few years after the discovery of the electron, Fleming had shown that this same device will operate to rectify radio wave impulses, and thus permit their detection with a sensitive direct-current instrument. From this was patented the Fleming valve.

Once the basic character of thermionic emission was understood, and spurred on by the opportunities opening up in the radio field, new inventions, improvements and applications of thermionic devices came rapidly. Of major importance was the three-electrode tube amplifier of De Forest. Industrial research laboratories in the communications and electric manufacturing business took the lead in developing techniques and in penetrating scientific exploration. Noteworthy were the vacuum techniques and the monomolecular layers of activating materials developed by Langmuir and the high-vacuum thermionic X-ray tube of Coolidge. In the Bell Laboratories, oxide-coated filament tubes of good performance were developed and applied particularly to use in long-distance telephony. Let me give just two illustrations of the marvellous powers of some of these instruments.

It has been calculated that the energy of a trans-Atlantic radio signal caught by the receiving station in Newfoundland comes in at about the rate required to lift a fly seven inches in a year!

What is the largest number that has any physical significance? This is impossible to answer, being largely a matter of definition. But one common answer to this is 10^{110}, or one followed by 110 ciphers. This is about the number of electrons (the smallest things known) which would be required to fill up the universe to the greatest distances discovered by astronomy, if the electrons could be imagined to be closely packed side by side to fill up this whole space. Yet this number, large as it is, is very small indeed compared with the aggregate factor by which the energy of a voice striking a telephone transmitter in San Francisco is amplified by electronic tubes in the process of a long-distance telephone conversation to London. This amplification factor is about 10^{256}, or unity followed by 256 ciphers. If the universe were multiplied in size by the number of times it is larger than an electron, it could still not hold as many electrons as the number of this telephone amplification factor!

Then, mostly within ten years or so, has come an active introduction of thermionic devices which are not highly evacuated, but operate with supplementary action of intense ionization of the gas in the tube. First of these were the low-voltage arc rectifiers, like the tungar. Most interesting and versatile are the thyratrons, which permit easy control of powerful currents and machinery, and give a new means of converting alternating into direct current, or vice versa. In this group also are some of the new types of lamps, of high efficiency or special colour.

Not so striking, but equally interesting, have been the useful applications of the photoelectric effect. First was the use of sensitive photoelectric cells to replace the eye or photographic plate in astronomical telescopes. Then came sunshine meters, devices to open doors or count people or sort merchandise automatically, or to register the speed and licence number of the unwary autoist. Most important thus far are the current-producing mechanisms in the sound-movie apparatus and in television equipment.

While, commercially, radio, sound movies and long-distance telephony are at present of greatest importance, of no less importance, especially to us as scientists, are the marvellous tools which have been put into our hands for further research in practically every field of science, from physics and chemistry to psychology and criminology.

So we see how, within one generation, the electron has been discovered and examined, with its aid our intellectual outlook upon the universe has expanded in content and simplified in basic concept, and in its use mankind has the most versatile tool ever utilized. The end of the story is far from told. Every fact or relationship of the electron appears fuzzy with uncertainties when closely examined, for it can truly be said that every discovery discloses a dozen new problems. The field of practical and commercial uses of electronic devices is certainly still largely in its early stages of exploration.

This story illustrates in vivid manner a number of characteristics of scientific work, some of which I shall simply enumerate: (1) progress comes by spurts of advance as some big new idea opens up new territory, alternating with periods of consolidation; (2) progress comes not by revolution or discarding of past knowledge and experience, but is built upon past experience and is its natural extension once the vision from new vantage points is secured; (3) there is nothing so practical in its values as accurate knowledge, and the pursuit of such knowledge has been most successful when not fettered with the initial demand that it be directed toward practical ends

I would not give the impression that it is only the electron which has given new life to modern physical science. A story of similar interest could be built around the new concepts of radiation and atomic energy as expressed in the quantum theory, or about the electron's big brother, the proton, or his rather nondescript cousin, the neutron. In the atomic nucleus is a field of further exploration of enormous promise, now only beginning to be opened up by use of radioactive materials, cyclatrons and high-voltage generators.

Although these things have happened very recently, no one has better described the process and intellectual value of this type of scientific research than did Aristotle in the quotation which is inscribed in Greek on the façade of the National Academy of Sciences building in Washington: "The search for truth is in one way hard and in another easy, for it is evident that no one can master it fully nor miss it wholly. But each adds a little to our knowledge of Nature, and from all the facts assembled there arises a certain grandeur."

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recipients of Nobel prizes for physics, chemistry and medicine (more than one quarter) have passed to Germans. Herr Hitler has decreed the creation of three German National Prizes of 100,000 marks (£8,300) each, to be awarded annually to Germans distinguished in art and science.

Gold Medal of the International Faculty of Sciences

At the dinner following the annual conference of the International Faculty of Sciences applied to Human Progress, held in London on January 30, the Faculty's Gold Medal was presented to Mr. John Logie Baird, inventor of the Televisor, and managing director of Baird Television, Ltd. The chairman, Dr. Joseph S. Bridges, said the presentation was made in recognition of Mr. Baird's outstanding contributions to the science of television. In acknowledging the presentation, Mr. Baird indicated the progress that had been made since he first, in 1925, secured a television image with distinct definition. While the high cost of the apparatus at present is a drawback to its wide use among amateurs, he looked forward to a substantial reduction in the near future. Great Britain, he said, definitely leads in the science of television and is the only country in the world which has a television service. Among other speakers, Dr. L. E. C. Hughes commented on the necessity of scientific workers in all branches co-operating more closely to ensure that the achievements are properly applied to the requirements of human progress, and indicated the value of the International Faculty of Sciences in bringing into close touch such workers in all the countries of the world. Prof. B. W. Holman, replying on behalf of "The World's Scientific Workers", stressed the necessity for the social sciences being developed to keep pace with other sciences, so that the achievements of the research workers could be applied in accordance with the objectives of the Faculty, namely, human progress.

Aboriginal Tribes of the Malay Peninsula

While of the aboriginal tribes of the Malay Peninsula the Sakai, the Semang and the Jakun, though by no means well known, have been the subject of careful investigation by a number of observers, the Temiar, a hill people of Perak, are virtually untouched in an anthropological sense. Yet they number nearly one half of the aboriginal population of 25,000. They have, however, been made the subject of a considerable study by Mr. H. D. Noone of the Perak State Museum, who has given some years to the investigation of their culture, their ethnic affinities, and their language, which is said to belong to the Austro-Asiatic group, and to show Indo-Chinese affinities. A preliminary outline of Mr. Noone's results in *The Observer* of January 24 is cabled from Singapore, where a number of the tribe are staying at present for the purpose of a record of their speech. It is there stated that Mr. Noone finds that the Temiar show traces of negritic influence and also an Australoid type, akin to the Vedda, but that, essentially a hill tribe, they link up with the hill stocks of Sumatra and other parts of south-east Asia. They are lighter skinned than the Sakai and belong to a higher order of intelligence and culture. They build communal long-houses instead of the rude shelters of the Sakai, use the bow, and hunt with the blow-pipe. Their religion is animistic. For driving out the spirits of disease, they make use of the religious dance, in which the medicine man is an important figure. These dances are performed in the event of an epidemic, the dancers becoming 'possessed' by a tiger spirit. Eventually they fall into a state of trance, which sometimes ends in complete rigidity.

Tracks for Cyclists

The recent Ministry of Transport accident inquiry proves that, notwithstanding the increase in the number of motor-cars, the casualties among motorists are decreasing. On the other hand, casualties to cyclists are increasing at an even greater rate than we might expect from the growth of the cycling habit. According to a paper read at the National Safety Congress, fatal accidents to pedal cyclists during the seven years 1928–34 had increased no less than 122 per cent. In *Roads and Road Construction* for January 1, it is suggested that the best way to check increase of these accidents would be to copy some of our Continental neighbours and increase largely the number of special cycle tracks available. In Germany there are already about 1,100 miles of track, about two thirds of which is State maintained. According to a recent statement, the decrease which has occurred in recent years in cycling fatalities in Germany can be attributed directly to the making of these tracks. The German authorities are aiming at the provision of no less than 24,000 miles of track. The opposition that cyclists' touring clubs make to special tracks seems to arise from a fear lest these tracks be made not wide enough, so that they will have to travel at the most two abreast, instead of as at present three or four or even more abreast. In the interest of the general safety, it is probable that the privilege of riding three or more abreast will soon be curtailed by law. In many places cycle tracks, like public footpaths, could be built without fences, and probably a large mileage of existing 'green roads' could be utilized. If a number of special tracks were constructed every year, the annual cost need not be large. They would add safety, health and enjoyment to the weekly tours of many cyclists who at present have to pass through main roads crowded by rapidly moving vehicles and sometimes in an atmosphere full of noxious vapours.

Road Lighting in the United States

In *World Power* of November some interesting statistics are given, relating to road accidents, which illustrate the responsibility of bad or non-existent lighting for road deaths and injuries. On the Mount Vernon Highway, near Washington, there were 2·87 accidents per million vehicles per mile, between July 1 and December 1, 1932. When lighting was suspended during the depression, the number of accidents increased to 7·02 over the same period per million vehicles per mile—an increase of 250 per cent.

In New Jersey at present, the night-time accident rates on three unlighted main roads carrying dense traffic are 270 per cent more than the day-time rates. Another striking figure is that more than half the 36,400 people killed by motor-cars in 1935 were injured during the hours of darkness, although the traffic volume was certainly not more than one third that during the day-time. It is concluded that it is not surprising that American engineers are alarmed when they see that New York State, for example, makes an annual expenditure of about twenty-two million dollars in getting rid of railway, street and highway crossings, and yet does little towards the illumination of roads at night. The total number of preventable accidents in 1934 due to railway crossings was 151.

Merseyside Fauna and Flora

The Liverpool Naturalists' Field Club has recently issued volumes of *Proceedings* covering its activities for 1934 and 1935. This brings its number of annual *Proceedings* since its inception in 1860 to seventy-five, a noteworthy accomplishment, for they provide a valuable reference on the changing fauna and flora of the industrial north-west of England. The two latest volumes consist largely of the Ornithological Section report by Eric Hardy, who has built up within the Society the largest organized bird study group in the area. This includes bird-census counts over special areas, organized surveys of bird-calls at dawn and dusk, and statistics of migration and bird-ringing, nesting and rookery counts, etc. The Ornithological Section, states the Committee Report, is now organized independently of, but connected with, the general Field Club. The *Proceedings* also include Mr. W. A. Makinson's presidential addresses for the two years: "The Joys of a Nature Lover" and "Trees and their Service to Man". Reference is made to the discovery, in the Field Club library, of proof that the Society's first president and founder, the Rev. H. H. Higgins, visited the convent at Sinai and examined the famous "Codex Sinaiticus" previous to the examination by the collector Tischendorf. Having traced the journals of this Sinai visit, it is hoped to publish them.

The Scripps Institution of Oceanography

The August issue of the *Collecting Net* (**11**, No. 5) contains an article entitled "Biological Research at the Scripps Institution of Oceanography" by Dr. Claude E. ZoBell. It is announced that Dr. T. Wayland Vaughan is retiring from the University of California, his successor being Dr. Harald U. Sverdrup. During Dr. Vaughan's administration, the Scripps Institute of Oceanography has expanded enormously, and since his appointment as director in 1924 he has gradually developed an extensive research programme in biological oceanography with workers in all subjects connected with it. Among the many great improvements an important one is the growth of the library, which now contains more than 14,600 volumes, 1,100 charts and 30,000 pamphlets. Dr. Vaughan has contributed to the Institution his own personal collection of 1,800 volumes and 6,000 reprints of relevant literature besides numerous periodicals.

Physics Research at Osaka University

Vol. 3 of the "Collected Papers in Physics" from Osaka University consists of thirteen copies of papers which have appeared in the Report of Radio Research in Japan, the *Proceedings of the Physico-Mathematical Society of Japan*, the *Japanese Journal of Physics* and the *Proceedings of the Institute of Radio Engineers of the United States*, between June 1935 and March 1936. They cover subjects such as atomic bombardment, short-wave production, modulation of oscillators, polar molecules, electron diffraction, neutrons and protons and dynatrons. The volume extends to about 125 pages, and is produced by wiring together the separate copies of the papers, with a title page and table of contents, the size of the page being 19 cm. by 26 cm. The original covers of the papers are retained. This inexpensive method of issuing collected papers from periodicals with pages of the same size seems worthy of extension.

Misunderstanding and Misprint

A correspondent has sent us a copy of a programme for 1936–37 of a science society of a university, which contains two amusing misprints. The title of a paper to be contributed by a member of the zoological department of the university was sent in as "Life History of the Ling Cod". The secretary appears not to have recognized "ling" as a food fish of the cod family, so he altered the word to "living". The printers put the finishing touch upon the title by changing the last word also, so that the title appears as "Life History of the Living God", which must surely represent the most ambitious subject of a paper by a zoologist ever announced.

The Influenza Epidemic

The Ministry of Health reports that during the week ending January 16 the number of deaths ascribed to influenza in the 122 great towns of England and Wales was 1,100, as compared with 768 in the previous week. The number of notifications of pneumonia in England and Wales was 2,823 as against 2,338 in the previous week. A considerable increase of influenzal cases has occurred in most of the naval and military commands; but the epidemic appears to be declining in certain parts of the south. The age distribution of deaths is somewhat reassuring, as it is not the type usually met with in severe epidemics. According to Science Service bulletins, a wave of influenza is passing over the United States.

Parkes Memorial Prize

Major E. F. W. Mackenzie, R.A.M.C., has been awarded the Parkes Memorial Prize for 1936 for his investigations into the ammonia-chlorine process of water purification in the field, coupled with research carried out by him in connexion with food supplies in India. The Parkes Memorial Prize is awarded annually to the officer who is considered by the committee to have done most to promote the advancement of naval or military hygiene by professional work of outstanding merit, and is open to medical officers of the Royal Navy, the Army and the Indian Army, with the exception of the professors and assistant professors of the Royal Navy Medical College at Greenwich and the Royal Army Medical College during their term of office.

Studies in Ancient Indian History and Geography

REGULATIONS have now been framed for the work of the Trust founded by the generosity of Dr. Bimila Churn Law, of Calcutta. The funds of the Trust will be used to facilitate the publication of original contributions to the literature on Buddhism, Jainism and the ancient history and geography of India, down to the end of the thirteenth century A.D. The Trust will be administered by the Royal Asiatic Society. Applications for assistance under the terms of the Trust for the period January 1, 1937–December 31, 1938, should be addressed to the Secretary of the Society, 74 Grosvenor Street, S.W.1.

Science and Society

THE Association of Scientific Workers has organized a series of five public lectures under the general title "Science and Society", to be given at University College, London, on successive Wednesdays, beginning February 17. The lectures cover a wide range of topics, and the whole series should prove of unusual interest to scientific workers. Prof. J. B. S. Haldane will talk on "Facts and Theories concerning Human Race Differences" on February 17, and the chairman on this occasion will be Sir F. Gowland Hopkins. On the following Wednesdays, the lecturers will be A. L. Bacharach on "Nutrition and Society", Prof. H. Levy on "The Socialization of Mathematics", Prof. P. M. S. Blackett, on "Physics" and Prof. Lancelot Hogben on "The Social Background of Science". This is the first of an annual series of lectures on the general implications of science which the Association hopes to arrange. Further information and tickets (1s. for each lecture, 4s. for course of five) can be obtained from the Assistant Secretary, Association of Scientific Workers, Kelvin House, 28 Hogarth Road, S.W.5.

Checking the Michelson-Morley Experiment

THE following cablegram has been received from Prof. W. B. Cartmel, of the University of Montreal: " 'A Simple Means of Checking the Michelson-Morley Experiment'. In a letter under the above title which appeared in NATURE of January 16, I reported experiments in which I found a large fringe-shift with a small interferometer having one arm inclined at an angle of 45° and the other arm level. Unfortunately, on continuing my experiments with improved apparatus, this fringe-shift disappeared altogether, so that we get the same result with one arm inclined and one arm level as we do with both arms level, the effect previously reported being apparently spurious."

Announcements

H.R.H. THE DUKE OF GLOUCESTER has accepted the invitation to become president of the British Empire Cancer Campaign. His Majesty the King, when Duke of York, was president of the Campaign from 1924 until his accession to the throne.

THE Council of the Physical Society has awarded the fourteenth Duddell Medal to Prof. W. G. Cady, of the Wesleyan University, Middletown, Connecticut, U.S.A.

MR. COLIN BEVAN REES has been awarded the Foyle Prize at the University College of South Wales for his essay on "Can Science make a Positive Contribution to the Elimination of Armed Conflict?"

DR. LOUIS VERVAECK, director of the service of criminal anthropology in Belgium, has been awarded the Cesare Lombroso prize for criminal anthropology.

MCGILL UNIVERSITY, Montreal, has recently received a gift of 17,000 dollars from the Rockefeller Foundation to cover the expenses of a three-year programme of research in genetics and experimental cytology.

APPLICATIONS for grants from the Ella Sachs Plotz Foundation for 1937–38 must be made before May 1. For the present, researches will be favoured that are directed towards the solution of problems in medicine and surgery or in branches of science bearing on medicine and surgery. Further information can be obtained from Dr. Joseph C. Aub, Collis P. Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Massachusetts, U.S.A.

THE Trustees of the Lady Tata Memorial Fund invite applications for grants and scholarships for research in diseases of the blood, with special reference to leukæmia, in the academic year beginning on October 1, 1937. The grants and scholarships are open to workers of any nationality. Applications must be submitted before March 31, and the awards will be made by the Trustees in June. Further particulars and forms of application may be obtained from the Secretary of the Scientific Advisory Committee, 138 Bedford Court Mansions, London, W.C.1.

ATTENTION may be directed to catalogue No. 42 of Messrs. E. P. Goldschmidt and Co., 45 Old Bond Street, W.1, on navigation, geography, travels and shipbuilding. The catalogue, which is illustrated with several reproductions of old maps, contains many old and rare items including Amman's "Die grosse Allegorie auf den Handel", 1622; Belleforest's "Cosmographie Universelle", 1575; Honter's "Rudimenta cosmographica", 1542, of which very few copies are known; a hitherto unknown first map of Japan, 1586; and Kepler's "Tabulae Rudolphinae", 1627–30, containing his rare world map, which Nordenskjöld believed to be the earliest map showing any indication of the Australian coast line.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 252.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Magnetic Effects associated with Bright Solar Eruptions and Radio Fade-Outs

THE association of certain disturbances of the earth's magnetic field with bright hydrogen eruptions in the neighbourhood of sunspots, first indicated by Prof. Young, led to the conclusion that the solar effect was propagated to the earth with the velocity of light. Fresh impetus has been given these investigations by the observation of extensive radio fade-outs reported by Dellinger[1], at whose request special spectroheliograms were made at the Mount Wilson Observatory, Carnegie Institution of Washington, to investigate possible correlations[2]. A notable fade-out, a marked magnetic and earth-current disturbance, and an unusually bright hydrogen eruption on the sun, all occurring simultaneously, were observed from 16^{h} 45^{m} to 17^{h} 03^{m}, G.M.T., on April 8, 1936, at the Huancayo (Peru) Magnetic Observatory of the Department of Terrestrial Magnetism, Carnegie Institution of Washington[3] and elsewhere. Since then, two other pronounced similar occurrences, one on August 25 and another on November 6, have been reported from the Observatory[4,5], and many instances of a less conspicuous nature have occurred[6].

The characteristic features of these phenomena as revealed so far are a marked increase in intensity of the $H\alpha$ line in the region of a sunspot, cessation of radio reflections from the ionosphere, in particular for the higher frequencies, and in equatorial regions an increase in the horizontal component of the earth's magnetic field, and increases in the electric currents flowing in the earth's crust such as would be induced by the magnetic changes. All the effects, as above noted, begin quite sharply at apparently the same time and end coincidently after a time-interval of the order of 45 minutes. Conditions after the disturbances appear to be normal. The terrestrial effects apparently are confined to the daylight portions of the earth.

The disturbances of the earth's magnetism which accompany these solar outbursts are distinct from the perturbations associated with magnetic storms—the latter are evident at all parts of the earth, while the strong magnetic effects recorded at Huancayo during the outburst of April 8 could not be discerned at the Carnegie Institution's Watheroo Magnetic Observatory, Western Australia, 169° west of Huancayo. Furthermore, both immediately before and immediately after the three notable outbursts mentioned, the earth's field was comparatively free of perturbations, while the perturbations of magnetic storms usually persist for several days; it is not to be implied, however, that the phenomena cannot or do not occur while a magnetic storm is in progress.

The nature of the mechanism which produces the magnetic effects may be surmised from the meagre data already in hand. The disturbance of August 25, for example, may be attributed to a sheet of current in the ionosphere flowing eastward over Huancayo and northward over Cheltenham (U.S.A.) with densities of 60 and 30 amp. per km. width of the current-sheet at the two places, accompanied by corresponding oppositely directed currents inside the earth[4]. In direction and magnitude this current approximates that assumed to produce the ordinary diurnal variations of terrestrial magnetism. Thus the magnetic effects may be ascribed to an increase of ionization, produced by radiation of shorter wave-length than visible light, accompanying the increase of $H\alpha$ intensity, causing an increase in the currents then flowing in the region of the ionosphere affected. The diurnal-variation currents are believed to flow in the lower, short free-path region of the ionosphere.

This hypothesis is consistent with the obvious explanation of the radio fade-outs—that they are due to increased ionization in the short free-path region where frequent collision causes large absorption of the radiated energy. Further, the rapid return to normal conditions, practically coincident with the cessation of the visible solar radiation, also indicates that the effect occurs in the short free-path region where recombination is very high.

An intensive investigation of these phenomena, designed to test this hypothesis and incidentally to clarify concepts of the diurnal variation of terrestrial magnetism and processes of ionization and recombination in the ionosphere, is under way at the Department of Terrestrial Magnetism.

A. G. MCNISH.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
Washington, D.C.
Dec. 24.

[1] *Phys. Rev.*, **48**, 705 (1935).

[2] Richardson, R. S., *Pub. Astr. Soc. Pacific*, **47**, 325 (1935); **48**, 122 (1936); *Terr. Mag.*, **41**, 197 (1936).

[3] Torreson, O. W., Scott, W. E., and Stanton, H. E., *Terr. Mag.*, **41**, 199 (1936);

[4] Fleming, J. A., *Terr. Mag.*, **41**, 404 (1936).

[5] Torreson, O. W., Scott, W. E., Davies, F. T., and Stanton, H. E., *Terr. Mag.*, **41**, 407 (1936).

[6] Dellinger, *J. H.*, *Phys. Rev.*, **50**, 1189 (1936).

Rainfall and Moon Phases in the Tropics

ON the low-lying east bank of the Demerara River, about eight miles from its mouth, is situate Diamond Plantation, the largest sugar factory in British Guiana, located approximately at 6° 42′ N. and 58° 10′ W. Preserved at Diamond is a valuable record of the daily rainfall for the past forty-six years. Through the courtesy of the Plantation authorities, I have been able to secure a copy of the register.

So many farmers and planters in the West Indies and British Guiana have faith in the new moon or the full moon bringing rain, that it seemed of value to determine, from the Diamond data, what factual foundation there is for the belief.

Popular belief does not definitely fix the fall of rain for the actual date of the new or full moon, but for some time near the date. Thus one frequently overhears such remarks as: "It will be new moon to-morrow and we should get some rain to-night or to-morrow", or "The moon is full to-night so we may get some rain to-night or to-morrow". It was therefore decided to compare the average rainfall for:

(*a*) The three-day period made up of the day before new moon, the new moon day and the day after new moon;

(*b*) The three-day period immediately preceding (*a*);

(*c*) The three-day period immediately following (*a*);

(*d*) The three-day period made up of the day before full moon, the full moon day and day following the full moon;

(*e*) The three-day period immediately preceding (*d*);

(*f*) The three-day period immediately following (*d*).

This was done for the year as a whole and for the dry seasons only, since it might be argued that it is only during the latter that farmers are worried about rain and trouble to note the supposed relationship between precipitation and moon phases. At Diamond the weekly rainfall averages less than two inches from the week ending January 21 to that ending April 29, and again from the week ending August 12 to that ending November 25. These periods were taken as constituting the dry seasons. During the rest of the year the rainfall averages more than two inches per week.

Comparison of Average Rainfall (1914–34) in Inches at New and Full Moon with Rainfall Prior and After, at Diamond, E.B., Demerara, British Guiana.

	New Moon			Full Moon		
	3 Days prior (*b*)	3 Days at (*a*)	3 Days after (*c*)	3 Days prior (*e*)	3 Days at (*d*)	3 Days after (*f*)
Year.	0·81 ± 0 06	0·82 ± 0 07	0·78 ± 0 07	0·85 ± 0 08	0·74 ± 0·06	0·93 ± 0 09
Dry Season	0·50 ± 0·06	0·51 ± 0 07	0 51 ± 0·08	0·48 ± 0·07	0·50 ± 0·07	0.62 ± 0 10

The results obtained for 259 new and 261 full moons (1914–1934), for the whole year, and for 147 new and 146 full moons, for the dry seasons, are set out in the accompanying table.

The differences between the means are as follows:

	Whole Year	Dry Season
a and *b*	0·01 ± 0·092	0·01 ± 0 092
a ,, *c*	0·04 ± 0·099	0·00 ± 0 106
d ,, *e*	0·11 ± 0·100	0·02 ± 0·099
d ,, *f*	0 19 ± 0·108	0·12 ± 0·122
a ,, *d*	0 08 ± 0·092	0 01 ± 0·099

It will be seen that none of the differences is significant and that there is no support whatever for the belief that there is likely to be more rain at the new or full moon than during the days just before or just after these phases. It is of interest to note, too, that the average rainfalls for the new moon and full moon periods are very similar.

C. HOLMAN B. WILLIAMS.

Sugar Experiment Station,
Department of Agriculture,
British Guiana.

Dec. 11.

Another Double Star Process giving Very Fast Particles

IN a recent letter[1] I pointed out that in order to explain the energies found in cosmic radiation it is necessary to introduce only one hypothesis: that the components of the double stars are magnetic dipoles (as the earth and the sun). Then a rotating double star acts as a cyclotron. A more detailed calculation[2] shows that energies of 10^{10} or 10^{11} (perhaps 10^{12}) electron volts are attainable, but as the accelerating process is rather complicated it seems unlikely that it can be responsible for the total intensity of cosmic radiation. Therefore it may be of interest to point out that there are also other—and more simple—double star processes which are able to give high-energy particles.

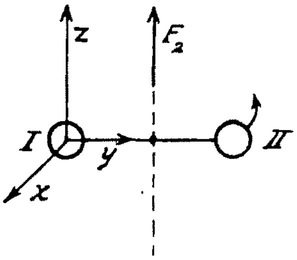

Fig. 1.

Let us assume that the two components I and II of a double star are parallel magnetic dipoles with the same moment (*a*). The star II rotates around I in the *x y* plane with the constant angular velocity ω_0 and at the constant distance R_0 from I. If we follow the symmetry line parallel to the *z*-axis, the resulting magnetic field is always parallel to it. This means that charged particles can move freely in this direction. The field along this line is composed of the field H_1 from the component I supposed to be in rest, and the field H_2 from the component II which moves with the velocity $R_0\omega_0$. Now a moving magnetic field gives rise to an electric field. In our case the electric field component along the symmetry line is

$$F_z = \frac{R_0\omega_0}{c} H_{2y},$$

where H_{2y} is the *y*-component of the magnetic field from II and *c* the velocity of light. The energy *V* (in electron volts) gained by a charged particle which has travelled from the *x y*-plane to infinity is

$$V = 300\int_0^\infty F_z dz,$$

and as $H_{2y} = \frac{3}{2} aR_0 z \left[z^2 + \left(\frac{R_0}{2}\right)^2\right]^{-5/2}$, we find

$$V = 1{,}200\,\frac{a\omega_0}{cR_0}.$$

If the period of the double star is 1 day, R_0 is 7×10^{11} cm. (ten times the radius of our sun) and

a is $2{\cdot}5 \times 10^{34}$ gauss cm.^{3} (five times the magnetic moment of the sun), we have

$$V = 10^{11} \text{ electron volts.}$$

If the orientation of the magnetic moments in relation to the rotation is the same as in our solar system, the accelerated particles have a positive charge.

HANNES ALFVÉN.

Physics Laboratory,
Uppsala.
Dec. 18.

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[1] NATURE, 138, 761 (1936).

[2] *Z. Phys*, in the press.

Luminous Efficiency of Rays entering the Eye Pupil at Different Points

WE have shown[1] that the impression of brightness produced by a light ray which forms an image on a fixed area of the retina depends in high degree on the position of entry of the ray in the eye pupil. For the ratio η of the apparent brightness for peripheral entry to the apparent brightness for central entry, values as low as 0·2 were found for white light and foveal vision. The following new features of the phenomenon have been revealed by later work:

(1) Measurements with white light. When the ray is imaged at the fovea the variation of apparent brightness with point of entry is large whatever the brightness level to which the eye is adapted. When the ray is imaged at a point a few degrees to the side of the fovea (parafoveal vision) there is very little variation of apparent brightness with point of entry for brightness levels below 0·001 c./sq. ft. As the brightness level is increased beyond this value, the effect sets in and is fully developed at a brightness level between 0·1 and 1 c./sq. ft. Fig. 1 shows the variation of $\log_{10}\eta$ with the logarithm of the brightness level, for foveal and parafoveal vision. In these experiments adaptation was secured by viewing a uniform brightness of the desired value. η was deduced from determinations of the smallest intensity of a ray, entering peripherally or centrally and imaged at the fovea or in the parafovea, which the subject could just perceive (liminal brightness increment).

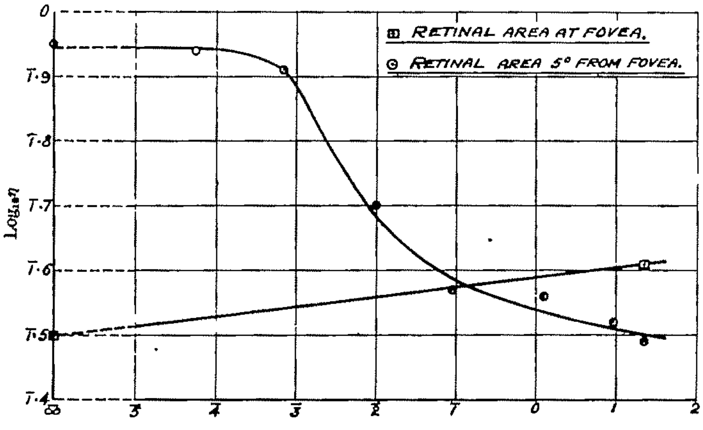

Fig. 1.

(2) Measurements with monochromatic light. Foveal vision. The change of apparent brightness with point of entry shows a relatively small variation with wave-length, being greatest in the blue, least in the yellow. It was observed, however, that the monochromatic light changes colour as its point of entry is varied. The difference ($\delta\lambda$) in apparent hue for central and peripheral entry as a function of wave-length λ for two subjects is depicted in Fig. 2. In addition, in the green and blue-green, the peripheral ray appears more saturated.

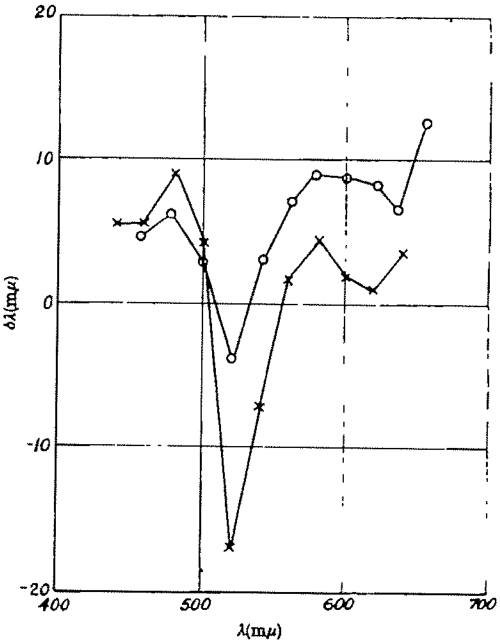

Fig. 2.

Full details of these investigations are being published, but we may perhaps add here the following comments:

(*a*) The retinal origin of the effect is definitely confirmed.

(*b*) For the parafovea, the effect sets in at the brightness level commonly associated with the change-over from scotopic to photopic vision.

(*c*) The three types of receptors of the trichromatic theory must exhibit the effect in different degrees. This appears to be necessary to explain the observed colour change of physically homogeneous light.

W. S. STILES.
B. H. CRAWFORD.

National Physical Laboratory,
Teddington, Middlesex.
Dec. 24.

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[1] Stiles and Crawford, *Proc. Roy. Soc.*, B, 112, 428 (1933).

Forbidden Transition in the Spectrum of Interstellar Ionized Titanium

AN exploration of the ultra-violet spectra of a number of stars has recently been undertaken in collaboration with Dr. Walter S. Adams, using the aluminized mirror of the 100-inch telescope, a new grating of high efficiency ruled by R. W. Wood on an aluminized Pyrex disc, and an off-axis Schmidt camera[1] of 32 inches focal length which gives, in the second order, a scale of 10·2 A. per mm. Two sharp lines at λλ 3241·99 and 3383·78 the appearance of which suggests an interstellar origin have been photographed in the spectra of five stars of early type: ξ Persei (*Oe*5), λ Orionis (*Oe*5), χ Aurigae (*B*1), χ^2 Orionis (*B*2) and 55 Cygni (*B*2). The interstellar sodium pair ($3s\,^2S - 4p\,^2p^0$) at λλ 3302·38 and 3302·98 were used as standards in determining the wave-lengths of these lines.

Since interstellar lines are likely to arise only from the lowest atomic level, a search was made in all spectra for terms having values close to 30,836·4 and 29,544·3 cm.$^{-1}$, corresponding to the observed wave-lengths. The only terms having even approximately these values are in the spectrum[2] of Ti II: $z^4F^0_{3/2}$ 30,836·52 and $z^4G^0_{5/2}$ = 29,544·37. Absorption from the ground state, $a^4F_{3/2}$, to these levels yields lines measured in the laboratory at λλ 3241·97 and 3383·76.

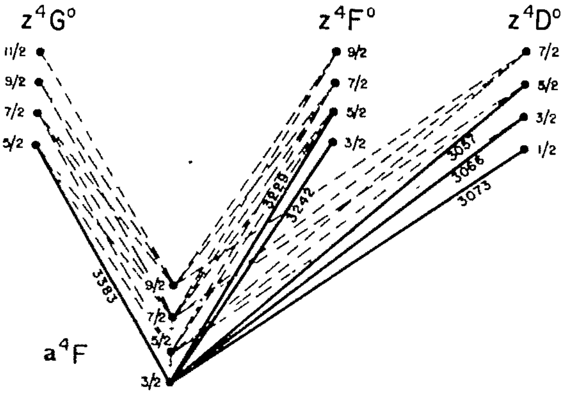

Fig. 1.

Fig. 1 shows that these lines are two of the twenty-eight possible transitions between the lowest term in the spectrum, a^4F, and the strong triad, z^4DFG^0. Four more lines from the ground level, a^4F, should occur at λλ 3229·18, 3072·97, 3036·36 and 3057·43. All these lines may be expected to be weaker than those at λλ 3241·97 and 3383·76. There was evidence for the line at λ 3229·18 ($a^4F_{3/2} - z^4F^0_{5/2}$) on an early plate. A longer exposure shows this line clearly and also the line at λ 3072·97 ($a^4F_{3/2} - z^4D^0_{1/2}$). The detection of these lines at the predicted positions confirms the identification of interstellar titanium. The lines at λλ 3066·36 and 3057·43 are satellites in the $a^4F - z^4D^0$ multiplet and could be detected only with difficulty.

The absence of all strong lines in these multiplets, excepting those arising from the very lowest sub-level, is of considerable theoretical interest. No absorption is observed even from the $a^4F_{5/2}$ level, which has an excitation potential of only 0·012 volt. In spite of the low density of radiation in interstellar space, all four sub-levels of the a^4F term would, at least after a number of years, become occupied in accordance with the Boltzmann relation, and absorption of all lines in each multiplet would necessarily be observed unless spontaneous downward transitions occur between sub-levels of the same term. The absence of absorption from any level but $a^4F_{3/2}$ appears to be definite evidence for the occurrence in interstellar space of the forbidden transitions, $a^4F_{7/2} - a^4F_{5/2}$ and $a^4F_{5/2} - a^4F_{3/2}$, which must emit lines at 76μ and 103μ. The $a^4F_{9/2}$ level cannot be filled unless there is already an accumulation in the $a^4F_{7/2}$ or the $a^4F_{5/2}$ level, and so in all probability no $a^4F_{9/2} - a^4F_{7/2}$ transition (59μ) occurs.

Atoms poised in one of the excited sub-states of the a^4F term in interstellar space can be interrupted and prevented from eventually making a spontaneous descent to the $a^4F_{3/2}$ state only by collisions with other atoms, electrons or with larger particles of matter, by absorption of stellar radiation, or by ionization through cosmic radiation. Collisions with other known atoms of sodium, calcium and titanium and with electrons are not likely to disturb a titanium atom more often than once in several weeks. It is harder to estimate the frequency of collisions with larger particles. Stellar radiation at λ3200 is diluted by a factor of about 10^{14} in interstellar space, according to Eddington's calculations, so that quantum absorptions must occur only at intervals of several centuries. Cosmic radiation may be expected to ionize each titanium atom once in something like 10^6 years, and can safely be neglected. The astrophysical evidence appears, therefore, to be consistent with a mean life-time of any duration up to several weeks for the excited sub-levels in question

It is possible to calculate the probability of the magnetic dipole radiation which is principally involved in the transitions here considered, where the inner quantum number alone changes ($\Delta L = 0$, $\Delta S = 0$, $\Delta J = 1$). Dr. W. V. Houston has very kindly made this computation for me, and finds that the mean life-time of the $a^4F_{5/2}$ state in Ti II is approximately 28 seconds It is, therefore, not remarkable that a titanium atom exposed to the conditions of interstellar space can nearly always return, after any type of excitation, to the lowest sub-level before revealing to us, in absorbing the next quantum of light, what state it occupies.

The theoretical life-time of about 28 seconds for the $a^4F_{5/2}$ state sets an upper limit to the mean density of interstellar matter, in aggregations of any specified size, if we assume a velocity distribution corresponding to Eddington's temperature of 10,000° K., and if we assume that collisions occurring more frequently than once in 28 seconds would maintain a distribution among the atomic sub-levels such that all lines in the multiplets would be observed. Various assumptions as to the sizes of the particles with which the titanium atoms collide lead to limiting densities ranging between 10^{-16} and 10^{-18} gm. cm.$^{-3}$. Since other evidence indicates that the density in space must be far less than this, it is clear that if an atom with a metastable state is to be useful as a density indicator it must have a life-time much longer than that of the $a^4F_{5/2}$ state of Ti II.

A consideration of the spectra and abundance of other elements indicates the possibility of detecting interstellar K I (7664), Ca I (4226), Sr II (4077), Sc II (3580), Fe I (3719) and Al I (3944). There is good evidence for the existence of interstellar K I and Ca I in recent spectra of distant *B* stars An attempt is being made to determine, from the ratio Ca I : Ca II, the electron pressure in interstellar space.

THEODORE DUNHAM, JUN.

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Dec. 14.

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[1] *Phys. Rev.*, **46**, 326 (1934).

[2] Russell, *Astrophys. J.*, **66**, 1 (1927).

Latent Impurities in Electrodes used for Spectrographic Research

IT has often been pointed out that for accurate results in quantitative spectrographic analysis, the standards of known composition, against whose spectra that of the specimen to be analysed is matched, should be made up on a base that simulates as closely as possible the composition of the specimen. This necessity arises from the fact that the intensity of the spectrum shown by a minor constituent of a mixture depends not only on the concentration of the element in question, but also on the nature of the major constituents. It has been shown, for example, that in the case of dilute solutions of lead salts, the lead lines are much stronger if the solution contains a considerable amount of zinc[1].

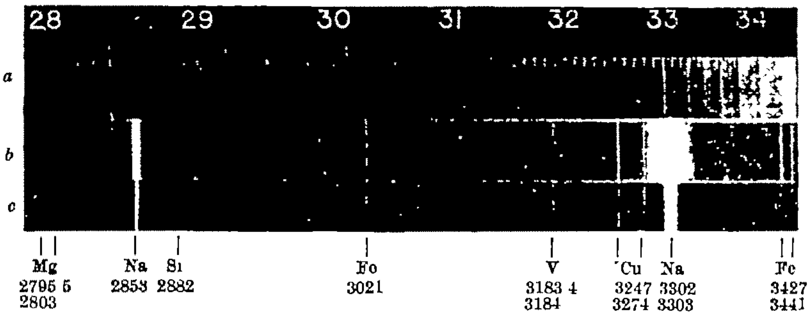

Fig. 1.

In the course of some analyses of animal tissues, which were begun in the Physics Department, Trinity College, Dublin, and are being continued in Cambridge, it has become obvious that this consideration applies not only to the constituents of the specimen, but also to impurities in the electrodes, and that failure to take account of it may render qualitative as well as quantitative results unreliable. The majority of workers in this field, and particularly those who were seeking only qualitative results, and did not, in consequence, have occasion to compare their specimens with standards of known composition, appear to have followed the practice recommended in all the practical handbooks of spectroscopy, of regarding a 'blank' spectrum of the electrodes alone, photographed in juxtaposition to the spectrum of the specimen, as being a sufficient safeguard against interpreting impurities in the electrodes as constituents of the specimen. But the fact is that in the case of carbon or graphite electrodes, impurities the strongest lines of which can only be faintly discerned in the 'blank' spectrum, may leap into prominence as soon as *any* mixture that approximately resembles a tissue ash is introduced into the arc.

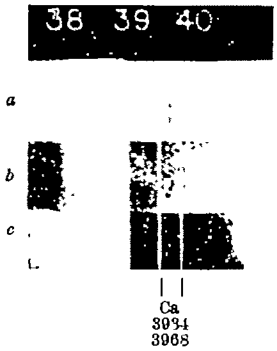

Fig. 2.

The accompanying illustrations (Figs. 1 and 2) show the effect of introducing pure sodium chloride into the arc struck between graphite electrodes, in which the principal impurities are vanadium, calcium and iron. (The manufacturers' claim that the sodium chloride is spectroscopically pure, except for a trace of silver, was verified by examining its spectrum in the silver arc.) It is clear that those lines of vanadium, calcium, iron and copper which are only with some difficulty visible in the spectrum given by the electrodes alone are greatly intensified by the presence of sodium atoms in the arc, while several lines of titanium, which could not be detected at all in the spectrum of the electrodes, also become visible on the plate, though they are not strong enough to show up in the reproduction. The chemical report accompanying the electrodes states that they contain 0·2 parts of titanium per million. The lines of silicon and magnesium, on the other hand, show no sign of intensification.

These results are in harmony with some observations of Papish and O'Leary[2], who found, using graphite electrodes, that the amount of chromium required to produce a spectrum of standard intensity was about sixteen times as great when a dilute solution of chromic acid was put on the electrodes as when an artificial ruby was used. Nobody appears, however, to have drawn from this observation the moral concerning the behaviour of impurities. It is hoped shortly to publish elsewhere, together with the results of the analyses themselves, a list of the elements that are likely, on account of this effect, to give misleading results in biological analyses. Meanwhile, it is clear that reports, by workers who have used carbon or graphite electrodes, on the distribution in living tissues of vanadium, titanium, copper, and possibly other elements, must be treated with reserve.

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Dec. 31.

[1] Nitchie, C. C., *Ind. and Eng. Chem.* (Anal. Ed.), 1, 1 (1929).

[2] Papish, J., and O'Leary, W. J., *Ind. and Eng. Chem.*, **3**, 11 (1931).

Luminescence of Solutions of Terbium Salts

VERY dilute aqueous solutions of terbium salts exhibit a bright luminescence when excited by the ultra-violet rays[1]. The maximal excitation is caused by the absorption of the wave-lengths coinciding with the broad absorption band of terbium, stretching from 290 mμ far towards the short wave-lengths[2]. The spectrum of this luminescence consists of 7 bands, each band being nearly 100 A. wide. The wave-lengths and frequencies of the middles of the bands are given in the accompanying table.

The second column gives a rough estimation of the intensities of the bands. It is seen that all the differences between the frequencies of the bands are fairly well expressed by the equation:

$$\Delta\nu_k = K\Delta\nu \qquad (1)$$

where $k = 1, 2 \ldots$ and $\Delta\nu = 272$ cm.$^{-1}$. The maximal divergence is observed for the last difference $- \Delta\nu_6$. The deepest term of Tb^{+++} is a ^7F inverted term[3]; equation (1) should thus hold for the differences between the frequencies of its components also. It may be expected, therefore, that the luminescence bands would be emitted when transitions from a single upper state on all the components of the multiplet of the deepest term take place. This assumption is confirmed by the fairly good agreement which exists between the wave-lengths of one of the luminescence bands (possessing the shortest wave-length) and an absorption band observed in the solutions of terbium salts ($\lambda \sim 488$ mμ). Since the frequencies of the emission bands are considerably smaller than the frequency of the exciting light, it seems that besides the transitions on the deepest term, transitions between excited levels not accompanied by the emission in the visible and ultra-violet regions occur also. It is to be noted that the transitions on the components of the multiplet ^7F presume the breaking of the selection rule[4] for the quantum number j. The length of the afterglow (longer than 0·001 sec.) shows that the level at the transitions on which emission takes place, belongs to the well-screened $4f$ shell; the level at the transition on which absorption takes place belongs probably to the $5d$ shell.

λ mμ	I	ν (cm $^{-1}$)	$\Delta\nu_k$ (cm $^{-1}$)	K
681	1	14684		
			241	1
670	1	14925		
			507	2
648	1	15432		
			697	3
620	3	16129		
			965	4
585	6	17094		
			1255	5
545	10	18349		
			2058	6
490	10	20408		

The investigation of the luminescence spectrum of terbium solutions with a spectrograph with a higher dispersion has shown that the bands of the luminescence spectrum have a well-defined structure, depending on the nature of the anion, monovalent and bivalent acids having been investigated.

A similar luminescence is observed with the optical excitation of terbium oxide solutions in concentrated sulphuric acid. A detailed account will be published elsewhere.

A. SEIDEL.

Commission for the Study of the Rare Earths
of the Academy of Sciences
of the U.S.S.R.,
Leningrad.
Dec. 22.

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[1] Filippow, A., Larionow, J., and Seidel, A., *C R. Acad Sci U S S R*, (10) 1, 253 (1936).

[2] Prandtl, W., und Scheiner, K., *Z. anorg und allg. Chem*, **220**, 107 (1934).

[3] Vleck, J. H. van, "Theory of Electric and Magnetic Susceptibilities", p 246 (Oxford, 1936).

[4] Ellis, S B, *Phys Rev*, **49**, 876 (1936).

Enzymic Properties of Natural Papain

ACCORDING to the generally accepted view, papain is an enzyme which converts proteins (true ovalbumin excepted) into peptones, and is without effect on the latter. Hydrolytic power towards peptones and true ovalbumin is only acquired after treatment with certain reagents ('activators'), especially hydrogen cyanide[1].

We found that freshly tapped latex (milk juice) obtained from fruits of *Carica papaya* at different stages of development and size, grown under natural conditions, splits both gelatin and Witte's peptone and need not be previously activated by hydrogen cyanide. (Ambros and Harteneck[2], investigating latex of fruits grown in a hot-house, sometimes found activity also towards peptones. The differences between their results and ours will be discussed elsewhere.) The degree of hydrolysis of gelatin falls short of that of peptone. On keeping, the activity of the latex towards gelatin is increased and that towards peptone diminished.

The preparations obtained by us from the natural latex by different methods showed different quantitative, and in some cases different qualitative, enzymic properties. Thus, for example, after extraction of the ether-soluble part of the latex, a solid fraction (I) was obtained which showed all the enzymic features of the fresh latex; several such preparations showed 'full activity' towards peptone and almost the same towards gelatin. 'Full activity' connotes that hydrogen cyanide does not enhance the activity of the preparation. Ether-extracted latex yields by centrifuging two fractions: (i) the supernatant fluid showing the hydrolytic properties of the sap; and (ii) the centrifugate, presenting the enzymic features generally attributed to papain, namely, splitting of gelatin, but no action on Witte's peptone; peptone cleavage and enhanced hydrolysis of gelatin after treatment with hydrogen cyanide. On boiling, the supernatant fluid (i) loses its hydrolytic properties, but it can serve as a specific activator of peptone cleavage. On adding boiled supernatant fluid to the centrifugate (ii), the system becomes effective also towards peptone, whilst its activity towards gelatin is diminished.

Contrary to the literature, true ovalbumin is split directly by a latex preparation.

It appears that the activation (or inhibition) by latex bodies of protein cleavage or peptone cleavage respectively are not identical processes. To account for this, it may be assumed (i) that two different enzymes with different specific activators and inhibitors are present in the latex; or (2) that the natural latex constitutes a complex enzymic system resembling the known 'mixed catalysts'. In these catalysts, certain components, which are themselves not necessarily active, induce new qualitative catalysing properties in the system as a whole. The natural latex, on this assumption, constitutes a complete enzyme system, and is therefore able to perform both hydrolytic functions. On partial or total removal of one or the other of these components—by natural accident, instability or storage, or technique of preparation—differences in quantitative effectiveness or even in specificity are produced.

The results presented above show that the accepted definition of the enzymic effectiveness and specificity of the natural papain requires correction. The accepted view is based on experiments which had, out of technical necessity, to be conducted, in the main, with preparations not fully representative of natural conditions.

A detailed report will be given elsewhere.

MAX FRANKEL
R. MAIMIN.
B SHAPIRO.

Hebrew University,
Jerusalem.
Dec. 13.

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[1] Willstatter and Grassmann, *Z physiol Chem*, **138**, 184 (1924); Willstätter, Grassmann and Ambros, *Z physiol Chem*, **152**, 164 (1926).

[2] *Z physiol Chem*, **181**, 24 (1929)

Attachment of the Sheep Hookworm to the Common Sheep Tapeworm

The study of the manner of feeding of the nematodes inhabiting the alimentary canal of vertebrates is one of the comparatively recent developments of helminthology. Hoeppli, Wetzel and others have shown that many nematodes which possess a well-developed buccal capsule—typified in the Strongylidæ and the Ancylostomidæ—are probably tissue feeders. Thus Wetzel[1] describes the feeding habits of *Chabertia ovina* (Gmelin, 1790) from the large intestine of the sheep and says:

"Longitudinal sections of specimens attached to the mucosa show that the worms have drawn a portion of the stratum glandulare into the subglobular toothless buccal capsule. On its base the tissue is strongly pressed together by the mouth wall and the anterior margin of the buccal capsule, forming a neck-like constriction. Opposite the place to which the parasite is attached a flexure is to be seen in the muscularis mucosa and in the submucosa . . . As to the marked regressive changes of the swallowed tissue and the necrotic masses at the bottom of the buccal capsule we have to assume further a histolytic action of the parasite. . . . From a general physiological point of view the whole process is nothing other than a pre-digestion of the elements of the propria mucosa before they are swallowed by the worm."

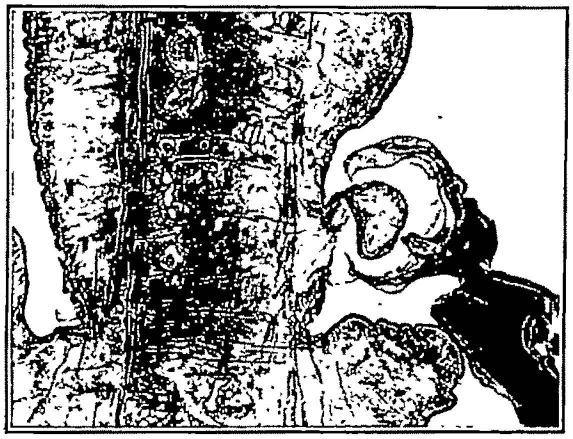

Fig. 1.

On two occasions during the past two years, in the course of frequent examinations of the fresh intestinal contents of sheep for nematodes, I have seen *Bunostomum trigonocephalum*, the sheep hookworm, attached to *Moniezia expansa*, the common sheep tapeworm, though, presumably, it is usual for this hookworm to satisfy its food requirements through the mucous membrane (hæmoglobin may be demonstrated in the worm). In one case, attempted fixation of the parasites to show their relationship was unsuccessful, the *Bunostomum* coming away on immersion in Carnoy, but in the other case the attachment was secure enough to overcome the tendency of the worms to contract on fixation. The accompanying photograph (Fig. 1) illustrates a section through the point of attachment. Although the cestode tissue is badly contracted, seemingly because of the unsuitability of Carnoy as a fixative, it will be seen that the effect of the *Bunostomum* on the cestode tissue is much like the effect of *Chabertia* on the mucous membrane as described by Wetzel. There is a similar withdrawing of a portion of tissue into the buccal capsule, a similar constriction of it at the mouth margin, and a similar tendency, as shown by the transverse muscle fibres, for the deeper lying structures to be drawn down towards the hold of the nematode. Finally, a certain amount of regressive change has taken place in the tissue within the buccal capsule, and the cestode cuticle, the sub-cuticular layer, and the sub-cuticular cells have all been destroyed.

While from this one example, it would be too much to say that *Bunostomum* utilizes *Moniezia* as a source of food, in addition to anything it derives from the mucous membrane, yet the occurrence of this one case has an interesting bearing on the factors which lead the nematodes of the alimentary canal to the mucous membrane. I have so far failed to demonstrate any chemotropic effect the membrane may have on these nematodes, but their possession of a strongly developed stereotropism is readily shown in many ways. They will swim freely in a suitable solution until contact with a membrane surface or its equivalent is attained and then, for some considerable time, they will remain at the surface. Would this stereotropism be sufficient to keep them at the mucous membrane, and is the mere presence of the tissue sufficient stimulus to cause them to feed, or at least, attempt to feed? Or, after all, does the mucous membrane exert a chemotropic effect on the nematodes, and is this particular *Bunostomum* an example of one that has failed to respond?

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[1] Wetzel, R., *North Amer. Vet.*, 12, 9, 25–27 (1931).

Structural Laws of the Mammalian Kidney, with a Theoretical Derivation

The structural laws to be described, though independent of theory, may be derived from certain general principles arising out of a 'diffusion-pressure' theory of the kidney. This theory has already been developed to some extent[1]. The principles of derivation are as follows:

(*a*) The renal secretory cells are equivalent in action throughout the Mammalia, and their function is to create a diffusion pressure of urea, etc., in the direction of the lumen.

(*b*) The shape of the kidney and the relations of tubule length to renal length remain uninfluenced by body weight.

(*c*) The mammalian kidney is so constructed that the mean blood and urine concentrations remain independent of the size of the animal.

From the first principle, the following equation may be derived:

$$V(C_U - C_B) = P\, C_B\sqrt{Vknl} \quad . \quad . \quad . \quad (1)$$

Here V is urine rate; C_U, C_B are the urine and blood concentrations; l is the length of the secreting tubule; k is the diffusion coefficient of urea, etc., which may be regarded provisionally as the diffusion coefficient through the tissue; P is a constant. As will be shown later, slight modifications make this equation independent of all changes of blood and urine volume.

Derivation of the structural relations and comparison with the actual data.

From (*c*) and equation (1) we have:

$$V = nl \times \text{a constant} \quad . \quad . \quad . \quad . \quad (2)$$

Since the mean concentration of total nitrogen in the urine is also, from (*c*), independent of body size, and introducing the well-known relation of metabolism to body surface, we derive:

$$nl = W^{0\cdot 666\cdots} \times \text{a constant} \quad . \quad . \quad (3)$$

From (*a*) we have directly that the secreting cells are independent of the size of the animal, or:

$$d = W^{0\cdot 000} \times \text{a constant} \quad . \quad . \quad . \quad (4)$$

The mass of the secreting tissue will be proportional to $nl \times d^2$ and since d is constant, from equation (4), the mass is therefore proportional to nl. Since from (*b*) l will be a linear dimension of this secreting tissue, we get from (3):

$$n = W^{0\cdot 444} \times \text{a constant} \quad . \quad . \quad . \quad (5)$$

and

$$l = W^{0\cdot 222} \times \text{a constant} \quad . \quad . \quad . \quad (6)$$

From the first principle (*a*), and equations (2) and (3), it follows that:

$$ng^2 = V \times \text{a constant} = W^{0\cdot 666} \times \text{a constant} \quad (7)$$

where g is the diameter of the glomerulus.

Hence from (5) we get:

$$g = W^{0\cdot 111} \times \text{a constant.}$$

Collecting the theoretical relations for the single measurements, we have:

$$\begin{aligned} n &= W^{0\cdot 444} \times \text{a constant} \\ l &= W^{0\cdot 222} \times \quad ,, \\ g &= W^{0\cdot 111} \times \quad ,, \\ d &= W^{0\cdot 000} \times \quad ,, \end{aligned}$$

The actual relations established by the minimum square error principle from the logarithmic values of measurements on the mouse, rat, rabbit, cat, echidna, dog, sheep, pig, man, horse and cow, from the available data of Peter, Putter, Inouye, Siewart, Moberg, O'Connor and Conway, etc., are:

$$\begin{aligned} n &= 4580\,W^{0\cdot 456} \\ l &= 1\cdot 78\,W^{0\cdot 196} \\ g &= 55\,W^{0\cdot 109} \\ d &= 50\,W^{0\cdot 006} \end{aligned}$$

where l is length of first convoluted tubule expressed in millimetres and g and d are expressed in microns.

It is hoped to present details shortly in the *Proceedings of the Royal Irish Academy*.

EDWARD J. CONWAY.

University College,
Dublin. Jan. 7.

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[1] See Conway, E. J., and Kane, F., *J. Physiol.*, 61, 595 (1926); Conway, E J, *Amer. J. Physiol*, 88, 1 (1929).

Claims of Geology in School Courses of General Science

THE Interim Report of the Sub-Committee of the Science Masters' Association on "The Teaching of General Science" (reviewed in NATURE of December 19; **138**, 1030) will have been read with much appreciation by all who are interested in school science. While this is under discussion it seems appropriate to direct attention to another report, on "The Teaching of Geology in Schools", by a Committee of Section C of the British Association. This latter report will appear in the forthcoming annual volume of the British Association, but unfortunately it was not available in time for consideration by the Science Masters' Sub-Committee. In it, amongst other recommendations, is a strong plea for the inclusion of a certain amount of geology (with physics, chemistry and biology) in all courses of general science. The Science Masters' Sub-Committee decided not to include any geology (or astronomy) in the syllabuses they suggested, "despite their obvious claims to inclusion". This decision will be regretted, at any rate by geologists, but it may be hoped that it is not final. Indeed the definition of general science arrived at by the Sub-Committee encourages the hope that the claims of geology can scarcely be overlooked: it begins, "General Science is a course of scientific study and investigation which has its roots in the common experience of children and does not exclude any of the fundamental sciences".

It is perhaps not yet generally recognized that many geologists regard the present outlook for their subject with grave disquiet, for although geology has never been taught in schools so widely as other sciences, its position in the educational system has recently become far worse than in the past. It is claimed that there are both cultural and utilitarian grounds for teaching it in schools of all types, but the absence of any mention of it in most curricula is leading to a scarcity of students which threatens to affect seriously the quality of professional geologists and to react adversely on teaching and research in the science.

It may, of course, be held that this position is not the concern of the schoolmaster, but it is noteworthy that the Sub-Committee of the Science Masters' Association takes a wider view of the teacher's responsibilities. While it is suggested that the training of experts cannot form a part of a school course, "the pre-preparation of experts" is one of the schoolmaster's tasks, "and this can best be achieved by broadening the syllabus; for it is at school that particular talents are discovered and their development fostered".

It is hoped that the position of geology in schools, in general science as well as in other courses, may receive sympathetic consideration in the light of the recommendations put forward in the report of the Committee of Section C, for it may be doubted whether one per cent of those who at school receive some training in science have an opportunity to discover any talent for work in geology.

A. E. TRUEMAN.

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Jan. 18.

The Hexlet

IN Prof. Soddy's recent article[1], the following expression occurs under the root sign in formula (2):

$$6(\alpha\beta + \beta\gamma + \gamma\alpha + \alpha\delta + \beta\delta + \gamma\delta) - 3(\alpha^2 + \beta^2 + \gamma^2 + \delta^2).$$

I find that this expression is equal to $27V^2\alpha^2\beta^2\gamma^2\delta^2$, where V is the volume of the tetrahedron whose vertices are at the centres of the four spheres with bends α, β, γ and δ.

Prof. Soddy, on hearing of this relation, suggested to me that the expression might (following the analogy of the inscribed circle in two dimensions) be related to the bend of the inscribed sphere. This does not turn out to be the case. It is, however, related to the sphere which touches the six edges of the tetrahedron and which cuts the four spheres orthogonally at their six points of contact, and is in fact equal to $12\varepsilon^2$ where ε is the bend of this sphere.

The expression does not change its value if we substitute for any of the original four spheres the opposite members of the hexlet touching the remaining three. The same sphere touches the edges of the four other tetrahedrons which can be formed in this way and thus cuts the spheres orthogonally at twelve other points of contact as well as the original six.

THOROLD GOSSET.

Cambridge.
Jan. 21.

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[1] NATURE, 139, 77 (Jan. 9, 1937).

THE beautiful result arrived at by Mr. Gosset thus gives an alternative very simple expression for the bend of any of five spheres in mutual contact, namely, $\sigma/2 + \sqrt{3}\varepsilon$, where σ denotes the sum of the bends of the other four, whilst the volume of the tetrahedron involved is $(2\varepsilon)/(3\alpha\beta\gamma\delta)$. It applies in general to tetrahedra for which the *sum* of opposite pairs of edges is, for all three pairs, the same.

I take the opportunity of recording that the tetrahedra formed by joining the four points of contact of any one sphere with the other four, when five are in mutual contact, have the *product* of opposite edges constant. This much simplified the original solution of the problem, and a proof by inversion has recently been sent me by Mr. Hodgkinson. This product is $4\{(\varphi + \alpha)(\varphi + \beta)(\varphi + \gamma)(\varphi + \delta)\}^{1/2}$ and the volume of such tetrahedra is given by

$$V = \frac{2}{\sqrt{3}}\left[\frac{\varphi}{(\varphi + \alpha)(\varphi + \beta)(\varphi + \gamma)(\varphi + \delta)}\right].$$

FREDERICK SODDY.

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Points from Foregoing Letters

From observations of disturbances of the earth's magnetism accompanying hydrogen eruptions in the sun, A. G. McNish infers that magnetic disturbance may be attributed to a sheet of current in the electrical layer of the upper atmosphere (ionosphere) together with oppositely directed currents in the earth.

A statistical investigation of the time-distribution of rainfall at Diamond Plantation in British Guiana, over a period of twenty years, leads C. H. B. Williams to the conclusion that there is no support for the local view that more rain is likely to fall at the new or at full moon than during the days just before or just after these phases.

Assuming that the components of a double star are parallel magnetic dipoles giving rise to an electric field, Prof. H. Alfvén calculates that energies of the order of 10^{11} electron volts, such as are found in cosmic rays, could be imparted to electrically charged particles.

Graphs showing the change in apparent brightness according to the point of entry of light rays into the pupil of the eye are given by Dr. W. S. Stiles and B. H. Crawford. The authors have also measured the differences in the apparent hue of monochromatic light in the case of central and peripheral entry.

Photographs of the ultra-violet spectra of several stars indicate, according to Dr. T. Dunham, jun., the presence in interstellar space of ionized titanium with a mean life-time up to several weeks. The author discusses these findings in relation to the temperature and mean density of interstellar matter.

D. A. Webb points out that in spectrographic analyses of tissue ash or similar materials, it is easy to mistake impurities in the electrodes used for the arc for constituents of the specimen, even if a blank spectrum of the electrodes is used as a control. This arises from the fact that the spectrum of the impurities may be enormously intensified by the introduction of the ash into the arc. Copper, vanadium and titanium are the elements most likely to give misleading results from this cause

A table showing the intensity of various bands in the luminescent spectrum excited by the ultraviolet in dilute solutions of terbium salts is submitted by A. Seidel. The author gives a formula for the differences between the frequencies of the seven bands observed and discusses the quantum transition levels which would account for them.

Max Frankel, R. Maimin and B. Shapiro state that the generally accepted view of the hydrolytic properties of papain requires correction. Latex of *Carica papaya* and preparations obtained directly from it, split not only proteins, but also peptones, though papain was supposed to acquire this latter property only by artificial activation. By fractionating the natural latex, several preparations were obtained, among them one which shows all the features generally attributed to papain. Furthermore, a thermostable natural activator inducing peptone cleavage was found. The properties of the various preparations suggest that the natural activation (and inhibition) of protein- and of peptone-cleavage respectively are different processes.

While it is usual for the nematodes of the alimentary canal of vertebrates to attach themselves, firmly or otherwise, to the mucous membrane, D. G. Davey reports an instance in which the sheep hookworm has drawn into its buccal capsule a portion of the common sheep tapeworm. He discusses its bearing on the factors which lead the nematodes to the mucous membrane.

From theoretical considerations, Prof. E. J. Conway has deduced certain relations between the weight of the kidney in mammals and several other factors such as the length of the secreting tubule (l) and the diameter of the glomerulus (g) of the organ in question.

Mr. T. Gosset, continuing the correspondence on the hexlet, states that he has derived a simple expression for the 'bend' of any of five spheres in mutual contact, and Prof. F. Soddy also notes a further development of the subject.

Research Items

Cave Man in Texas, U.S.A.

A JOINT expedition of the University Museum and the Academy of Natural Sciences, Philadelphia, excavated in the Williams Cave, Guadalupe Mountains, Culberson County, Texas, in 1934 and 1935. Dr. E. B. Howard was a member of the expedition in the first year, and in the second Mr. and Mrs. Richard G. L. Ayer, of whom the latter has described the results (*Proc. Acad. Nat. Sci. Philadelphia*, 88, 599). The cave is situated south-west of Signal Peak, the southern termination of the Guadalupe Mountains, two hundred feet up on the side of a steep limestone canyon. Its dimensions are roughly forty feet wide at the entrance and forty-eight feet deep. Three burials were found. The first was in the back half of the northern section eighteen inches below the surface, as was most of the Indian material, and was covered with a large basket, mostly decayed. Two children were found close together, apparently covered with the same netting. The upper skull was covered by a small basket in perfect condition. With this burial were *Olivella* shell and circular pink shell beads. Near were fragments of closely woven cloth and a ball of purple paint. The second was a typical cradle burial, near the north wall. A coarse woven basket was over the burial, and close by fragments of another basket contained painted sotol strips. The cradle was triangular in shape, and the body wrapped in soft hide painted red. This was covered with another piece of hide with the fur on, and over all had been a rabbit fur blanket, now much disintegrated. A bag of charms was on the cradle. The third burial was a bag burial of an adult. The bag was of deer or antelope hide painted red, and contained charred bones. The culture of the archæological remains recovered from the cave corresponds to the Hueco cave dwellers. Twenty-two forms of mammal remains are reported, of which 22·7 per cent are extinct, including the giant sloth. There is evidence of a difference in climate.

Genetics of Cancer

IN the spontaneous development of breast cancer in mice, the genetic factor of the animals and the functional activities of the gonads play important parts. Dr. L. Kreyberg, of Oslo, in the "Reports of the Second International Congress of Scientific and Social Campaign against Cancer" (Brussels, 1936), puts forward the evidence showing that spontaneous breast cancer in mice is in principle equivalent to tumours induced by synthetic carcinogenic agents, the difference being that in the former case the agent is of an intrinsic and physiological origin. The susceptibility to induced tumours and spontaneous breast tumours is genetically different. Work on the genetics of tumour-bearing mice indicates that both chromosomal and extra-chromosomal or cytoplasmic factors are concerned. Dr. Clara Lynch, of the Rockefeller Institute for Medical Research, in a paper in the same volume, shows that the induction of tumours of different types is controlled by different genetic factors, and considers the initial change in carcinogenesis to be of the nature of a somatic mutation. Longevity is important in the development of cancer, and the inheritance of long life as well as susceptibility to mammary cancer and to leukæmia appear to be controlled to a greater extent by the female parent than by the male.

Leeches of the North Sea and Baltic

LIEF. 29, Teil VI.c2 of "Die Tierwelt der Nord- und Ostsee" ("Hirudinea". By Konrad Herter. Akademische Verlagsgesellschaft m.b.H., 1936) contains a very good account of the marine and brackish water leeches of these regions. The marine forms all belong to the Piscicolidæ with the exception of a few visitors, but in brackish waters members of the Glossiphoniidæ, Hirudinidæ and Herpobdellidæ occur. Keys to the sub-orders, families and genera are given and the species belonging to each genus are described and figured. Technique for collecting and preserving follows, with accounts of general anatomy, distribution, movement, nutrition, excretion, respiration, circulation, sense organs, nervous system, reproduction and development. The work is well up to the standard of this most useful series.

Diseases of Garden Plants

THREE fungal parasites of garden plants have been recently described (*Trans. Brit. Mycol. Soc.*, 20, Parts 3 and 4, Nov. 1936). Miss Catherine C. Burt found the fungus *Didymellina dianthi*, a new species, upon the leaves of Sweet William. This name is given to the perfect stage of a fungus the conidial stage of which is known as *Heterosporium echinulatum*. *D. dianthi* is apparently a specific parasite of the Sweet William; carnations and pinks are highly resistant. Mr. N. C. Preston has established the pathogenicity of the fungus *Myrothecium roridum* upon *Viola* plants. It can apparently enter unwounded tissue, and may cause considerable destruction of its host under cultivation. Dr. George Trapp has considered the parasitism of *Botrytis cinerea* on the Japanese laurel, *Aucuba japonica*. The fungus can enter the host through a crack in the cuticle or through a nectary surface, when the atmosphere is completely humid. Symptoms of the disease, and the life-history of the causal organism, are also described.

Lead Arsenate Treatment of 'Leather Jackets'

How best to combat the ravages of the crane fly larvæ, commonly known as 'leather jackets', is one of the problems that besets those interested in turf management. Investigations on the subject are being carried out at the St. Ives Research Station, and some of the more recent experiments have recently been described by R. B. Dawson and R. B. Ferro (*J. Board of Greenkeeping Research*, 4, No. 15). The requirements necessary in the ideal material are several. It must not damage the turf, and preferably not even cause a temporary disfigurement; at the same time it must be economical in use, simple to apply and be harmless to human beings and grazing animals. Lead arsenate satisfies many of these conditions, and experiments carried out with it at a number of different centres have given very promising results. Treatment was successful with either the powder or colloidal form, though preference for the former was shown by many of the workers who had the handling of it, and moreover it is cheaper.

Generally as good control was obtained with the lighter as with the heavier dressings, and since lead arsenate is expensive and the areas requiring treatment frequently large, this is a result of economic importance. It is recommended that before embarking on large-scale dressings, periodical treatment with orthodichlorbenzene emulsion should be carried out to determine whether or not the turf contains the larvæ. The lead arsenate should then be applied in powder form at the rate of 1 oz. per sq. yd. (2·7 cwt. per acre) or if worm control is also desired, at the rate of 1½ oz. per sq. yd. Applications should be made by hand or mechanical distributor after bulking with fine soil or other carrier, at any time during autumn, winter or spring, and grazing animals kept off the turf until the arsenate is well washed into the soil, as it has poisonous properties. The larvæ die in the soil, so no labour other than the distribution of the lead arsenate is involved.

Growth of the Tanna Fault in Japan

During the destructive earthquake of November 26, 1930, in the Idu peninsula, remarkable displacements occurred along the Tanna fault. This fault runs north and south through the western slopes of the volcanoes that lie near the east coast of the peninsula. The intersection of the fault by the Tanna tunnel at a depth of 525 ft. shows that its plane is inclined steeply to the west. In an interesting memoir (*Bull. Earthq. Res. Inst.*, 14, 619–631 ; 1936), Mr. H. Kuno studies the growth of the fault since the Lower Pleistocene age. He shows that the channels of three rivers on the west side of the fault now lie 1 km. to the south of their former continuations on the east side and that the slope of the ground on the west side, if produced, would lie about 100 m. above the slope on the east. Cutting the map along the line of the fault and shifting the west side through a distance representing 1 km. to the north, and lowering the height of each contour-line on that side by 100 m., the two sides fit well together, except in the northern part of the district, in which the vertical displacement was much less. Mr. Kuno thus concludes that the block on the west side of the fault was shifted about 1 km. to the south over the greater part of the fault and raised 100 m. or more in its southern part, relatively to the block on the east side. It is interesting to notice that the displacement during the Idu earthquake of 1930 was similar, the greatest relative movements of the western block being 1·2 m. to the south and 0·6 m. upward.

Optical Experiments with Pinholes

Mr. F. J. Hargreaves has recently published a paper under the above title in which he describes how the diffraction phenomena produced by telescopes can be reproduced by looking through pinholes of different diameters (*J. Brit. Astro. Assoc.*, 47, 2; December 1936). It is quite easy to see the phenomena of a single star, double stars or even of planets, the latter being simply illustrated by the warp and weft of a piece of fabric remaining invisible through a small pinhole, though easily seen through a large one. The large diffraction pattern in the former case hides the details, and in the same way fine detail on a planet or the moon is invisible in a telescope of small aperture, though easily seen in one of large aperture. The experiments are very clearly described, and users of telescopes will find much that is both interesting and instructive in the paper.

Time Effects in Spectrophotometry

Mr. W. M. H. Greaves has a paper under this title in *Mon. Not. Roy. Astro. Soc.*, Supplementary Number, 96, 9 (October 1936). He points out that Schwarzschild's law, $D = \varphi(It^p)$, where D is the optical density of the image or any other measure of photographic effect, I is the intensity of the light, t the time of exposure, and p the constant for any particular plate, is only a first approximation. The work of Kron and others has shown that it is valid only over a very limited range, and errors occur in spectrophotometric measurements which involve the use of different exposure times, if the law be applied. Mr. Greaves is concerned with applications to practical spectrophotometric technique, and develops simple formulæ which are capable of high accuracy over the limited ranges of the variables employed in practice. Two formulæ are given which correct for time effects, and it is suggested that they may be of assistance to workers who desire to be free from the restriction of using identical exposure times in all comparisons—a procedure which seriously limits the output. When unequal times are used, it is essential that the character of the emulsion should be investigated, and also that the value of a certain constant ε should be determined. No account has been taken of temperature effects in the paper, but from the work of Webb (*J. Opt. Soc. Amer.*, 25, 4; 1935) it does not appear that serious errors will be introduced, for ordinary working temperatures, if the variation of ε with temperature be ignored. It is important, however, to calibrate plates at approximately the same temperature as that at which they are to be exposed.

Controlled Grain Size in Steel

It has been known for some time that by a control of the degree of de-oxidation of molten steel prior to casting, combined with the addition of a small amount of aluminium, steels can be produced with a grain size which is much finer than is normally the case. The majority of the work hitherto published is of American or German origin, and a paper read by T. Swinden and G. R. Bolsover before the Iron and Steel Institute in September last represents the first publication in Great Britain on an exceedingly important subject. The authors show that the fine-grained steel so produced is characterized by a very much higher impact value than is the normal material. In the case of nickel-chrome steels subject to 'temper brittleness', it is shown that these fine-grained steels, although still showing this phenomenon, are less affected than are the steels as ordinarily manufactured. The low-temperature brittleness produced by tempering in the region of 250°–400° C. after a preliminary quenching is less pronounced in the fine-grained steels than in the coarser ones. An exceedingly interesting field is opened up by the proof that these fine-grained steels retain their impact value to a very much greater extent when strained and re-heated to 250° C. than do materials of similar composition but with larger crystal size. The ageing after quenching at 650° C. again does not produce anything like the degree of embrittlement in the new material as obtains with ordinary steels. Cracking during hardening appears to be eliminated or greatly reduced, while the machinability of the 'controlled grain' steel is not appreciably different from that of ordinary engineering materials of similar composition.

Physics of the Solid State

FIFTIETH ANNIVERSARY OF THE PHYSICAL SOCIETY OF ZURICH

THE Physical Society of Zurich celebrated its fiftieth anniversary by holding a meeting on January 13–16 to discuss the "Solid State".

This Society was originally founded by students in order to discuss physical and technical problems. One of the early and rather unusual rules governing the selection of new members was that no professors should be admitted. This rule was abandoned later when the Society included in its list of members such distinguished names as: P. Weiss, A. Einstein, M. von Laue, P. Debye and E. Schrodinger, who were all at some time on the staff of either the University or the Technical High School in Zurich.

The jubilee meeting was opened by the president of the Swiss Board of Education, and his address was followed by a speech from Prof. P. Weiss, of the University of Strasburg, who represented the foreign members of the Society.

The first scientific address was given by Prof. P. Niggli, of the Technical High School, on the subject of "Mineralogical Problems of Crystal Structure". Prof. Niggli gave first a general survey of the various crystal types and discussed in particular the case in which whole groups of the constituent parts of the crystal are partially substituted by other groups without thereby altering the lattice. He gave the rules governing these substitutions, and discussed the problem on the basis of the geometrical structure theory.

On the following day, Prof. W. L. Bragg, of the University of Manchester, gave an account of the structure of binary alloys in connexion with the Hume-Rothery rule, and discussed the lattice transformation in alloys in their relation to order-disorder phenomena.

Prof. P. Debye, of the Kaiser Wilhelm Institute of Physics, Berlin, dealt in his lecture with the semi-crystalline nature of liquids. He discussed the effect of the waves of thermal agitation in a liquid upon the scattering of monochromatic light by the liquid. Whereas, in a gas, light originally monochromatic becomes slightly less so after it is scattered, in an ideal crystal, this light splits into two components; and in a liquid, generally speaking, into three spectral lines, except when the coefficient of expansion becomes zero, as for example in water of maximum density, where only two lines appear, as predicted by the theory. From these experiments, Prof. Debye concludes that a liquid is, on the whole, much nearer to a solid than it is to a gas.

On the following day, Dr. A. Müller, of the Royal Institution, London, gave a summary of the work on long-chain compounds of the paraffin type. He discussed the relations between the structure and physical properties of these substances and dealt with the problem of crystal transformations.

Prof. H. Mark, of the University of Vienna, lectured on the kinetics of polymerization of certain substances which form very long chains, and gave an account of the elasticity of rubber, which he treated as a problem of statistics of the configuration of these long chains.

The evening lecture was delivered by Prof. A. Sommerfeld, of the University of Munich, who gave an excellent account of the modern theory of the metallic state, and of the specific heat and electrical conductivity of metals.

The final address was by Prof. M. von Laue, of the University of Berlin, who discussed the theory of the "Kossel- and Kikuchi-lines" which are observed when a source of X-rays or electron waves is placed inside a crystalline medium.

The papers presented at the meeting will be published together.

The meeting was well organized and attended, for which the president of the Society, Dr. R. Sanger, was largely responsible. At the same time, there was an informal atmosphere and lively discussion. The meetings arranged by the Physical Society in Zurich nearly every year are now well-known in scientific circles, and provide opportunities for the exposition of recent scientific work in a place convenient for scientific men of all nations. A. M.

International Cancer Research

REFERENCE has already been made in these columns to the Second International Congress of the Scientific and Social Campaign against Cancer which was held in Brussels last autumn (NATURE (1936), 138, 727). The text of fifty-five reports or reviews which were read at the Congress have now been published*. Each report is given at length in one of the six official languages, while summaries of the reports are given in all six languages. Some of the reports, such as that of Cook, Haslewood, Hewett, Hieger, Kennaway and Mayneord on "Chemical Compounds as Carcinogenic Agents" and that of Reding on "Predisposition and Resistance to Cancer", have good bibliographies, while others have no references. The greater part of the volume is concerned with the biology, diagnosis and therapy of cancer, and there are interesting reviews on the statistical investigation of mortality from cancer in different States and among different races.

The last four papers on the statistics of morbidity and mortality from cancer are from London, Munich, New York and Batavia, and show that the total mortality from cancer is of the same order in almost all parts of the world. As Dr. Cramer points out, "cancer in man is an experiment carried out on man of which the end results are represented by the cancer mortality statistics, while the beginning of the experiment is unknown". The problem of the cause of cancer is to determine the beginning of the experiment, and hints of this are given by analysis of the statistics. Dr. Bonne gives relative cancer mortality figures for Malays and Chinese in Batavia, Chinese in Singapore, Filipinos in Manila, Japanese in Tokyo and Austrians in Innsbruck. The total mortality from cancer in these groups is of the same order, but the distribution according to sites is quite different. Cancer of the liver, which is rare in Europe, is common in the East, and cancer of the lung is more common in Europe than in the East. The results given in these statistical papers show the magnitude and extent of the fight against cancer.

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* IInd International Congress of the Scientific and Social Campaign against Cancer. Vol. 1. Reports. Pp. xvi+503. (Bruxelles: Ligue Nationale Belge contre le Cancer, 1936.)

The fact that these reviews are given by invitation by scientific workers of sixteen different countries indicates how widespread is the effort to combat malignant disease. The report brings together work from research workers in chemistry, histology, medicine, surgery, radiology, geography, and statistics, and will no doubt have a beneficial influence in making workers aware of what is being done in cancer research outside their own fields. It is probably as good a general review of the whole field as can be found, although there are too few illustrations in some parts of the work, and several chemical formulæ are incorrectly represented.

The reports deal mainly with work of the last three years, and if similar publications are produced at each triennial congress, they would continue to improve co-operation between research workers in different countries and sciences.

Historic Flora of Mexico

THE Smithsonian Institution has just received, for study and identification of specimens, part of the celebrated Sesse and Mocino collection of the flora of Mexico, which recently came to light in Madrid after more than a century. The collection was sent by Spanish officials just before the outbreak of the revolution to Dr. Paul Standley, of the Field Museum of Natural History in Chicago, an authority on the plants of Mexico. Dr. Standley has distributed it to American institutions specializing in various plant families represented, for study under his direction.

The story of this collection is one of the most colourful in the history of botanical exploration. In 1787, Charles III of Spain sent to Mexico a botanical expedition headed by Dr. Martin Sesse y Lacasta, the most eminent of Spanish botanists, for the purpose of making a complete collection of the flora of Mexico and setting up a chair of botany in the National University at Mexico City. The lectures of Sesse and his companions aroused the interest of a young Mexican physician, Dr. José Mariano Mocino. He became so absorbed in botany that he gave up his practice, obtained an appointment as a member of the expedition, and for more than twenty years engaged in almost constant exploration. He covered all central Mexico, and made trips so far south as Guatemala and so far north as California. In 1804, Sesse and Mocino went to Spain, where they began to work up their collections. Sesse died five years later, and Mocino was made director of the Cabinet of Natural History in Madrid. About this time, Madrid was invaded by the French. A change in Government meant nothing to the Mexican botanist, absorbed in the plants for which he had risked his life so often. He was popular with the invaders, and they did not disturb him. Then the French were driven out and the vengeance of the Spaniards, incensed at his "traffic with the enemy", fell upon the head of Mocino. He was thrown into prison and placed in chains, to be rescued by the return of the French army.

Once again the French were driven out. This time Mocino took no chances. He loaded his manuscripts and drawings into a mule cart and, old and feeble as he was, walked beside it throughout the hasty retreat across the mountains. He finally arrived safely at Montpellier in France, but nearly blind and penniless. He might have starved had it not been for the friendship of the celebrated Swiss botanist De Candolle. The latter, however, borrowed his drawings and took them with him to Geneva. Mocino in the meantime was negotiating to return to Spain, and finally was assured that he would not be bothered. He wrote to De Candolle asking for the immediate return of his drawings. The result was one of the most extraordinary incidents in the history of botany. De Candolle asked for volunteers—anybody in Geneva with any artistic talent—to copy them as a patriotic duty. The volunteers came—society girls, college students, ministers. Altogether 120 of them were put to work and completed the job in ten days. With his drawings returned, Mocino started back to Spain. In Barcelona he was taken ill and died, giving his drawings to a physician who had befriended him. This man apparently attached no value to them and they disappeared. Had it not been for De Candolle's copies, they would have been lost completely to science.

Meanwhile, the manuscripts of Sesse and Mocino and the plants they had collected remained at Madrid. Nobody attached any value to them or paid any attention to them. It was not until 1888, nearly a century after the collections were made, that the manuscript was published in Mexico City. Meanwhile most of the plants had been rediscovered and described, so that Mocino and Sesse were deprived of their hard-earned glory.

The specimens, however, remained at Madrid. Many of the species described in the manuscript could not be identified with any known in Mexico at the time of the publication, and it was impossible to match the descriptions and other specimens. Perhaps there are species still unknown to science. It is noteworthy that Mocino was especially interested in medicinal plants, and spared no effort to obtain everything to which curative properties were ascribed by natives.

The Pontifical Academy of Science

FEDERICO CESÍ of the Princes of Acquasparta, John Heck, a Dutchman, Francesco Stelluti of Fabriano and Anastasio de Filiis, Count-Palatino of Terni, founded at Rome on August 17, 1603, an Academy of Science and called it the *Lynceorum philosophorum Ordo seu Consessus seu Academia* with the motto: *Sagacius ista.* Galileo Galilei joined it after 1610.

Finis eius, they proclaimed, *est rerum cognitionem et sapientiam non solum acquirere, recte pieque simul vivendo, sed et hominibus voce et scriptis ubique ullius noxa pacifice pandere.*

Though its fortunes varied, the Academy's aims and activities were always scientific.

In 1847, Pope Pius IX, continuing the interest that previous popes had shown, decided to restore the Academy with a new constitution; he reconfirmed its possession of the Senatorial Palace on the Campidoglio, began the regular publication of the "Acts", and placed it in direct dependence upon the pope and his government with the new title of the "Pontifical Academy of the New Lincei". Later, in 1877, it was still further enlarged by Leo XIII, who increased the number of its fellows (*Soci*) and began the publication of the "Memorials".

Finally, in 1922, His Holiness Pius XI changed its residence, which after 1870 had been the Palace of the Apostolic Chancellery, to the Vatican Gardens, giving it the beautiful little house of Pius IV which is one of Ligorio's finest works of art, and providing generously for its financial rehabilitation. In 1923, he altered its name to "Pontifical Academy of Science—the New Lincei".

Following the Papal Letter, "*In multis solaciis*" of October 28, 1936, and in view of the great importance attaching to the Academy itself, he decided to adapt it to the new and more obvious needs of the times by providing it with a new constitution and a complete revision of its membership, keeping, however, for its former members their rank of 'fellows'.

This new Academy, "The Pontifical Academy of Science", is directly dependent upon the Pope himself, and is composed of seventy 'Pontifical academicians', appointed by the Pope, belonging to every nation and religion, chosen from among the most famous men of science in the world. To these are added the 'Supernumerary academicians' by reason of their office, and the 'Honorary academicians' by reason of their good services towards the Academy itself. *Ab eis itaque Apostolica haec Sedes id auxilii ac decoris expectat ac praestolatur, cuius hic veluti doctorum hominum Senatus, seu "Scientificus" Senatus, certum portendit auspicium.*

The members of the Academy aro as follow:

Presidente, Prof. P. Agostino Gemelli, O.F.M.; *Segretario*, Comm. Prof. Giuseppe Armellini; *Tesoriere*, M. se Gr. Uff. Prof. Lepri Giuseppe; *Bibliotecario*, P. Don Anselmo Albareda, O.S.B.; *Censori*, S. E. Gr. Uff. Prof. Emilio Bianchi, S. E. Gr. Uff. Prof. Filippo Bottazzi, *Cancelliere dell' Accademia*, Comm. Dott. Pietro Salviucci.

Accademici Pontifici Onorari. Emo Card. Gaetano Bisleti, Emo Card. Eugenio Pacelli, Emo Card. Francesco Marchetti Selvaggiani, P. pe Ludovico Chigi Albani della Rovere, Prof. Pietro De Sanctis.

Accademici Pontifici. Abderhalden, Emil (Halle), Amaldi, Ugo (Roma), Armellini, Giuseppe (Roma), Barrois, Charles (Lille), Bianchi, Emilio (Milano), Birkhoff, George David (Cambridge, Mass.), Bjerknes, Vilhelm Frimann Koren (Oslo), Bohr, Niels (Kopenagen), Boldrini, Marcello (Milano), Bottazzi, Filippo (Napoli), Branly, Edouard (Paris), Buytendijk, F. J. J. (Groningen), Carathéodory, Constantin (Munchen), Carrel, Alexis (New York), Castellani, Aldo (Roma), Colonnetti, Gustavo (Torino), Crocco, Gaetano Arturo (Roma), Cuenot, Lucien (Nancy), Dal Piaz, Giorgio (Padova), Debye, Peter (Berlin-Dahlem), De Filippi, Filippo (Roma), de la Vallée Poussin, Charles (Louvain), Fauvel, Pierre (Angers), Gemelli, Agostino (Milano), Gherzi, Ernesto (Zi-ka-wei, Shanghai), Ghigi, Alessandro (Bologna), Gilson, Gustave (Louvain), Giordani, Francesco (Napoli), Giorgi, Giovanni (Roma), Godlewski, Emil (Krakow), Gola, Giuseppe (Padova), Grégoire, Victor (Louvain), Giudi, Camillo (Torino), Guthnick, Paul (Berlin-Neubabelsborg), Houssay, Bernardo (Buenos Aires), Keesom, Wilhelmus Hendrikus (Leiden), Lemaître, Georges (Louvain), Lepri, Giuseppe (Roma), Levi-Civita, Tullio (Roma), Lombardi, Luigi (Roma), Luigioni, Paolo (Roma), Marconi, Guglielmo (Roma), Mendes Correa, Antonio Augusto (Porto), Michotte, van den Berch Albert (Louvain), Millikan, Robert Andrews (Pasadena, Calif.), Morgan, Thomas Hunt (Pasadena, Calif.), Nobile, Umberto (Napoli), Noyons, Adriaan Karel Marie (Utrecht), Panetti, Modesto (Torino), Parravano, Nicola (Roma), Pensa, Antonio (Pavia), Petritsch, Ernst Felix (Wien), Picard, Emile (Paris), Pistolesi, Enrico (Pisa), Planck, Max (Berlin), Rasetti, Franco (Roma), Rondoni, Pietro (Milano), Lord Rutherford of Nelson (Cambridge), Schrödinger, Erwin (Graz), Sherrington, Sir Charles (Oxford), Silvestri, Filippo (Portici), Sperti, George (Cincinnati, Ohio), Taylor, Hugh Stott (Princeton, N.J.), Toniolo, Renato (Bologna), Tschermak-Seysenegg, Armin (Prag), Vallauri, Giancarlo (Torino), Vercelli, Francesco (Trieste), Volterra, Vito (Roma), Whittaker, Edmund Taylor (Edinburgh), Zeeman, Pieter (Amsterdam).

Accademici Pontifici Soprannumerari. Albareda, Anselmo, prefetto della Biblioteca Apostolica Vaticana; Gatterer, Aloys, prefetto del Laboratorio Astrofisico della Specola Vaticana; Mercati, Angelo, prefetto dell' Archivio Segreto Vaticano; Schmidt, Wilhelm, direttore scientifico del Museo Missionario etnologico lateranense; Stein, Johann, direttore della Specola Vaticana.

University Events

CAMBRIDGE.—Prof. W. J. de Haas, of Leyden, has been appointed Scott lecturer for the year 1937–38.

Prof. L. T. Hogben will lecture in the Zoological Lecture Room on Wednesday, February 10, at 5 p.m., on "Some Neglected Aspects of the Species Problem".

OXFORD.—The following appointments to professorships have been made: Mr. C. N. Hinshelwood, Trinity College, to the Dr. Lee's chair of chemistry; Mr. Hugh Cairns, Balliol College, to the Nuffield chair of surgery; Mr. R. R. Macintosh, to the Nuffield chair of anæsthetics.

Science News a Century Ago

The Ashmolean Society

In Oxford, on February 6, 1837, at a meeting of the Ashmolean Society, "Mr. Holme of C.C.C. read a paper on the formation and habits of the British aquatic coleoptera, which are included in the sections *Hydradephaga* and *Phithydrida* of Macleay, and exhibited specimens which showed the voracity of some specimens of the genus Dyticus, and concluded by drawing attention of the members to the question whether the mole cricket is able to swim, which Mr. Curtis thinks probable, from the resistance which the thorax and elytra offer to water. Mr. Duncan read a paper, in which he gave an outline of the progressive development of animals from their embryo to their perfect state especially of the frog—of one species of which, the *Rana paradoxa*, he exhibited a specimen in the tadpole state, nearly transformed." (*Athenæum*.)

Of the individuals mentioned in this note, one was presumably Alexander Macleay (1767–1848), F.R.S., the entomologist and colonial statesman, another Philip Bury Duncan (1772–1863), keeper of the Ashmolean Museum in 1826–55, and a third John Curtis (1791–1862), the author of "British Entomology" (1824–39).

Lieut. Wellsted's Exploration of Arabia

At a meeting of the Linnean Society held on February 7, 1837, the chairman, A. B. Lambert, spoke of the researches of Lieut. Wellsted in Arabia Felix, and said that this traveller had added much to the knowledge of the natural history of the district. He had ascertained the tree producing myrrh, and also the dragon-tree. He had surveyed the northern coast of the Red Sea, where he had many opportunities of confirming the descriptions of Bruce, whom he considered the most accurate traveller in those regions who had ever returned to Europe. Mr. Lambert also exhibited some specimens of manna brought by Lieut. Wellsted from Mount Sinai, considered to be the produce of a tamarisk, which was supposed to be identical with that on which the children of Israel fed in the wilderness.

Aylmer Bourke Lambert (1761–1842), well known for his botanical writings, was an original member of the Linnean Society, while James Raymond Wellsted (1805–42) was an officer in the service of the East India Company.

The Properties of Electricity

On February 7, 1837, F. W. Mullins, M.P., sent a communication to the *Philosophical Magazine* (**10**, 281) entitled "On the Development and Action of Electricity in Voltaic Combinations". In his concluding paragraph he said: "I believe light, as well as heat, to be a property of electricity, else, how account for its existence in its *purest form in vacuo*, where electricity is the only agent? But I shall refer to these subjects again and at greater length when I have more leizure than I have at present, merely adding that I do not believe my views to be irreconcilable with Mossotti's theory, and that I am quite satisfied that though chemical action may be supposed to develop electricity, still electricity is the prime mover; electrical and material attractions and repulsions, when brought into play by certain arrangements of elements, inducing and creating all chemical phenomena. . . ."

Heat Transfer in Locomotive Boilers

At a time when the caloric theory of heat still held sway, Jacob Perkins, on February 7, 1837, read a paper to the Institution of Civil Engineers entitled "On Locomotive Engines and the means of Supplying them with Steam". The practical defects of the existing system of locomotives arising from the furring up or burning out of the tubes of the boiler, he considered, could be overcome through the medium of steam surcharged with caloric. If a tube hermetically sealed be filled to a sixtieth of its contents with water, the steam arising from the water will not acquire sufficient elastic force to burst the tube; but will have a remarkable property of transferring heat. The steam in the vertical tube being saturated with heat, becomes a medium through which the heat ascends by its own levity, so that the tube would become red hot were it not immersed in water.

Perkins, who was born in America in 1766 and died in London in 1849, was a pioneer in the use of high-pressure steam, and had before 1837 constructed boilers and engines working at pressures of 800–1,600 lb. per sq. in.

Science News in the *Athenæum*

In its issue of February 11, 1837, the *Athenæum* gave the following notes of scientific interest.

French Academy of Sciences. M. Becquerel is elected vice-president of the French Academy of Sciences for 1837, by a large majority of votes; and M. Magendie, the last vice-president, passes on to the presidency. The Minister of the Interior has commanded a bust of the late celebrated botanist, M. de Jussieu, to be executed for the Academy, by the skilful hands of M. David.

Acoustics. MM. Cagniard Latour and Demonferrand have invented an instrument which they propose naming the Acoustic Pyrometer, and which will emit sounds according to the temperature in which it may be placed.

M. Melloni. The able and celebrated philosopher, M. Melloni, who was exiled from Italy, has been recalled by the Duchess of Parma: M. Arago appealed to Prince Metternich on his behalf, at the same time laying before His Highness an analysis of his merits, and his beautiful discoveries. The Prince submitted this statement to the Duchess and interceded, and consequently M. Melloni is now at liberty to return to his native country.

Societies and Academies

London

Royal Society, January 28.

R. D. Preston and W. T. Astbury: The structure of the wall of *Valonia ventricosa*. The cell wall of *Valonia ventricosa* has been studied in detail by means of X-ray diffraction photographs and the polarizing microscope. It consists of layers in which the cellulose chains in any one layer are inclined to those in the preceding and subsequent layers at an angle which is on the average rather less than a right angle. The chains of one set of layers form a system of meridians to the wall, while those of the other set build a system of spirals closing down on the two 'poles' defined by the meridians. The development of the rhizoids is associated with regions of the wall adjacent to the poles of the spiral. The plane of spacing, 6·1 A., of the cellulose crystallites is, roughly speaking, confined within an angle of about 60° to the wall surface. The path of the cellulose spiral is that of a logarithmic (equiangular) spiral described on the surface of a sphere or prolate spheroid.

W. D. WRIGHT: The foveal light adaptation process. A further series of observations on adaptation phenomena have been recorded by the binocular matching method, in which effects induced by light-adapting the right eye are measured relative to the constantly dark-adapted left eye. For white adaptations, the sensitivity of the red and green responses is inversely proportional to the adaptation intensity, and the recovery curves for these responses are linear; for the blue, the response is reduced to a less extent than for the red and green, and the recovery curves are non-linear. They may indicate a monomolecular or bimolecular reaction, whereas the red and green processes appear to recover at a constant rate. With red adaptations, the green recovery is linear and the red non-linear, but while the red sensitivity is inversely proportional to the adaptation intensity, the green is reduced to a relatively less extent as the adaptation is increased. With green adaptations, the reverse occurs. The application of the method of observation for clinical purposes is suggested and the relation of the results to illuminating engineering problems emphasized; in particular, an 'adaptation factor' should be measured in heterochromatic photometry, if the true visual efficiency of light sources is to be found.

W. S. STILES and B. H. CRAWFORD: The effect of glaring light source on extrafoveal vision. The smallest difference of brightness between a test object and its background such that the presence of the object can just be detected (the liminal brightness increment) is in general raised if there is an unshielded light source in the field of view. If the light source produces an illumination E ft. c. at the eye and is located at a point $\theta°$ from the test object, then for foveal vision of the test object the increase in the liminal brightness has been found to be equal to that which would be produced in the absence of the light source by raising the background brightness from its original value B to the value β, where $\beta = B + kE/\theta^n$ and k and n are constants having values approximating to 10 and 2 respectively. Tests were made to see if a similar formula applies when the test object is viewed by extrafoveal vision. Four extrafoveal points situated at approximately 5°, 10°, 25°, and 50° from the fovea in the temporal, lower, upper, and nasal meridians respectively, were studied for two subjects. The formula was found to be true, in general, as an approximation, and for k and n the values 16 and 2 respectively were derived as representative for extrafoveal vision.

Dublin

Royal Irish Academy, December 14.

J. J. NOLAN and P. J. NOLAN: Atmospheric electric conductivity and the current from air to earth. Measurements were made at Glencree of the field and air-earth current by C. T. R. Wilson's method. Hence the conductivity at the earth's surface was determined. Simultaneous observations of the concentrations of positive and negative ions were made. The mean mobilities of the ions were determined. Values of the total conductivity calculated from the results found exceeded by only about ten per cent the values derived from the Wilson experiment.

Edinburgh

Royal Society, January 11.

F. FRASER DARLING: Observations on animal sociality. Animal sociality is difficult to define because of widely differing foundations and the existence of different types within one species. Red deer show closely-knit female groups, loose stag companies and, at the breeding season, harem formations superimposed on the hind groups. The matriarchal system emerging is an evolutionary advance on small patriarchies in grazing herds. Flocking of birds is found outside or within the breeding season. Flocks on a traditional family basis are rare. Observations on herring gull colonies showed that egg-laying was earlier and time taken less in the larger colonies. This was reflected ecologically in the higher survival rates in larger groups.

H. S. RUSE: The geometry of Dirac's equations and their expression in tensor form. Associated with Dirac's equations for general relativity, as obtained from the theory of two-component spinors, are four null vectors which may be regarded as defining the vertices of a skew quadrilateral upon a quadric surface in a three-dimensional projective space. A study of this simple geometrical configuration throws light upon the relationships of the various tensors associated with the Dirac theory, the whole of which can be thrown into a tensor form not explicitly involving spinors.

Moscow

Academy of Sciences (*C.R.*, 4, No. 2; 1936).

J. DUBNOV and N. EFIMOV: Pairs and bundles of grids.

M. M. GUREVIČ: Change in the brilliancy of a bundle of rays on refraction.

N. IVANOVA: Route of the particles comprising the showers of ultra-penetrating rays.

W. A. OSIPOV-KING: A new mode of construction of polarization prisms.

L. M. SCHAMOVSKIJ: The elementary photographic process in ion crystals.

F. M. ŠEMJAKIN: The question of periodic reactions.

A. POLESICKIJ: The lower limit of the formation of mixed crystals of a new type.

W. A. DEVJATNIN: A chemical method for the determination of vitamin B_1.

O. E. ZVIAGINCEV and E. L. PISARŽEVSKAJA: Action of sulphide minerals on solutions of gold and platinum salts.

A. I. ZUITIN and V. V. IVANOVA: Some data on the structure of the testes in hybrids of yak and cattle.

M. CH. ČAJLACHJAN: New facts in support of the hormonal theory of plant development.

A. L. BEHNING: Caspian Peracaridæ in the Manytch basin.

E. M. KROCHIN and F. V. KROGIUS: The lake form of *Oncorhynchus nerka* from Lake Kronotsk, Kamchatka.

G. M. RALL: Character of the propagation of certain rodents as a factor of their numbers in Nature.

N. V. NASSONOV: (1) Influence of various factors on morphogenesis following homotopical subcutaneous insertions of cartilage in the axolotl. (2) Morphogenesis following heterotopic and heteroplastic insertions of cartilage under the skin of the axolotl.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, February 8

University of Leeds, at 5.15.—Dr. J. Hammond, F.R.S.: "Growth and the Function of the Mammary Gland".*

Tuesday, February 9

St. Mary's Hospital Medical School, at 5.30.—Prof. E. D. Telford: "Some Disorders of the Peripheral Circulation" (succeeding lectures on February 16 and 23).*

Wednesday, February 10

Bedford College for Women, at 5.15.—Dr. Friedrich Zeuner: "The Climate of the Countries adjoining the Ice-Sheet of the Pleistocene".*

Royal Society of Arts, at 8.15.—Olaf Bloch: "Applications of Photography to Scientific and Technical Problems".

Thursday, February 11

Institution of Civil Engineers, at 6.—H. Coyne: "The Construction of Large Modern Water Dams" (Joint Meeting with the British Section of the Société des Ingénieurs Civil de France and the Institution of Structural Engineers).

Royal Aeronautical Society, at 6.30—(at the Royal Society of Arts, 18 John Street, Adelphi, W.C.2).—F. W. Meredith and P. A. Cooke: "Aeroplane Stability and the Automatic Pilot".

Friday, February 12

Royal Astronomical Society, at 5.—Annual General Meeting.

J. H. Reynolds,: Address on the award of the Gold Medal to Dr. Harold Jeffreys.

Royal Institution, at 9.—Prof. I. M. Heilbron, F.R.S. "Pigments Associated with the Fatty Tissues of Plants and Animals".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Engineering Inspector in the Roads Department of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (February 11).

Head of Engineering Department in the North Staffordshire Technical College—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (February 17)

Lecturer in Physics and Mathematics in the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon (February 27).

Director of Antiquities, Palestine—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (March 31).

Analyst and Demonstrator at the Harper Adams Agricultural College, Newport, Shropshire—The Principal.

Chief Chemist of the Indian Jute Mills Association, Calcutta—S. G. Barker, 191 Coombe Lane, Wimbledon, S.W.20.

Official Publications Received

Great Britain and Ireland

British Commonwealth Scientific Conference, London, 1936. Report of Proceedings. (Cmd. 5341.) Pp. 74. (London: H.M. Stationery Office.) 1*s*. 3*d*. net. [141

Report for 1936 (No. 49) of the Marine Biological Station at Port Erin, Isle of Man. Drawn up by Prof. R. J. Daniel. Pp. 25. (Liverpool: University Press of Liverpool) 1*s*. 6*d*. net. [141

City and County of Newcastle upon Tyne. A Study of the Diets of Sixty-nine Working Class Families in Newcastle upon Tyne. Pp. 45. (Newcastle upon Tyne: City Health Department) 1*s*. [141

Other Countries

Verhandlung der Schweizerischen Naturforschenden Gesellschaft. 117 Jahresversammlung vom 28 bis 30 August 1936 in Solothurn. Pp. 451. (Aarau: H.R. Sauerländer und Co.) [111

U.S. Department of Agriculture Circular No 246 Life History and Control of the Asiatic Garden Beetle. By H. C. Hallock. Revised by I. M Hawley and H. C Hallock. Pp. 20. 5 cents. Circular No. 407: Plowing as a Means of Destroying Wireworm Pupæ in the Pacific Northwest. By F. H Shirck. Pp. 8. 5 cents. Technical Bulletin No 541: Deterioration of Book and Record Papers. By T D. Jarrell, J M Hankins and F. P Veitch. Pp. 20. 5 cents. (Washington, D C.: Government Printing Office.) [111

Conseil Permanent International pour l'Exploration de la Mer. No 16: Faune ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. Pp. 48. (Copenhague. Andr. Fred. Høst et fils) 4.00 kr. [111,

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol 88. Zoological Results of the George Vanderbilt African Expedition of 1934, Part 6: Birds By Witmer Stone. Pp. 529–598. The Archæological and Faunal Material from Williams Cave, Guadalupe Mountains, Texas. By Mary Youngson Ayer. Pp. 599–610. (Philadelphia: Academy of Natural Sciences) [111

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University Vol 18, No. 4 (Mathematics, No 20) On a Pair of Surfaces Mutually Related, 5 By Sôzi Matumura Pp. 95–132. Vol 18, No 5 (Mathematics, No 21). Über Flachen und Kurven, 17; Beitrage zur Geometrie der Kreise und Kugeln, 17. Von Sôzi Matumura Pp. 133–164 (Taihoku: Taihoku Imperial University.) [121

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 22, No. 1. The Templeton Crocker Expedition to Western Polynesian and Melanesian Islands, 1933. No. 30: Diptera. By C. H. Curran, with the collaboration of C. P. Alexander and E T. Cresson. Pp 66+2 plates. (San Francisco California Academy of Sciences) [131

Bulletin of the American Museum of Natural History. Vol. 72, Art. 5: The Distribution and Habits of Madagascar Birds; Summary of the Field Notes of the Mission Zoologique Franco-Anglo-Américaine à Madagascar. By A. L. Rand Pp. 143–499. Vol. 72, Art. 6 Some Muridæ of the Indo-Australian Region. By G. H. H. Tate Pp 501–728. (New York: American Museum of Natural History) [131

University of Illinois: Engineering Experiment Station. Bulletin No 287: The Biologic Digestion of Garbage with Sewage Sludge. By Prof Harold E. Babbitt, Benn J. Leland and Fenner H. Whitley, Jr. Pp. 112. 1 dollar. Circular No. 27: Papers presented at the Twenty-third Annual Conference on Highway Engineering held at the University of Illinois, February 26–28, 1936. Pp. 160 50 cents. Reprint No. 9 Correlation between Metallography and Mechanical Testing. By Herbert F. Moore. Pp 24. 20 cents. (Urbana, Ill.: University of Illinois) [131

Loris: a Journal of Ceylon Wild Life. (Published by the Ceylon Game and Fauna Protection Society, Gammaduwa.) Vol 1, No. 1, November 1936. Pp 60. (Colombo and London: The *Times of Ceylon* Co., Ltd.) 2*s*. 6*d*. [141

Calendario del Santuario e delle Opere di Beneficenza Cristiana di Pompei, 1937. Pp 200. (Pompei: Scuola Tipografica Pontificia.) [161

Ceylon Part 4. Education, Science and Art (D). Administration Report of the Acting Director of Agriculture for 1935. By Dr. J. C. Hutson. Pp. 105. (Colombo: Government Record Office.) 1.10 rupees. [181

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 167: Control of Barley Diseases. 2: Loose Smut and Leaf Stripe. By G. Howard Jones. Pp. ii+21+12 plates. (Cairo: Government Press.) 4 P.T. [181

The Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 13: Two New Statistical Tables based upon Fisher's '*t*'. By M. Vaidyanathan. Pp. ii+14. (Delhi: Manager of Publications.) 6 annas; 3*d*. [181

Herbertia. Vol 3. Dedicated to Arthington Worsley. Edited by Hamilton P. Traub. Pp. 160. (Orlando, Fla: American Amaryllis Society.) [191

National Geographic Society. Contributed Technical Papers, Stratosphere Series, No 2: The National Geographic Society—U.S. Army Air Corps Stratosphere Flight of 1935 in the Balloon *Explorer II*. Pp. 278. (Washington, D.C.: National Geographic Society) 1 50 dollars. [191

Iowa Geological Survey. Technical Paper No. 3: Iowa Coal Studies By Prof. H. L. Olin. Pp. 80. (Iowa City: Iowa Geological Survey) [201

Michigan State College of Agriculture and Applied Science. Agricultural Experiment Station Report, Two Years ended June 30, 1936. Pp 61. (East Lansing: Michigan State College of Agriculture.) [201

Catalogues, etc.

Catalogue of Rare Books and Manuscripts (No 208) Pp. 36. (Leicester: Bernard Halliday)

Vacuum Thermocouples. (Vac. 36) Pp. 4. Thermal Compressor for Pressures up to 1000 Atm (Com. 36) Pp. 4. (Delft: P. J. Kipp and Zonen; London: W. Edwards and Co.)

A Supplement of Scientific Books. No 3, 1937. Pp. 20. (Cambridge: W. Heffer and Sons, Ltd.)

Kodak Recording Films and Papers. Pp. 8. (London. Kodak, Ltd)

Industrial Organisation and Management: a Selection of Books to Borrow. Pp. 4. (London: Management Library)

Sale List of Chemical Apparatus. (GT 1180.) Pp. 8. (London: Griffin and Tatlock, Ltd.)

The B.D.H. Guide to the Addendum 1936 to the B P. 1932. Pp. 12. (London: The British Drug Houses, Ltd.)

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Peking Man: The New Skulls and the Evolutionary Problem

ALL but ten years have elapsed since the investigations initiated through the palæontological researches of Dr. J. G. Andersson of the Chinese Geological Survey culminated in the identification of Peking man. It was in 1927 that the late Dr. Davidson Black boldly, on the evidence of a tooth, differentiated a new genus of man, *Sinanthropus pekinensis*. His temerity was fully justified two years later when in December 1929, Mr. W. C. Pei found the first skull of Peking man in the cave of Choukoutien ; but it is only now, after the discovery of the three new skulls in November last, which are described by Prof. Franz Weidenreich in this issue of NATURE (see p. 269), that it is possible to appreciate in something like true perspective the momentous character of Dr. Davidson Black's first diagnosis.

The early recognition of the distinctive character of the human relics from these Pleistocene deposits eliminated many possibilities of doubtful interpretation, and prepared the way for the pregnant studies of the bearing of this great discovery on the general problem of human evolution, by which the late Sir Grafton Elliot Smith, Sir Arthur Keith, and others have made Peking man a crucial point in discussion. Much, however, as they have rested their argument for the course of evolution by which modern man has appeared upon indications afforded by distinctive or rudimentary characters in *Sinanthropus*, it will be gathered from the description of the new skulls by Prof. Weidenreich, and from his comparative study of their morphology, that the interpretation of *Sinanthropus* in terms of the evolutionary process now involves a change even more fundamental than anthropologists had contemplated.

Great significance in an evolutionary context has been attached to the combination of primitive and modern, if rudimentary, characters exhibited in Peking man. Prof. Weidenreich himself in recent studies has extended and given greater precision to this diversity of character, more especially in his investigations of the teeth and the conformation of the jaw, suggesting not only that in these characters does Peking man tend to approach modern man, but also indicating specifically a resemblance to certain of the modern Mongols. He now argues that this resemblance is further emphasized in the recent discoveries, while the broad and flat nasal bridge in one specimen, immediately, if tentatively, institutes a further point of resemblance to the Mongol in the possession of the characteristic, flat nose.

One of the most remarkable characters to which attention is directed by Prof. Weidenreich is the conformation of the brain, as shown in the endocranial cast ; but even more striking in this connexion is its remarkable size. In both male and female it is large for a primitive brain ; but in the male it is placed at approximately 1200 c.c., which is within no very distant range from the capacity of the modern brain, especially in the female. We need, then, feel no surprise at the cultural development of this early and primitive type of man as it is to be seen in the artefacts and in the evidence for the use of fire found in the cave of Choukoutien.

It is, however, when Prof. Weidenreich turns to the comparative study of *Sinanthropus* that his conclusions attain their most startling character. For here he now finds that the new evidence definitely places *Sinanthropus* at a lower stage in development than *Pithecanthropus*, the ape-man of Java, approximately in a geological sense his contemporary. Discussion, which hitherto has proceeded on the line that *Sinanthropus*, while standing in relation to *Pithecanthropus*, was definitely on the line of advance, is thus not a little confounded. On the other hand, Prof. Dubois, in his study of *Pithecanthropus* and early man in Java (see p. 294), offers a way out by removing *Pithecanthropus* from the human line and associating him with the gibbon, while in the recently discovered Solo man of Java—the *Javanthropus* to which Weidenreich and others see resemblances in Peking man—he sees, not a line leading to the Neanderthal stock destined to die out, but a member of a group, including Rhodesian and Wadjak man, which is on its way to becoming modern man in the person of the Australian aborigine.

Anthropologists, while congratulating Prof. Weidenreich on this great discovery made under the auspices of his laboratory, are deeply indebted to him for the dispatch with which he has placed at their disposal the new material for further discussion of this intricate and fascinating problem.

The Agricultural Research Council

THE Agricultural Research Council took over, on its formation in 1931, the functions of the Development Commissioners' Advisory Committee on Agricultural Research, and was charged with the duty of organizing and developing research so that the resources available for that purpose should be used to the utmost advantage. The wisdom with which that committee had developed and guided research had won for it the admiration of farmers and scientific investigators alike, particularly of those who could recall the backward position of Great Britain in agricultural research in the early years of this century. Research had so developed, however, that a more comprehensive body was needed for its guidance, one with powers such as that of forming committees and sub-committees which could bring the experience of specialists to bear on the various problems

While the Agricultural Research Council is analogous to the Medical Research Council, and to the Department of Scientific and Industrial Research, its administration is more complicated because it has not built up, nor does it control, its own research centres. The general relationship of the Agricultural Departments with the research institutes, university departments of agriculture and agricultural colleges remains unchanged, the Council giving criticism and advice on research programmes and grants; in 1934–35 the sum of £329,695 was included for research and advisory work in the estimates of the Agricultural Departments with appropriations in aid from the Development Fund. The Council has powers to initiate special services—a function eminently appropriate for a body having such a 'bird's-eye-view' of research and of the industry as a whole.

The second report of the Council* describes the continuation of a survey of agricultural research in Britain, but is devoted more particularly to those activities or institutions which have been the object of special inquiry during the period under review. Animal diseases continue to receive special attention, in accordance with a policy adopted by the Council early in its career—that of furthering work on certain diseases which might spread should the Government decide to encourage the live stock industry. The Council found that an increase in the number of trained investigators was one of the most urgent needs in this field of research, and took appropriate action.

Amongst the work of the specialist committees of the Animals Diseases Committee, that on braxy and braxy-like diseases may be noted; after reviewing the situation, it was decided that, as a foundation for further successful research in this field, more accurate information should be obtained on such questions as the incidence of infections of sheep by anærobic bacilli, and a special investigator was appointed to undertake a survey. As an example of research of special value to large tracts of the Empire, as well as to Britain, reference may be made to the work on sheep blow-flies at Bangor and at Aberdeen. Promising results have been obtained by studying separately the several factors involved in blow-fly attacks; thus, at Bangor, high humidity at the base of the wool was found to be one of the essentials for the eggs and larvæ of the fly, and work is in progress to investigate the conditions causing high humidity.

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* Committee of the Privy Council for the Organisation and Development of Agricultural Research. Report of the Agricultural Research Council for the period October 1933—September 1935. (Cmd. 5293.) Pp. iv+130. (London: H.M. Stationery Office, 1936.) 2*s*. net.

The Agricultural Research Council performs an important function in serving as a link with other organizations interested in agricultural research. Thus, it was recognized early on that there was a common field in the study of human and animal nutrition in its bearing on health, and joint committees were formed with the Medical Research Council to investigate iodine deficiency and to co-ordinate work on tuberculosis in animals. Again, the Milk Marketing Board made a grant of £4,000 towards research on contagious abortion in cattle, and this was made to the Council.

As an example of the energetic action taken in consequence of the recommendations of its committees, the instance may be quoted of the report of the special committee on *Brucella abortus* infection, recommending that the Council should investigate this problem at a centre of its own, possessing an adequate area of land. The additional powers necessary to carry this into effect were promptly sought and secured.

The promptitude and vigour evident throughout this report emphasize the fact that the creation of the Agricultural Research Council was an event of the first importance for the science and practice of agriculture in Great Britain.

Peary: The Man and the Explorer

Peary
By William Herbert Hobbs. Pp. xv + 502 + 8 plates. (New York: The Macmillan Company, 1936.) 5 dollars.

THE appearance of yet another book on Peary would scarcely attract much attention were it not written by an author of international reputation, one who knew both Peary and Greenland. Prof. Hobbs gives a hint in his preface as to the reason for writing the book, namely, that Peary, for various reasons, has never had "the full acclaim that was his due". One of those reasons is the publication, in England and in America, of several books which, in no uncertain terms, pronounce that the claim of Peary to have reached the Pole was at least open to doubt, if not actually fraudulent. These books have had a vogue which must have deeply offended ardent supporters such as Prof. Hobbs. The real student of polar literature can have little regard for such books, and can only regret the existence of those writers to whom the phrase about bygones has no meaning at all, and who delight in resurrecting distasteful controversies of the past.

The present book, therefore, is at once a biography of a man and a refutation of the slurs that have been cast upon the claims of that man; yet the friendly critic must deplore that the author took upon himself that dual task when the first alone would have been more effective. The word "claim", introduced into the literature of polar exploration by the American Press and, be it admitted, by Peary himself, should never appear in such a book as this. Prof. Hobbs would probably answer that it was through the false claims of Dr. Cook to have reached the Pole a year earlier than Peary that the latter was put on the defensive; in other words, that it was not Peary who began the claiming.

It will be remembered that, owing to Peary's curious methods of navigation and the lack of witnesses on his final dash to the Pole in 1909, there was no decisive proof of his having been there, and his amazing rate of travel as soon as he left his last white companion gave his detractors the chance of beginning an undignified controversy. In the absence of documentary evidence, Peary's friends fell back on the argument that his character was such that he must have been where he said he had gone, upon which the scandalmongers began to ferret out his past in an endeavour to bring to light circumstances which might give a contrary colour to his character. In the opinion of the writer they failed to do so, and the verdict should be that Peary reached the vicinity of the Pole as he said he did, but it seems an odd way of arriving at a valuation of such a deed.

The announcement of a new life of Peary, therefore, gave hopes that it would so portray the man that the world at large would see without a doubt that his character did not permit of the kind of subterfuge of which he was accused. The picture begins with great promise: we are introduced to a very pleasant boy in a small town in Maine in the mid-seventies of last century. We read his delightful letters to his mother, about his work and his play, his associates and his plans for the future. At his college he was a very hard worker, as indeed he was throughout his life, and he won the praise and the friendship of his professor, who on one occasion described his standard with the queer phrase of "at least 100 per cent".

Devoted to the study of birds and becoming an expert taxidermist, he yet found time for winter sports, for horse-breaking and for writing poetry; all these in addition to a close attention to his more direct profession of surveying and civil engineering.

From his letters at this time, it is obvious that Peary was very ambitious, anxious to become outstanding in some way or another, a hard but cheerful worker and a pleasant companion. In spite of his love of the open air, we find him, after a short period as a surveyor, becoming a draughtsman in the Coast and Geodetic Survey, from which he rises by sheer merit, through a severely competitive examination, to a junior post in the Civil Engineering Corps of the United States Navy. At thirty years of age he has won his spurs as an engineer, making reconnaissance surveys for the projected canal in Nicaragua, which was afterwards abandoned in favour of the Panama site. It was at this period that his attention was turned to the polar regions by reading a paper on the inland ice of Greenland. With characteristic energy he followed up that lead by going to Greenland in 1886, alone, to try conclusions with the inland ice. With no one except a Danish companion, and by man-hauling their sledges, he managed to penetrate 100 miles on the ice-cap, just three years after Nordenskiöld's somewhat similar journey and two years before Nansen's famous crossing. For a man without experience it was a real feat, and on his return he was obviously wavering between his old love of surveying in the tropics and the new one of journeying in the Arctic.

It is at this stage in the book that the reader feels, with regret, that he has parted with the man and has met the explorer, that he will henceforth read the records of deeds as presented to the world but not of the thoughts and aims which led to the doing of those deeds.

Peary was a good writer and a prolific one, and his descriptive pieces are simple and effective. In his later books a certain egotism tends to assert itself, an egotism which, if read from private letters, might be a pleasant enough revelation of the man, but which, in a published narrative, is apt to jar. The author of this biography missed a great chance, if indeed it ever presented itself, by not continuing to quote from Peary's private correspondence. If, for example, he could have had access to his letters to his faithful and adventurous wife, we might have had a far truer picture of the man, of his hopes and his fears and his faith, than we can ever get from numerous quotations from his published books We believe that the child was really father of the man, and that somewhere there are private letters which reflect the writer faithfully as did his schoolboy letters to his mother. In this book, however, Peary becomes a public man henceforth, and we have to judge him from his own public account of himself. With this limitation, the book deals so faithfully and meticulously with his career that certain attributes of the great traveller stand out more and more clearly as it proceeds. The first is his indomitable determination and fierce energy. Not once but a dozen times, failure, even ignominious failure, faced him, yet he persisted in overcoming the obstacle. Whether it is a broken leg or a lost depot, a lack of funds or frost-bitten feet, he goes steadily on with his plans and his journeys. One can have nothing but admiration for his will to succeed, and his persistent pursuit of his self-appointed goal.

It is interesting, also, to trace Peary's gradual evolution as a polar traveller. He sampled, in succession, nearly all the possible modes of polar travel. Beginning with man-hauling with a white man, he goes on to dog-sledging with white men; then he gradually introduces Eskimo into his parties until finally he trusts almost entirely to the natives for transport. This argues an ability to adapt himself to conditions which was singularly lacking in many of the explorers of last century, and still more does it point to a treatment of the natives which, whatever its principles, was extraordinarily effective in winning sterling service.

Most of the great polar travellers have had an outstanding physique, and Peary was well in the forefront in this respect, as witness many incidents on his journeys. Even the fact that, in his final journey to the Pole, at fifty-three years of age, he rode on the sledges a great part of the time, does not detract from his record as a man who could outlast most of his fellows, as he did often enough in his younger days.

Peary's contributions to the technique of polar transport must have been many, and the only cause for hesitation in making a fuller tribute to him on this account is that in his later writings he invariably claimed that tribute in full measure himself, and in so doing, tended to dim his own reputation by insistence on what was his due.

The concluding chapters of the book, on the great Cook controversy, are, in the main, disappointing. The biographer admits that Peary handled the matter badly, that he was no match for Cook as a student of mass psychology. The reader who has read the book with sympathy will welcome that admission, but at the same time he will feel aghast that an explorer should ever have to study the psychology of a public to whom he tells his story. One is tempted to a base parody in suggesting that he who lives by the Press shall fall by the Press, and that brings us to the chief and, one hopes, sufficient excuse for the less pleasing aspects of Peary's life. He was, throughout his career, dependent on others for financing his expeditions; he was therefore living on his reputation, and forced by circumstance to bolster his own fame by his own writings, and to attack any force that tended to dim it. This book has not given us the real Peary—perhaps it was impossible to do so—but it gives us a clearer view than any other biography of a man whose name is much too great to be affected permanently by the snappings of minor detractors. F. DEBENHAM.

Butterflies of the Genus *Erebia*

Monograph of the Genus *Erebia*
By B. C. S. Warren. Pp. vii + 407 + 104 plates (London: British Museum (Natural History), 1936.)

IT might be difficult to decide whether a description of much of the taxonomic work that has been and still is being done as merely careless can be regarded as lenient or just. It certainly would not be harsh. In the latter half of the eighteenth century it was not unusual for one author to tackle the whole of the natural world, and, considering the magnitude of the task and the degree of development of knowledge at the time, the result was at least comprehensive. Since that time, our knowledge has grown to such an extent that the size of the taxonomic group with which any single author can hope to grapple effectively has become more and more restricted, and the superficial character of much of the work that has been done has added so much to the labour involved in revising even a single genus, that the systematist confronted with the classification of a suborder no larger than the Rhopalocera may well stand dismayed at the prospect.

It is not surprising, therefore, to find a volume of some 400 pages and more than 100 plates entirely devoted to a revision of the genus *Erebia*, which comprises some 69 known species, represented by 225 subspecies (geographical races), in addition to which there are 90 named forms and nearly 280 aberrations. The task of dealing with the nomenclature alone is no light one, as the number of names involved exceeds 900, nearly 600 of which are actually used to designate species, subspecies, forms and aberrations.

In directing attention to the need for this revision, Mr. Warren points out that of the many systematic works which include a treatment of *Erebia*, Dr. T. A. Chapman's paper is the only one in which any attempt is made to study the structural characters of all the known species of the genus.

The author puts forward the following five points, which in his opinion "cover the essentials of a genuine systematic work", and which have been aimed at in the production of this book:

> "(1) To supply definite proof, on an anatomical basis, of the real affinities of every hitherto described species, subspecies, form and aberration of *Erebia*; (2) to establish the correct use of every valid name, and to eliminate those that are only synonyms or homonyms; (3) to provide reliable data for the identification of species; (4) to treat the variation of each species comprehensively, but at the same time in as simple a manner as possible; (5) to give the distribution of each race accurately, but not in great detail, avoiding long distribution lists which would encumber the work without being of compensating value."

It is becoming more generally recognized that many of the distribution lists published are based on identifications of questionable accuracy, and that they unnecessarily increase the bulk and cost of production of any taxonomic work.

There is great need for more treatises like the volume under review, monographs in which every effort is made to state and display facts with simplicity, but with absolute precision. In the matter of illustrations, Mr. Warren has not confined himself to a single aspect of a subspecies or form, either in displaying the facies of the insect or the structure of the genitalia, and a study of the figures of different specimens of the same subspecies, even from the same locality, indicates that the book is fully, though not in any way too lavishly, illustrated. There has been a good deal of controversy in the past over the respective merits of photographs and drawings, particularly in connexion with the figuring of genitalia. Mr. Warren has taken the trouble so to dissect and photograph these structures that it has been possible to give a perfectly satisfactory picture, admirably arranged for purposes of comparison.

An interesting feature of this valuable and beautifully produced monograph is an original discussion on the androconial scale and its development in the genus *Erebia*, which it may be hoped will encourage students to make a special study of these scales in other butterflies.

Stellar Constitutions and Systems

Five Halley Lectures
Pp. iv +30 +32 +32 +18 +30. (Oxford : Clarendon Press ; London : Oxford University Press, 1936.) 8*s.* 6*d.* net.

THE Halley Lecture in the University of Oxford was founded by the late Henry Wilde, on the return of Halley's comet in 1910. The lecture is given annually on a subject connected with astronomy or terrestrial magnetism. The University by decree has defined astronomy to include astrophysics, and terrestrial magnetism to include "the physics of the external and internal parts of the terrestrial globe". Lectures under this benefaction have been given by many outstanding investigators in astronomy and geophysics. Most of the lectures have been of more than ephemeral value ; though many of them have afterwards been published in booklet form, most of them are now out of print.

It was a happy idea of the Savilian professor of astronomy to endeavour to form a permanent record of the lectures. Of those already delivered, which had been printed by the Oxford University Press, only five were available in sufficient numbers to justify binding in a single volume. It so happened that these five lectures were on astronomical subjects. The volume under review will be, it is hoped, the forerunner of similar volumes to appear in the future.

The lectures included in this volume comprise "The Rotation of the Galaxy", by Sir Arthur Eddington ; "The White Dwarf Stars", by Prof. E. A. Milne ; "The Composition of the Stars", by Prof. H. N. Russell ; "Red-Shifts in the Spectra of Nebulæ", by Dr. E. Hubble ; and "Dimensions and Structure of the Galaxy", by Dr. J. S. Plaskett. In reading through these lectures again, one cannot but be impressed by the able manner in which the subjects were dealt with, and unsolved problems were discussed.

The problem that was uppermost in the mind of Sir Arthur Eddington was the bearing of the rotation of the galaxy on the time-scale of stellar evolution "Geological time swallows up at least 1,500 million years ; we must allow a reasonable margin beyond that for the evolution of the solar system, say 3,000 million years altogether. The minimum requirement of our model system is that it will keep going for that time without collapse. Actually we are hard put to it to invent a galaxy with even this limited degree of permanence, which shall at the same time embody the main features of stellar motion and distribution enumerated on p. 6. As for those who dabble in the long time-scale of billions of years now fashionable (and I have to confess myself one of them) we must simply ignore them. Whatever the study of individual stars may bring forth in its favour, the evidence of galaxies and of systems of galaxies is dead against so leisurely a rate of progress. The problem of the galaxies is unapproachable except from the standpoint that the material universe is a much more evanescent affair". The lecture ended with these words : "Perhaps the lesson of the galaxies is to wake us from our dream of leisured evolution through billions of years. It is hard to credit our stellar system with so much age and endurance. It is more like a young man in a hurry". Since this lecture was delivered, astronomical opinion has been veering steadily in favour of the short time-scale for stellar evolution as opposed to the time of billions of years formerly current.

Prof. Milne discussed the white-dwarf stars and the nature of 'dense matter', sketched out his views on stellar evolution and described the relationship of novæ and of white dwarfs to his scheme. The recent appearance of two bright novæ, in addition to several fainter novæ, has given a great impetus to the study of the many complex problems that these interesting stars present. Milne's theory of the cause of a nova outburst, though not yet proved, still offers the most plausible working hypothesis. It may be mentioned that the large folding diagram (Fig. 3), which accompanies this lecture, has been omitted from the review copy of this volume. It is to be hoped that the omission is peculiar to this copy only, for without the diagram in question it is not possible to follow much of the argument.

In his lecture, Prof. Russell gave an admirable résumé of the present state of knowledge about the composition and physical conditions of the visible portions of the stars. The only stellar spectrum that has been studied in sufficient detail to permit a complete qualitative analysis is that of the sun. It is found that seven elements—magnesium, iron, silicon, sodium, potassium, calcium and aluminium—make up 96 per cent by weight of the solar metals, and these are the seven principal constituents of terrestrial rocks. The determination of the abundance of the non-metals is more difficult, as the lines in their spectra are faint and of very high excitation potential. The more conspicuous features of the distribution are a general decrease in abundance for the heavier elements and a greater abundance of elements of even atomic number than of elements of odd number. This relation has been noticed in terrestrial data also, and attributed in some way to the constitution of atomic nuclei. Another result of interest, confirmed in other ways, is that hydrogen is of the order of 1,000 times as abundant, atom for atom, in stellar atmospheres as all the metals together. The complicating factor in these investigations is that the maximum intensity of the lines of one element depends more often than not on the degree of ionization of another element. Further progress in the detailed quantitative analysis of stellar atmospheres is dependent upon the more detailed investigation of stellar spectra. The great 200-inch telescope, with a focal length in the Coudé form of about 500 feet, will permit a more complete investigation of the spectra of the brighter stars than has hitherto been possible.

Dr. Hubble's lecture dealt with a problem the solution of which must also await the completion of the 200-inch telescope—the interpretation of the red-shifts in the spectra of the extra-galactic nebulæ. "This telescope should penetrate to distances where the effects of red-shifts are so great that the requisite data will lie well above the threshold [of the photographic plate]. Such data will afford critical empirical tests of the interpretation of red-shifts as representing actual motion, and will establish the form of the velocity-distance relation in regions where the velocities, whether real or apparent, are considerable factions of the velocity of light". The method of investigation is to examine the apparent departure of the distribution of the extra-galactic systems from statistical uniformity. This apparent departure from a uniform distribution is attributed to the reddening of the light from the systems, which increases with distance. The effect to be expected will differ according to whether the reddening is, or is not, interpreted as a velocity effect.

The remaining lecture, the most recent of the lectures on an astronomical subject, was given by Dr. J. S. Plaskett in 1935, and dealt with the present state of knowledge about the dimensions and structure of the galaxy. During the past twenty-five years there have been considerable changes in current ideas as to the dimensions of the galaxy. Eddington, in the first of the lectures in this book, when referring to some dynamical investigations that he made in 1913–15, remarks: "But when I turn to the efforts I then made to fit the theory to the observed properties of the system, it is like a glimpse of the middle ages. Is it possible that only fifteen years ago we thought the stellar universe was like that! With some misgiving I found I must place the sun at least 500 parsecs away from the centre of the system; but I did not expect to be believed. Nowadays 7,000 parsecs is the minimum estimate".

The great expansion in the size of the system followed from Shapley's application of the luminosity-period relationship for the Cepheid variables to the estimation of the distances of the globular clusters. He gave the system a diameter of 260,000 light-years. The diameter of the largest known external systems, the Andromeda nebula, was later estimated by Hubble to be about 40,000 light-years, so that there seemed to be a great disparity in size between the galaxy and the external systems. Subsequent investigation has tended progressively to reduce this disparity. The revision of the zero-point of the Cepheid period-luminosity curve, and allowance for the presence of absorbing material within the system, which dims the light of distant stars and causes distances depending on any luminosity method to be overestimated, has reduced the dimensions of the galactic system. The distance from the sun to the centre of the galaxy derived dynamically from investigations of the rotation of the galaxy is now in good agreement with that deduced from the distribution of the globular clusters—about 10,000 parsecs or 32,000 light-years. The diameter of the system is of the order of 100,000 light-years.

Concurrently with the reduction in the size of our own system, the extimated dimensions of the Andromeda nebula have been enlarged. Hubble, in 1932, identified 140 nebulous objects in and near the Andromeda nebula as globular clusters, dynamically connected with the system. Many of these were outside the limits of the system shown on long-exposure photographs. In 1933, Stebbins and Whitford, from photo-electric measures, showed that faint nebulosity extended to much greater distances than had been supposed. These investigations have combined in showing that there is no great difference in size between the Galaxy and the Andromeda nebula. Dr. Plaskett ends his lecture, however, with a note of caution: "While the dimensions, structure and dynamical organization of the Galaxy have been here fairly definitely stated, the proposed model must be considered only as a preliminary attempt at the solution of this difficult but very important astronomical problem. In view of the changes that have occurred in our conceptions of the Galaxy during the past twenty years, one would be very rash to predict that even approximate finality had been reached. All that can safely be said at present is that the concept developed has a certain unity, completeness, and probability, and it can only be hoped that it makes a useful introduction to more complete knowledge".

H. S. J.

Modern Sociologists

(1) Comte: the Founder of Sociology. By F. S. Marvin. Pp. 216.
(2) Veblen. By J. A. Hobson. Pp. 227.
(London: Chapman and Hall, Ltd., 1936.) 6*s*. net each.

(1) Mr. Marvin's "Comte", notwithstanding the brevity of treatment imposed by the limitations of the series of which it forms part, is one of the best and most lucid expositions of the doctrines of the founder of 'sociology' extant. Its merits, however, are not confined solely to its treatment of the positive philosophy and the religion of humanity as originally formulated. The author, having in mind the aim of the series to bring the principles of sociological thinkers into relation with the problems of to-day, has essayed the by no means easy task of evaluating the position of Comtian theories at the present time. In so doing, Mr. Marvin has analysed current trends of modern society in thought, in scientific discovery, and in social development, with an acute perception and a sanity of judgment, which not only provide an efficient antidote to current moods of superficial pessimism, but also convey a gospel to scientific workers and practical sociologists.

(2) Veblen is a thinker of a very different order from Comte; and notwithstanding Mr. Hobson's acute and sympathetic analysis of his work, it is difficult to evade the conclusion that his sociological doctrines were little more than a sublimation of personal experience. His early life on a Middle-West farm and in Chicago at the close of the nineteenth century, when the corrupting influence of financial interests was at its height, fundamentally affected his reading of history and his view of the development of society. His interpretation of the evidence of anthropology, upon which much stress is laid by his admirers in the United States, is superficial and lacking in understanding. This view would probably not meet with the assent of the author of this exposition. The brief introductory sketch of the events of Veblen's life given here needs revision as to its dating.

Über Katalyse und Katalysatoren in Chemie und Biologie

Von Alwin Mittasch. Pp. vii + 65. (Berlin: Julius Springer, 1936) 3.60 gold marks.

A lifetime's work on technical catalysts lies behind this little pamphlet. While Haber proposed and outlined experimentally the idea of nitrogen fixation, and Bosch developed the apparatus for it, Mittasch solved one of the main practical difficulties attached to the process, by the discovery of an iron catalyst of a certain composition.

Few people know more about technical catalysts than does the author; much of the existing knowledge has grown up under his direction and has never been published. It is astonishing how little all this important work has contributed to the elucidation of the principles of catalytic action. The pamphlet gives no scientific views on this subject. Besides reviewing the various aspects of chemical catalysis, it surveys a great number of biological phenomena in which small quantities of substance have big effects: the action of enzymes, poisons, heredity are all spun together in a web of loose analogies. Some of the points referred to are of quite recent date and impress upon the reader the wideness of the author's knowledge. This factual survey may be of some use, even though there is no idea underlying it.

One is reminded of Gudden and Pohl's treatise on photo-electric conductivity which, when introducing the chapter on selenium, notes that this particular field is most obscure owing to the great amount of technical work done in it. It seems that technical research conducted under an employer's authority, in an atmosphere of secrecy, is far less effective in discovering the principles involved in a process than pure research open to world-wide discussion.

M. Polanyi.

Witches and Warlocks

By Philip W. Sergeant. Pp. 290 + 15 plates. (London: Hutchinson and Co. (Publishers), Ltd., 1936.) 12*s*. 6*d*.

Dr. Margaret Murray's study of witchcraft in western Europe, which revived the theory of a Dianic cult and brought its manifestations into relation with modern ideas on the character of primitive religion, gave an orientation to the numerous studies of witchcraft which followed, and demanded from her imitators and successors something more than descriptive narrative to justify publication. Mr. Sergeant's claim to serious attention lies in his careful and detailed analysis of the evidence in the cases of the Lancashire witches, and the part played by the Mathers and others in the persecution of the Salem witches in America, as well as in his account of the Elizabethan Dr. Dee and his evil genius Kelly. On the theoretical side he is not equally happy. His knowledge of primitive religion is scarcely adequate to the demand—his reference to totemism seems particularly wide of the mark—nor does his knowledge of the literature of that subject appear to be extensive.

Aluminium-Legierungen

Von A. Grutzner. Unter Mitarbeit von G. Apel. Teil 1. Patentsammlung geordnet nach Legierungssystemen. Pp. vii + 342. 35 gold marks. Teil 2. Patentsammlung. Nebst einem Markenverzeichnis bekannter Aluminium-legierungen, von Prof. Dr. A. von Zeerleder. Pp. iii + 343–868. (Zugleich Anhang zu Aluminium Teil A in Gmelins Handbuch der anorganischen Chemie, Achte Auflage, herausgegeben von der Deutschen Chemischen Gesellschaft.) (Berlin: Verlag Chemie, G.m.b.H., 1936.) 54 gold marks. (Ausland preis, 40 50 gold marks.)

The alloys of aluminium are so numerous that a complete table of them has been compiled, which runs to more than 800 pages and is issued in two parts. The table facilitates reference to the patent literature, and a further useful feature is a supplementary list of all the known alloys of the metal in the alphabetical (or numerical) order of their trade names, together with the names of patent holders and percentage compositions.

The New Discovery of Three Skulls of *Sinanthropus pekinensis*

By Dr. Franz Weidenreich,

Visiting Professor of Anatomy, Peiping Union Medical College, and Honorary Director of the Cenozoic Research Laboratory, National Geological Survey of China

FOLLOWING the recovery of several fragments of a very small adult skull of *Sinanthropus* from Locus I (Locality 1) in the latter part of our spring field season at Choukoutien, we had the good fortune during the fall season of this year to unearth three additional more or less well-preserved skulls, two of which were recovered on one day. All three skulls belong to adult individuals. The skull recovered first, and designated as Skull I of Locus L (Fig. 1), is the largest, with a cranial capacity of approximately 1,200 c.c. and with its coronal and sagittal sutures partly fused. The second skull (Skull II of Locus L, Fig. 2) is the smallest of the group, with a cranial capacity not higher than 1,050 c.c., and its coronal, sagittal and lambdoid sutures fused. This skull shows a clear indication of the persistence of a metopic suture. The third skull (Skull III of Locus L, Fig. 3) is smaller than Skull I, but larger than Skull II. The cranial capacity of Skull III is approximately 1,100 c.c. Although all the sutures of this skull are still patent, yet other characteristic features make it evident that we are concerned with a young adult individual. Parts of the face are preserved in all three skulls ; thus, in Skull III both nasal bones and the entire lateral border of the orbit in complete connexion with the brain case ; in Skull II the frontal process of the maxilla, the lower border of the orbit, the cheek-bone and fragments of the alveolar process of the upper jaw with palate and ten teeth *in situ* (premolars and molars), which, however, are not connected with the skull. Belonging to Skull I are several teeth only. In addition, we have a great number of very small fragments apparently pertaining to the face, yet it is rather doubtful whether it will be possible to undertake even a partial reconstruction.

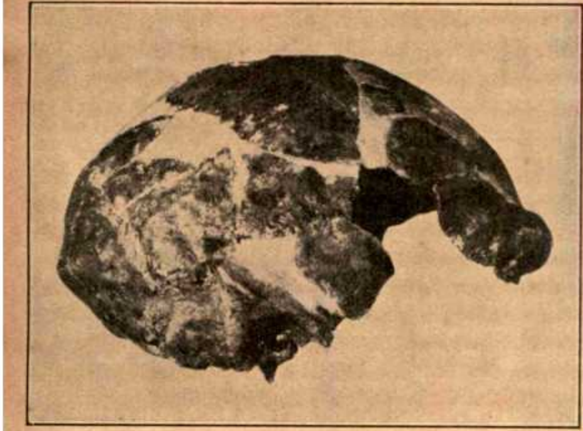

Fig. 1.

Sinanthropus pekinensis, Skull I, Locus L, adult male. Norma lateralis, right side. × ⅓.

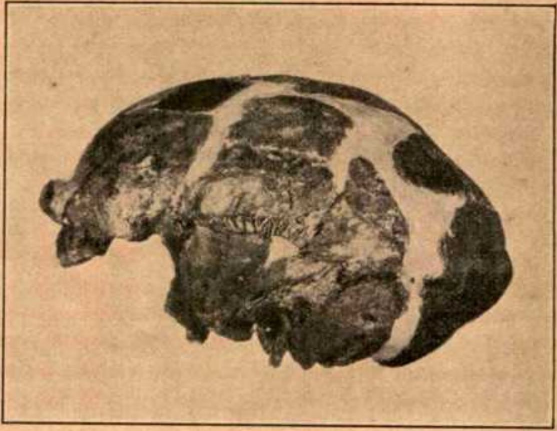

Fig. 2.

Sinanthropus pekinensis, Skull II, Locus L, adult female. Norma lateralis, left side. × ⅓.

As has been noted in the case of all teeth of *Sinanthropus* recovered hitherto, it is also true for *Sinanthropus* Skulls I and II, namely, that they possess a large and a small type of teeth. I had previously arrived at the conclusion that the large teeth may belong to male individuals and the small to female individuals. This assumption has been confirmed by the fact that the large type of teeth pertain to the bigger skull (Skull I) while the small type of teeth is to be found in the small skull (Skull II, Fig. 4). Thus it seems quite certain that the latter represents the skull of a female individual, and the former that of a male individual.

Parts of the base are missing in all three skulls. Skull I is the most defective, with only the right temporal bone being preserved. In Skull II both temporal bones are present, but a great part of the supraorbital region is broken off. Skull III is the most complete one ; the entire occipital bone with the posterior border of the foramen magnum is preserved. However, the right temporal bone has been lost.

All three skulls have the same appearance as Skull I of Locus E described by Davidson Black (1931). However, since this skull belongs to a child of eight–nine years (cf. Weidenreich, 1935), the characteristics of the *Sinanthropus* type are much more pronounced in the recently recovered skulls such as, for example, the size and thickness of the supraorbital ridges and the occipital torus, the crest of the vertex and the muscle markings of the temporal bone. The greatest transversal diameter of all three skulls is represented by the biauricular breadth with the breadth decreasing gradually above the ear aperture. The accompanying table (see below) shows the results derived from the more essential skull measurements in comparison with those available for *Pithecanthropus*, Neanderthal and recent man. The measurements 8–13 giving the corresponding ratios reveal that *Sinanthropus* as a whole occupies the lowest place in the order of all hominids in regard to those peculiarities which determine its position in the line of evolution. This is particularly true for Skull II of Locus L, while Skull I of Locus L in part falls within the range of variations of the Neanderthal group. However, Skull II apparently is even lower than *Pithecanthropus*, the difference being that the *Sinanthropus* skull shows a more pronounced frontal tuber than *Pithecanthropus*, the entire forehead of which is flattened. The smallness and lowness of *Sinanthropus* Skull II is all the more remarkable since the skull fragments recovered last summer and considered to pertain to an adult individual are still smaller in dimensions than the respective parts of Skull II of Locus L and *Pithecanthropus* (cf. Weidenreich, 1937).

TABLE*

	Sinanthropus				*Pithe-can-thropus*[2]	Neanderthal group				Recent man[3]	Chim-pan-zee[3]
	I Loc. L	II Loc. L	III Loc. L	I Loc. E[1]		Nean-derthal	Spy I	La Cha-pelle	Rhod-esia		
Sex	♂	♀	♂	♂ (child)	♀	♂	♂	♂	♂	♂+♀	♂+♀
1. Greatest length (g-op)	198	191	195	188	183	201	203	208	206		
2. Glabello-inion length (g-i) ..	195	188	194	185	177	199	198	195	204		
3. Greatest breadth :											
a. auricular	148	145	147	144	140	—	—	144	142		
b. temporo-parietal	136	137	—	133	130	147	147	156	146		
4. Last frontal breadth	89	88	90	82	85	107	104	109	100		
5. Auricular-bregmatic height(po-b)	107·5	98	100	93	94	—	118	115	116		
6. Calvarial height (over glabello-inion line)	84	65·5	78	70	66·2	80·5	81	79	90		
7. Cranial index	68·7	71·8	—	73·6	71·0	73·1	72·4	75·0	70·9	—	—
8. Length-auricular height index ..	53·4	*50·7*	51·0	50·3	51·4	—	*54·7*	55·4	56·3	*63·8*	*51·2*
9. Calvarial height index	43·1	*34·8*	40·2	37·9	37·9	*40·4*	40·9	40·5	*45·4*	*59·8*	*32·5*
10. Bregmatic index (Schwalbe) ..	39·5	*44·2*	39·2	39·5	40·9	*38·4*	34·5	36·5	36·4	*28·0*	*50·0*
11. Bregmatic angle (Schwalbe) ..	47°	*39°*	44°	43°	42°	*44°*	46°	45·5°	48°	*59°*	*39°*
12. Superior inion angle (lig) ..	74°	*60°*	62°	64·5°	70°	*66·5°*	68°	68·5°	70°	*84°*	*50°*
13. Inion angle (lio)	—	—	*96°*	—	99°	118°	122°	113°	*107°*	*119°*	*110°*
14. Capacity (c.c.)	c.1200	*c.1050*	c.1100	914	1000?	*c.*1370	—	1620	1325	*1325*	*410*

* The figures in italic type represent limiting values of the individual groups, with the exception of recent man and chimpanzee. Measurements of Locus E skull not considered in limiting values on account of its immaturity.

[1] After Davidson Black's figures, but the position of inion has been rectified. [2] Reconstruction after Weinert. [3] Average figures of all races.

Since the character of a type is not always defined by the general shape only but also by the feature of details, it deserves special attention here that the new *Sinanthropus* skulls completely agree with Skull I of Locus E in this respect. This is true, for example, in respect to the position and form of the ear aperture—with the exception of the cleft of the tympanic part of the temporal bone which is distinctly an infantile character in recent man and is missing in all adult *Sinanthropus* skulls—and in regard to the smallness and form of the mastoid process, as also the very narrow space between the temporal lines on both sides.

As to the face, the parts preserved in Skulls II and III yield a rather good idea of the general structure, at least so far as the upper parts are concerned. The nasal bridge is broad and flat (the index of the inter-orbital breadth is 29·8 average); Neanderthal group: Spy I, 28·8; Rhodesia, 28·6; La Chapelle aux Saints, 26·8; recent man, 24·3 (average). There is no groove between the root of the nose and the forehead. The orbit is very low (orbital index of Skull III, 77·2; Rhodesia man, 75·5; La Chapelle, 81·9; Gibraltar, 91·1; recent Australian, 78·8 (average male); the lateral border recedes backwards below the frontal zygomatic suture. The lacrimal fossa is missing in all skulls. The orbit is deep and the superior orbital fissure very small. The cheek bone is remarkably high, as high as that of the Rhodesia skull. A canine fossa does not exist and the anterior surface of the frontal process of the maxilla is slightly convex and not depressed as in recent man. The upper jaw, therefore, must have projected considerably. The palate is broad and high.

Earlier (1935) I was able to demonstrate that a close connexion between *Sinanthropus* and certain groups of the present Mongol race could be assumed. The occurrence of the so-called 'torus mandibularis' on the inner side of the mandible of some of the *Sinanthropus* jaws as well as on those of recent Mongols, especially Eskimos and Lapps, and furthermore the occurrence of shovel-shaped medial and lateral upper incisors in *Sinanthropus*, as also in modern Mongols, indicate some direct relationship between Peking man and the Mongol group of recent mankind. Whether or not the broad and flat nose of *Sinanthropus* points to the same direction I do as yet not venture to state. However, in addition, there is another conspicuous feature which, I believe, serves as further evidence for the assumption of such a special relationship. All three adult skulls show a large 'inca-bone' (*os epactale*) which, it is true, is not confined to the ancient Peruvian natives as the name suggests but also occurs in other races of to-day. However, it is much more frequent in the American Indian and Mongol group (up to 7·8 per cent) than in the latter (up to 2 per cent).

One of the most striking features revealed by the recently recovered skulls is met with in the endocranial casts. I had previously remarked (1936) that, in the *Sinanthropus* Skull of Locus D (Black's Skull II), the pole of the frontal lobe of the brain projects far outward and continues with a sharp keel downward (orbital rostrum). This peculiarity is especially pronounced in Skull III, and in somewhat different manner also in Skulls I and II of Locus L; in the latter two the keel is not so sharp, but nevertheless it projects downward in a very straight line. In this respect the endocast of Skull III resembles that of a chimpanzee, while Skulls I and II resemble more that of a gorilla. At any rate, all endocasts differ distinctly in this respect from those of Neanderthal man or *Pithecanthropus*. Skulls II and III are furthermore remarkable for the existence of an astonishingly low and narrow temporal lobe, a condition which I had pointed out when describing the temporal bone of Skull III of Locus H (1936 *a*).

As to the relation to *Pithecanthropus*, *Sinanthropus* Skull II of Locus L, together with the fragmentary *Sinanthropus* of Locus I mentioned above, prove incontestably that there is no appreciable difference between *Pithecanthropus* and *Sinanthropus* so far as the general shape and the lowness of the skull caps are concerned. Since it has been assumed that these two *Sinanthropus* skulls belong to female individuals, it is very probable that *Pithecanthropus* also belongs to the same sex, a probability which had already been pointed out by E. Dubois and Hrdlička. The *Sinanthropus* skulls differ from *Pithecanthropus* by only two characters, namely, in that the frontal bone proper is more vaulted in *Sinanthropus*, although its inclination to the glabella-inion line is distinctly more pronounced than in *Pithecanthropus* (compare measurements 10 and 11 of table). Furthermore, the supraorbital ridges of *Sinanthropus* are separated from the forehead by a really broad furrow, while in *Pithecanthropus* they continue gradually to the brow. The latter phenomenon, however, seems to have some connexion with the formation of the frontal air-sinuses. In *Pithecanthropus* these sinuses are conspicuously large and extend far lateralward over the roof of the orbit, whereas in all cases in *Sinanthropus* they are very small and closely confined to the interorbital region. I consider this appearance in the case of *Sinanthropus* as an indication of its being more primitive than *Pithecanthropus*, and the latter, in spite of the absence of prominent frontal tubera, as a more advanced type of hominid.

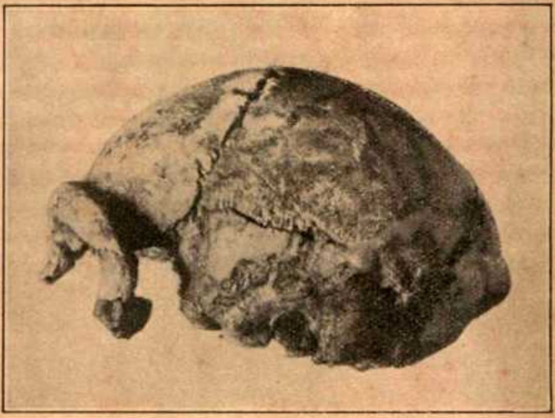

Fig. 3.

Sinanthropus pekinensis, SKULL III, LOCUS L, ADULT MALE (YOUNG). NORMA LATERALIS, LEFT SIDE. × ⅓.

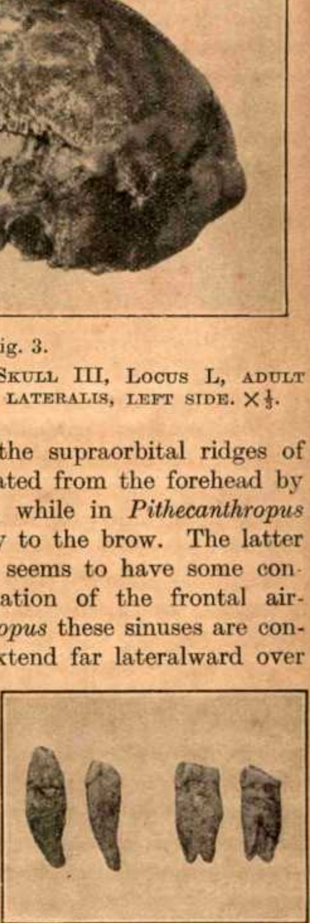

Fig. 4.

UPPER CANINES AND UPPER FIRST PREMOLARS OF MALE SKULL I AND FEMALE SKULL II. × ½. FROM LEFT TO RIGHT: CANINE, SKULL I, CANINE, SKULL II; PREMOLAR, SKULL I, PREMOLAR, SKULL II.

Another important fact is disclosed by *Sinanthropus* Skull I of Locus L. This skull is not only the largest of all *Sinanthropus* skulls recovered hitherto (*c.* 1,200 c.c.) but at the same time also the highest. Although its general structure and essential details show the same characters as the lowest Skull II of Locus L, yet its greater cranial capacity approaches closely the more primitive representatives of the Neanderthal group as revealed by the table. I had earlier (1936 *b*) assumed that there must be some relation between *Pithecanthropus* and *Javanthropus soloensis*, the latter resembling the former in several primitive characters. On the other hand, there is no doubt that *Javanthropus* has many peculiarities in common with *Sinanthropus*, as recently demonstrated by C. U. Ariëns Kappers (1936) in regard to the endocasts. I should not be surprised if *Pithecanthropus* at some future date should be found to represent nothing else but a special female type of *Javanthropus*. Since *Javanthropus* as a whole represents a very primitive form of Neanderthal man, the line linking *Pithecanthropus* and *Sinanthropus*, respectively through *Javanthropus* or Neanderthal man, to recent man is continuous. The fact that there may be certain racial deviations does not matter greatly, since the determining factor does not depend on relatively minute differences but on the main course of human development itself.

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The Structure of Liquids

THE Edinburgh discussion of the Faraday Society on September 24–26 on the subject of "The Structure of Liquids and Solutions" was a particularly successful and satisfactory conference. The choice of subject had been very happily timed. The theory of the structure of liquids, which has been in recent years approached from a number of different angles, appears now to have reached a stage in which a larger synthesis is possible, and the bringing together in Edinburgh of many of those who have most notably contributed to these theories has markedly helped towards such a synthesis.

The earlier approach to the theory of liquid structure was almost inevitably an extension of the theory of gases, and the continuity of the two states as established theoretically by Van der Waals seemed to justify this treatment. This approach, however, had led to but little advance in explaining most of the characteristic properties of liquids. A recent tendency, on the other hand, which has taken its origin in the X-ray studies of liquid structure, has been to treat the liquid as more closely analogous to the crystalline solid. This has proved a much more fruitful line of advance for ordinary liquids, that is for liquids at temperatures far removed from their critical temperatures.

The chief difference between liquids and crystals is that in liquids we have irregularity of position and orientation of molecules in the place of the regularity of the crystal arrangement. This irregularity is limited by the general condition that in liquids the molecules are approximately close-packed. A great advance in the study of liquids is the development of the precise method of defining the molecular or atomic *configuration* of a liquid under any conditions. This has been achieved by means of the distribution function $g(r)$ of Debye and Prins, which gives the probability of finding a molecule at every distance from an arbitrarily chosen one (see Fig. 1). The peaks of the distribution function correspond to the perfect co-ordination spheres surrounding atoms in a regular crystal structure, and Prins has suggested that one can be derived from the other by considering each co-ordination sphere of mean radius r_k and

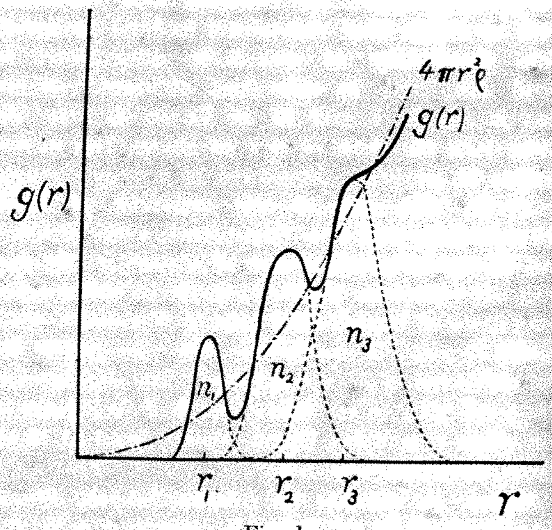

Fig. 1.

containing n_k molecules to be smeared out by a form of error function, so that the distribution function may be written

$$g(r) = \sum_k g_k(r) = \sum \frac{n_k}{4\pi r_k^2} \sqrt{\frac{c}{r_k}}\, e^{-\frac{1}{\lambda^2}\left(\frac{r-r_k}{kT}\right)^2}$$

Bernal has attempted to apply this idea to the conditions of equilibrium of liquid structures. Any possible configuration of the liquid can be defined by a distribution function depending on only three variables, the average number N of close neighbours of any molecule, the mean distance R of these neighbours, and the variability of this distance, which is equivalent to the measure of the irregularity of the structure. Of all configurations defined in this way, that one will be stable for which each free energy is a minimum for any variations of N, R and λ With rise in temperature the values giving such a minimum will change, the co-ordination number in general falling and the irregularity increasing. We may think of the change of configuration of a liquid on heating as equivalent not only to change in the number of excited vibrations, as occurs in a crystal, but more to the transformation of one crystalline phase into another. In a liquid there is an infinite sequence of different configurations, while the condition that the free energy remains constant for any change of phase becomes the general condition of minimum free energy for all configurations. The increasing potential energy on passing from a low-temperature to a high-temperature configuration consequently gives to liquids a term in the specific heat which does not exist in the crystalline solid, and makes the specific heat of liquids at low temperatures larger than can be explained by any theory based on the excitation of degrees of freedom alone.

Prof. F. London, who presented an admirable introductory paper on "The Nature of the Forces acting between Atoms and Molecules in Liquids", discussed particularly the structure of what should be the ideal, but what is actually the most anomalous of liquids, liquid helium. Here the importance of zero point energy is so great that the minimum of potential energy has little effect in fixing the configuration of the liquid, so that each atom has only four neighbours instead of the twelve that occur in normal liquids. E. Bartholomé and A. Eucken and L Brillouin dealt with the theory of specific heats of liquids. So far, however, no quantitative theory has been successfully evolved to cover either the behaviour of liquids at very low temperatures or near the critical point, where the general theory indicated above would require considerable modification.

The crucial question of whether the liquid and crystalline states form a continuum in the same sense as liquid and gaseous states was much discussed. J. Frenkel claimed that such a continuum exists, from theoretical considerations, and believes that the transition between crystals and liquids can only be achieved at low temperatures under large negative pressures. F. Simon, on the basis of experimental evidence, considers that, if it occurs at all, it is only at high temperatures and positive pressures. According to Bernal, on the other hand, for purely geometrical reasons no intermediate state should be possible. This question, however, is probably premature, as the theory is not sufficiently advanced and the experimental conditions very difficult to achieve.

Several very notable semi-empirical generalizations on the properties of liquids were given to the conference. According to Bauer and Magat, it appears that a number of properties of liquids, notably their specific volume, surface tension and specific heat, can all be plotted on the same curves, if the temperature ordinate be taken as $\theta = (T - T_F)/(T_C - T_F)$, where T_C and T_F are the critical and melting temperatures respectively. These generalizations would seem to imply that the structures of different liquids resemble one another far more than do the structures of corresponding crystals; they would almost merit the sweeping statement *that there is only one liquid state*. This requires to be qualified, however, by the possibility that for all the liquids investigated, except water, which is as usual anomalous, the molecules or molecular groups are in a state of free rotation, and that consequently the generalization applies only to assemblages of effectively spherical units. Liquids with highly asymmetrical molecules would tend towards the greater regularity of the liquid crystalline state. Hudleston has shown that similar regularities occur in the compressibilities of liquids, and that they can be referred to a very simple semi-empirical law, while A. G. Ward, by considering the constant B in the viscosity temperature relation,

$$\eta = A e^{B/RT},$$

has shown that it is closely related to the latent heat of melting and the general physical type of the liquid.

A new method of investigating the properties of liquids, the measurement of absorption of ultrasonic waves studied by M. P. Biquard and J. Errera, has led until now to highly anomalous results. This absorption is found to be larger, and sometimes as as much as a thousand times larger, than that which would be expected under existing theories, and this suggests very forcibly that there are some phenomena in liquids, possibly related to changes of configuration, that have an appreciable characteristic time of the order of a millionth of a second.

The second part of the conference, devoted to solutions, is more difficult to summarize because here general principles were not so much in evidence. Prof. J. H. Hildebrand, in his introductory paper, laid stress on the need of greater precision in defining the nature of the intermolecular forces in solutions and the meaning of association. In particular he emphasized the much greater importance of the extremely active hydrogen and hydroxyl bonds in liquids compared with the less localized dipole forces.

There was considerable discussion as to the validity of Raoult's law for liquid mixtures and in the changes of entropy on solution, but the general impression, well expressed in Prof. J. Kendall's paper, was that in this field anomalies are more apparent than regularities. The structure of liquids themselves being so complex, that of solutions, except dilute solutions of very simple substances, must be far more so. There are so many factors, in the size and shape of the molecules, in the existence of active association centres and in the possibility of formation of limited or indefinite clusters, that it is only in groups of fairly closely related substances in the same solvent that regularities may be expected. Thus, for example, J. A. V. Butler has shown that a series of aliphatic alcohols dissolved in water have heats of solution which can be calculated additively from the number of carbon atoms they contain, and that the entropy of solution is a linear function of the heat of solution.

The value of new methods, such as those of density and magnetic susceptibility, in studying solutions, was brought out in many papers. Perhaps the most important was the study of the infra-red absorption of solutions carried out by J. Errera. He was able to show, for example, by a change of frequency in absorption in a solution of alcohol in carbon tetrachloride, that the alcohol molecules are appreciably associated in pairs at concentrations so low as 0·1 mol.

With the analogous use of Raman spectra, it should be possible to determine in liquids and liquid mixtures the degree and kind of molecular association, because whenever this association is a close one it will affect both infra-red and Raman spectra. It may even be possible in some cases to calculate the intermolecular potentials from some form of model structure, as proposed by Magat. But so far, except in the case of water, where quantitative agreement can be got, the results are only qualitative. It is clear, however, that the time has come to begin attack on the problems of liquids and solutions on the basis of molecular theory, and that all this means we shall be able to explain many, at any rate, of the difficulties that have remained unresolved by the application of classical methods in this field.

The Edinburgh discussion of the Faraday Society showed the beginning of this process, and it is to be hoped that if the lead there given is followed up, the structure of liquids will no longer remain the most unsatisfactory part of molecular physics.

Obituary Notices

Mr. P. A. Ellis Richards

BY the death on December 22 last of Percy Andrew Ellis Richards at the age of sixty-eight years, Great Britain lost one of its foremost public analysts, chemistry one of its most devoted servants, and the teaching profession one who graced it throughout a long and successful career. Born in 1868, and educated at St. Paul's School and King's College, London, he studied analytical chemistry under the late Prof. C. W. Heaton, whom he succeeded as lecturer in chemistry at Charing Cross Hospital. After the passing of his chief, he set up in practice as a consulting and analytical chemist, and was soon appointed public analyst for the parish of St. Martin-in-the-Fields, continuing his work in this capacity when his parish was joined with others to form the City of Westminster. Not long after, he was appointed to a similar post at Hammersmith, and held both until a few years ago, when failing health compelled his retirement.

During his analytical career, Richards carried out work upon the 'facing' of rice, on vinegar, and on preservatives in imported meat for the Local Government Board—now the Ministry of Health. He also served on the Departmental Committee on Preservatives and Colouring Matters in Food appointed by the Minister of Health in 1923, and on the Departmental Committee on 'Improvers' in Flour in 1925. He contributed numerous papers to scientific journals upon topics not only in his own sphere, but also upon other subjects such as the saline waters of Boston Spa and of Salsomaggiore, ancient Russian and Irish bog oak, the determination of platinum in alloys, and the determination of iron in animal organs in connexion with researches on pernicious anæmia.

Richards' merits as a teacher were no less than those as an analyst. Very many past students of Charing Cross and the Royal Dental Hospitals and of Queen's College, London, will recall with gratitude his gentle and painstaking manner no less than his powers of lucid exposition of difficult points in chemistry and metallurgy. He was the author of what is perhaps the best-known work on practical chemistry for medical students.

Richards was unstinting in the service he gave to chemistry. He was a fellow of the Chemical Society, a fellow of the Institute of Chemistry and a member of the Society of Public Analysts. He served the Institute for two periods of four years as a member of Council and for another four-year period as examiner in food and drugs. He was for seventeen years honorary secretary to the Society of Public Analysts and for two years its president.

A marked ability in matters financial was put to very good use as bursar of Queen's College, treasurer of the Royal Dental Hospital and sometime auditor to the Institute of Chemistry. For many years honorary analyst to Charing Cross Hospital, his marked interest and ability in medical chemistry and toxicology led to his being consulted in some famous cases.

During Richards' life scientific history has been made. From the beginnings of the Periodic Law which his early days witnessed, we have progressed as far as the expansion of the Periodic Table to include elements that Nature has apparently never made, but which her creature man has. To readers of NATURE the enormous growth of chemistry within the past forty years or so will need no stressing, nor will the recent coming into its own of Richards' side of it—analytical chemistry. This part of the science, once almost contemned, has been called upon successfully to elucidate problems ranging from the detection of elements in far-off worlds to the fixing of the approximate age of our own world.

Science had in Richards a loyal and energetic servant who contributed his due, and more, to its advancement; it mourns one who at the height of his powers was laid aside, and to his infinite regret had to look on while work to which he had devoted his life was being brought to a successful conclusion. His interest in science never flagged during his years of failing health, and it afforded him keen pleasure to witness the ultimate glorious success of the branch of it which he had made his own.

F. W. EDWARDS.

Mr. L. de Whalley

MR. LAWRENCE DE WHALLEY, formerly chief chemist of Messrs. Tate and Lyle, died at his home at Orpington on January 9 aged eighty-three years. He was born and educated in Lancashire, and was successful in obtaining a scholarship at the Royal School of Mines, London, where he worked under Huxley, Valentin and Edward Frankland, whose honorary assistant he became. He attended Prof. Seeley's geological excursions and was keenly interested in Nature and natural history, an interest he never forsook. At the University of London he obtained his B.Sc. with honours in physics, and was one of the original members both of the Physical Society and of the Society of Chemical Industry, being honoured at the latter's jubilee in 1931, when he was presented with its memorial plaque. He was also a fellow of the Institute of Chemistry and of the Chemical Society, a member of the Society of Public Analysts and one of the founders of the Chemical Club. His earliest appointment was at the works of Messrs. Forbes, Abbot and Leonard, now part of the South Metropolitan Gas Co. In 1890 he joined his two brothers-in-law, the late John Joseph Eastick and Charles E. Eastick, later managing director of Martineaus, Ltd., at the refinery of Messrs. Abram Lyle and Sons at Plaistow Wharf, Victoria Docks, London, and became chief chemist when J. J. Eastick left to take up an appointment in Australia. This position he held until his retirement in 1930.

De Whalley was a great authority on matters of sugar refining, particularly in regard to bone charcoal, and was one of the first to see the advantages of using kieselguhr for sugar filtration. He introduced the affination process at Plaistow Wharf, and greatly improved the manufacture of golden syrup. He originated the iron test for sugar liquors and the sulphide stain method for sulphites, and was one of the first to adopt Molisch's alpha-naphthol test. He attended many international conferences on sugar analysis both in Great Britain and on the Continent and visited many foreign countries and refineries in regard to process developments. He was chairman of the Congress of Sugar Chemists (The Raffinose Conference) at the Sugar Institute in Berlin in 1910, when he contributed some work on raffinose in raw beet sugar. During the Great War, he was a representative at the Royal Commission on Sugar Supply; in August last he attended the meeting of the International Commission for Uniform Methods of Sugar Analysis.

De Whalley was a good mathematician and linguist and a lover of the classics, having in early life learnt Latin and Greek. He spoke French, German, Russian and Polish and was frequently engaged in the translation of technical works even up to within a week of his death. For many years he was an abstractor in the sugar section for the *Journal of the Society of Chemical Industry.*

In addition to his scientific work, de Whalley found time to interest himself in many other different spheres, and was for many years secretary and later president of the Cheerybles Musical Society. He was also a Freemason of long standing and high rank, Grand Lodge of England.

De Whalley married in 1883 Annie, only daughter of Z. Eastick, an early gas works chemist, and leaves a widow and twelve sons and daughters, nine of whom are married, and nineteen grandchildren.

We regret to announce the following deaths:

Prof. Michael Lenhossek, emeritus professor of anatomy in the University of Budapest, and president of the Hungarian Academy of Sciences, an authority on the histology of the nervous system, on January 26, aged seventy-three years.

Dr. F. Sowerby Macaulay, F.R.S., known for his mathematical work, on February 9, aged seventy-four years.

News and Views

Science and Social Ethics

THE attitude of scientific workers towards warfare, and what it now signifies to the future of the human race, has been the subject of many articles and other communications published in NATURE in recent years. Following a leading article in the issue of May 9, 1936, a letter from twenty-two graduate workers at the University of Cambridge was published in NATURE of May 16, and similar views on the international character of science and the barbarity of war were afterwards expressed by representatives of science in Cape Town and Bangalore. Whatever part physical conflict between individuals or communities has taken in the progressive development of man in the past, it cannot be questioned that the outlook for the future is very dark if all the resources of modern science are to be available for destructive purposes in the struggle for superiority among nations. Dr. Goebbels, who practically controls the Press of Germany, has said: "War is the most simple affirmation of life. Suppress war, and it would be like trying to suppress the processes of Nature". Such a primitive conception of the functions of war leaves out of consideration man's ethical and spiritual nature, and regards him purely as a fighting animal. Those of us who believe in a higher destiny for the human race cannot think it will be achieved through the use of high explosives, poison gas and incendiary bombs to settle disputes between civilized communities. It is because of such uses of their discoveries that scientific workers have not only the right but also the responsibility of making a collective pronouncement upon these disturbing aspects of our so-called civilization. Science has a message to deliver and a social mission to perform with far higher aims than those usually associated with it in the public mind. It believes in the evolution of social ethics, and therefore associates itself with all spiritual teaching which will promote peace upon earth and goodwill among men. On this account we are glad to put on record the following resolution adopted at the spring session of the Church Assembly at Westminster last week; and we suggest that a similar resolution might just as appropriately be passed at a representative assembly of workers for the advancement of natural knowledge.

The Christian Church and War

THAT this Assembly—

(1) endorses the Resolution of the Lambeth Conference, 1930, that war as a method of settling international disputes is incompatible with the teaching and example of our Lord Jesus Christ;

(2) deplores the general rearmament throughout the world;

(3) calls upon all Christian people to redouble their efforts to promote international good will;

(4) assures the Government of its moral support in all efforts to remove the political and economic causes of war, and in securing a general reduction of armaments by international agreement;

(5) welcomes the declared policy of the Government to adhere to the Covenant of the League of Nations, and to use armed force only for the defence of the country and in the interests of international security and peace;

(6) recognizes the right of the Government to maintain such forces as the Imperial Parliament deems necessary for the pursuance of this policy, and believes that, so long as this policy is maintained, Christian citizens may bear arms in the service of their country;

(7) affirms the responsibility of Christian people to support, criticize, or oppose all defence programmes in the light of Christian principles and in relation to their advancement of the Kingdom of God.

The University of Oxford Appeal

ON February 9, in speeches by Lord Halifax and others at the Goldsmiths' Hall in London, the appeal that the University of Oxford is making for money was launched. The capital sum aimed at is a million pounds, and some of the needs for which this sum is required are urgent. About a quarter of it is needed to ease the fund which the University has been accumulating for paying its share of the large cost of the extension to Bodley's library now being built. A similar amount is needed for the erection and equipment of new laboratories and other buildings. The remainder is required as a trust fund, the interest of which may be used to endow for a period of years new developments in any subject which looks promising, rather than be tied down to this particular subject or that. These needs are altogether separate from those of the medical school, which have been generously met by Lord Nuffield recently, and cannot be paid for out of his two million pounds gift. That gift, unlike some gifts, will not in any way be a liability on the University, but obviously the new school of clinical research which it is calling into existence, by quickening research throughout all departments of the University, must indirectly make new endowments of scientific departments a necessity. The needs for which the appeal is being made are, indeed, independent of, and of longer standing than, those of the medical school, and Lord Nuffield has recognized this by subscribing an additional £100,000 towards the million pounds required.

AGREEMENT has been reached as to the order in which the immediate scientific needs should be met. Most urgent is a new physics building for Prof. F. A. Lindemann. The Clarendon Laboratory of 1872, in which his department is housed, was never a suitable place for research, and despite the ingenious makeshifts its deficiencies have called forth, has now become almost intolerable. It is proposed to adapt this laboratory for the Department of Geology, at present cramped in the Museum itself, and to erect and equip a new building near the old and consequently near the other Physics Department, the Electrical Laboratory. The Clarendon should be a suitable place for the Department of Geology, which under the new professor to be elected soon should readily take on a new lease of life within it. Next, it is intended to build a physical-chemistry institute—the first *University* building for this subject—not, as might be thought most convenient, next to the Inorganic Laboratory (there is quite insufficient space available there for an adequate new building, especially when possible extensions of both departments are envisaged), but immediately on the other side of the Organic Chemistry Laboratory from it. Researchers in physical chemistry who now do their work in the laboratories and cellars of Balliol, Trinity and Jesus Colleges, overflowing at times into the engineering and organic chemistry laboratories, should find in the intended University institute an ampler and much more convenient home. After that building has gone up, it is hoped to rebuild, near by, the Physiology Laboratory, which dates from 1884.

Reflection of Radio Waves from the Middle Atmosphere

THE method of studying the ionized regions of the upper atmosphere by emitting small pulses of electric waves and recording the echoes reflected from the ionosphere is now well-known and is in everyday use in many parts of the world. The commonly recognized reflecting regions are at heights of 80 km. and above. Communications to the correspondence columns of NATURE of May 9 and 23, 1936, described observations indicating the existence of reflecting regions at much lower heights. These new regions were first discovered in May 1935, and an account of their investigation over a period of about a year from that date was given in a paper presented on February 4 to the Royal Society by R. A. Watson Watt, A. F. Wilkins and E. G. Bowen. A summary of the paper will be found on page 299. It appears from this work that there may be three electrified regions in the middle atmosphere at average heights of 10, 40 and 60 km., which are capable of reflecting radio waves of frequencies of the order of 6 megacycles per second and above (wave-lengths 50 metres and below). The lowest region has been found to be stratified to such an extent as to indicate the existence of five distinct layers at heights between 8·5 and 13·5 km., with reflection coefficients as high as 0·7. The observations so far made do not indicate any marked diurnal or seasonal changes. An interesting feature of the investigation so far conducted is that echoes from these layers have been recorded at sensibly vertical incidence at wave-lengths at and below those now in use for the television service. The existence of such echoes would cause the picture seen in a television receiver to have a doubled or blurred appearance. There is, however, insufficient evidence available to state how serious this possibility may be in the development of television services on the wave-lengths at present in use.

Auroral Display on February 3

REPORTS from various observers in Yorkshire and south Lancashire, who witnessed a display of the aurora borealis in the evening of February 3 last, have appeared in the *Yorkshire Post*. The aurora, which was evidently a striking phenomenon to those favoured with a clear sky, began about $18^h\ 30^m$ and lasted for an hour. One observer at Bradford noted a broad band of red passing overhead from east to west. On inquiry at the Royal Observatory, Greenwich, it was stated that a magnetic disturbance, which could be associated with this aurora, had been recorded at the Abinger magnetic station. The disturbance began suddenly on February 2 at $23^h\ 5^m$ U.T., and within a few hours a range of 220γ in horizontal force had been registered. The disturbance then died down, but was renewed between 17^h and 22^h on February 3; a typical movement (associated with auroras) in declination occurred about 19^h with a range of $\frac{3}{4}°$, the range in horizontal force being 190γ. At the commencement of the magnetic disturbance on Feb. $2^d\ 23^h$, the centre of the large sunspot, reported on p. 228 of NATURE of February 6, was about 40° west of the sun's central meridian and the following extremity of the spot about 32° west. A statistical analysis made at Greenwich of big sunspots and associated magnetic storms shows that spots of the size of the recent one are associated, in about two out of three cases, with either a large or a small magnetic storm, occurring on the average about $1\frac{1}{2}$ days after the central meridian passage of the spot. It may be added that 27 days (or a solar synodic rotation) before the aurora on February 3, the Abinger magnetic traces at about $19\frac{1}{4}^h$ on January 7 show a movement distinctive of auroral activity. An observer at the Saltburn Coastguard Station who saw the aurora on February 3 is reported by the *Yorkshire Post* as having stated that he "saw the lights a month ago".

The United States Floods

WHILST it is fully expected that the liability of the countryside to flooding through the possible bursting of the riverside levees in the Mississippi Valley will continue to be a menace for another week or ten days, yet there has been a perceptible diminution in the anxiety felt as regards the general situation, which is much more satisfactory than at the time of our previous issue. The crest of the flood wave is gradually diminishing in height. It did not quite reach the anticipated level at Cairo, and as it passes down the valley, unless reinforced by fresh rains, it should subside in intensity. There is believed to be a margin of at least four feet available above water surface level from New Madrid to New Orleans, and this should be adequate for the occasion. None the less, caution is being exercised, and some 120,000 workmen are being kept on the alert along the course of the river to deal at once with any incipient signs of weakness in the banks. In the Ohio Valley, the inhabitants are being permitted to return in detachments to their houses. The total death roll, as at present ascertained, amounts to 407, and the number of homeless is still in the neighbourhood of a million. At Louisville, several persons have been killed and a score or so injured in a series of explosions due to the ignition of an accumulation of gas in buildings following the inundation of the town.

As regards the damage done in the Ohio Valley, more accurate computation raises the figure to 527 million dollars (105½ million pounds) for the five States of Indiana, Kentucky, Illinois, West Virginia and Ohio. The fund contributed to the American Red Cross for the relief of sufferers has reached a total of three million pounds and the American Senate has passed a Bill authorizing a relief appropriation of 790 million dollars (158 million pounds). President Roosevelt has sent to Congress a report of the National Resources Committee with a message advocating the sanction of a "long-range plan and policy for construction" to ensure protection for the nation from a repetition of such calamitous experiences. The scheme is estimated to cost 2,750 million dollars (550 million pounds) and would occupy a period of about six years to complete. It covers flood protection and drainage work in almost every State of the Union.

Floods in France and Southern England

THE north of France has been experiencing an abnormal amount of rainfall during the past few days which has resulted in the flooding of extensive areas of country between Dunkirk and Cassel and between Hazebrouck and Armentières on the Flanders frontier. The River Lys has overflown its bank both at Armentières and Bethune, while at Houthnes a number of dwellings have had to be evacuated. The bursting of a dam at St. Denis, north of Paris, has resulted in local flooding to a depth of five feet, and some fifty families have had to leave their homes. In southern England, after some further heavy rainfall and a resumption of the rise in the level of the Thames, the flood waters are again subsiding, and there does not seem to be further cause for alarm.

A Volcano under an Ice-Sheet

AT an evening meeting of the Royal Geographical Society on February 8, Dr. Niels Nielsen gave an account of volcanic eruptions in 1934 and 1936 underneath the ice-cap of Vatnajokull in Iceland. Subglacial volcanic outbursts of this character have been known for many years from the catastrophic floods—known in Icelandic as *Jökullhlaup*—which result from the melting of the ice adjacent to the hot lavas and ashes, but until the investigations of Dr. Nielsen and his collaborators, no scientific accounts of these phenomena were available. It appears likely that there are at least two types of these volcanic outbursts—one, as at Grímsvotn, probably of central type, with a relatively small output of ash material but enormously energetic, forming craters in the ice; and another at Hágongur, perhaps a fissure eruption, which produced a considerable amount of lava but so little energy that it was unable to penetrate through an ice-sheet only 100–200 metres thick. The volume of glacial melt-water liberated by the first of these volcanic outbursts was in the neighbourhood of ten thousand million cubic metres. The geological interest of these remarkable phenomena is great. Following upon the University of Glasgow geological expedition to Iceland in 1924, Dr. Martin Peacock postulated that the early-glacial 'palagonite formation', a great series of globular basalts and tuffs which covers very extensive areas in Iceland and builds up some of the highest mountains in that island, was formed by the extrusion of lavas under the thick Pleistocene ice-sheet. Dr. Nielsen (*Geografisk Tidsskrift*, Dec. 1936) has shown that rocks wholly similar to the palagonite formation have been formed in these recent eruptions, with the result that Peacock's hypothesis is now brought within the realms of established fact.

Transition State in Chemical Reaction

THE thirty-sixth Bedson Lecture was delivered by Prof. M. Polanyi, of the University of Manchester, on February 1, in Armstrong College, Newcastle-on-Tyne. Prof. Polanyi took as his subject, "The Transition State in Chemical Reactions", and illustrated his remarks with particular reference to the ozone-oxygen reaction. Molecules are closely-packed groups linked by chemical bonds and separated by wider gaps from other molecules. The course of a chemical reaction between the molecules involves the breaking of these original chemical bonds, with the formation of new ones. During this change, the gaps between the initial molecules disappear and new ones appear between the final molecules, and between these two states there must be an infinite number of atomic configurations. At some point between the initial and final gaps separating the molecules, there is an intermediate state when no distinction can be drawn between the initial and final states. This is defined as the 'transition state of the reaction'. Turning from the purely geometric to the energy conception of the transition state, Prof. Polanyi demonstrated how the potential energy in the reaction between the molecules rises to a maximum. The position of the maximum indicates the transition state, and further, the energy of the reaction must be sufficient to surmount this energy barrier. Hence the plotting of the energy changes occurring in the reaction of two particles will indicate the transition state and the energy of activation of the reaction. Prof. Polanyi traced the evaluation of the energy changes and showed how it was possible to determine the heat of activation by application of wave mechanics and molecular constants. He also indicated how various properties of the transition state determine the changes in reaction rate caused by varying conditions such as hydrostatic pressure, change of solvent, etc.

Scientific Associations of Coventry

A JOINT meeting of the Coventry Engineering Society and the Midland Branch of the Institute of Physics was held in the Coventry Technical College on February 5, when Sir James Jeans delivered a lecture on "Some Large Scale Problems of Astronomy". Sir Alfred Herbert, president of the Society, presided over an audience of more than 900. Prior to the meeting, a civic reception was given to Sir James Jeans, and in welcoming him and Lady Jeans to Coventry, the Mayor (Alderman A. H. Barnacle) mentioned some well-known men of science who had been associated with Coventry. Among them were Thomas Huxley, who spent his boyhood in the City, and Sir Norman Lockyer, who was born at Rugby and spent his youth at Ashow, and was connected by marriage with some of the oldest families in Coventry. In speaking of Sir Norman's work, the Mayor pointed out that he founded NATURE, which he referred to as the leading scientific periodical of its kind in the world. In his reply, Sir James recalled an early visit to Coventry when he was about five years of age; he was shown a tree which he was told marked the centre of England, but, he continued, "I wondered how a tree could be the centre of an area which I imagined was nothing like circular". Following the reception, a private dinner in honour of Sir James and Lady Jeans was given in the ancient St. Mary's Hall by Sir Alfred Herbert. Among those present were representatives of the Institute of Physics and well-known local industrialists and civic officials.

Centenary of Practical Marine Screw Propulsion

To mark the centenary of practical marine screw propulsion, a special exhibit was opened at the Science Museum, South Kensington, on February 11. In accordance with the usual practice of the Museum, this shows both the history of the pioneer experimental work, as well as the subsequent developments and current practice in marine screw propellers. In February 1837, Francis Pettit Smith successfully tried his first screw-propelled steam launch (a model of which is shown) on the Paddington Canal. The screw had two complete turns; on one of the trips it struck an obstacle, and about one-half of it was broken off. To the inventor's astonishment, this accident materially increased the speed of the boat. The S.S. *Archimedes* (1838) was fitted with a double-threaded screw of half a turn, in accordance with Smith's amended patent. Other historical exhibits include models of Ericsson's experimental screw of 1837, and those of the S.S. *James Lowe* (1838), the S.S. *Novelty* (1839–40), and the first French screw steamer *Napoléon* (1843). Screws were at first used as an auxiliary means of propulsion, and in order that they should not impede the vessel when under sail only, lifting screws (an example by Maudslay, 1846, is shown) were introduced, which could be disconnected from the shaft and raised clear of the water. Other developments represented are the 'common screw', which was the most successful form of propeller up to about 1860, Hirsch's propeller (1860–66), and the adjustable pitch propeller patented by Griffiths in 1868. Various examples of modern practice are also included, notably a model of the four-bladed bronze propellers of the Cunard White Star liner R.M.S *Queen Mary*, which are 20 ft. in diameter, each weighing 35 tons. These are the largest screw propellers which have ever been cast in one piece.

Gift to the Massachusetts Institution of Technology

IN connexion with the announcement last month of a bequest of one million dollars to the Massachusetts Institute of Technology under the will of Mr. Charles Hayden, Dr. Karl T. Compton, president of the Institute, has issued a statement in the course of which he says that: "Mr. Hayden's generous bequest to the Massachusetts Institute of Technology only serves to emphasize the constructive value of his life-long interest in the institution and the great personal loss suffered in his passing. At the time of his death, he was not only a member of the corporation of the Institute but was also a member of its finance committee, chairman of its student loan fund committee and chairman of the research associates of M.I.T. To the latter two of these activities Mr. Hayden had been a generous contributor as well as active in their administration. Mr. Hayden's interest . . . in his professional training in mining engineering was given material expression in his contribution of a principal portion of the funds used in the construction of the Institute's building devoted to mining and metallurgy. In addition to these major contributions Mr. Hayden was continually and quietly contributing to student needs. . . . His specific bequest of one million dollars to the Institute gives us great encouragement and will enable us quickly to make substantial progress in the twelve and a half million dollar program of objectives which were approved by the corporation last October as representing the urgent needs of the institution at this time"

Lawrence Memorial Medal

THE Lawrence Memorial Medal of the Royal Central Asian Society has been awarded to Sir Charles Bell, the great authority on things Tibetan, whose friendship with the late Dalai Lama was an outstanding event in British relations with Tibet, and who has an intimate and authoritative knowledge of events in Tibet and Mongolia, on which he has written valuable books. This is the second award of this medal, the first having been made to Major J. B. Glubb, in recognition of his work in administering the nomad territory of Northern Arabia, which lies within the frontiers of Trans-Jordania, and the success he has had in promoting friendly relations between the tribes of that region. The Lawrence Memorial Medal was founded by the Society in memory of T. E. Lawrence, under the then president, the late Lord Allenby. It exists to recognize work of outstanding distinction in travel, research or letters, when such work contributes to the study and the solution of the problems of Asia, made by officials, travellers, students or others who are working in the area covered by the activities of the Royal Central Asian Society.

London Television Service

THE first public demonstrations of the reception of television programmes from the British Broadcasting Corporation's experimental station at Alexandra Palace were given on the occasion of the Radio Exhibition at Olympia in August 1936. These were followed in November by the inauguration of the present television broadcasting service from the same station. In accordance with the recommendations of H.M. Postmaster-General's Television Advisory Committee, the programmes were shared between two separate transmitters installed respectively by the Baird Television Co., Ltd., and by the Marconi–E.M.I. Television Co., Ltd. The object of this arrangement was to enable an adequate, practical test to be made to ascertain the relative merits of the two systems of transmission, which differ considerably in technical details and in scanning speed and picture frequency. According to an announcement in *The Times*, the Television Advisory Committee has now recommended that the experimental period should be terminated, and that a single set of technical standards should be adopted for public transmissions from the London station. This recommendation has been approved by the Postmaster-General, and provides for a standard of interlaced scanning at a speed of 405 lines per picture, with a picture frequency of 50 per second. The result of this decision is that in future the B.B.C. television programmes from the Alexandra Palace will be emitted by the Marconi–E.M.I. system, although it may be possible to convert the Baird system to the required standards at a later date. The adoption of the new standards, which will not be altered before the end of 1938, will render possible a certain degree of simplification in the design of television receivers. In common with those of other firms, the existing receiving sets made by the Baird Company are capable of receiving the Marconi–E.M.I. transmissions.

Sir Joseph Banks's London House

IT is too late to protest against the destruction of Sir Joseph Banks's town house at 32 Soho Square, and our commercial age will demand its removal together with many other examples of eighteenth century domestic architecture. Only the tablet placed on the house in 1911 and the description and plan in *Country Life* of September 27, 1913, will remain to us. Sir Joseph moved there from New Burlington Street in the autumn of 1777, and remained there until his death in 1820. The Linnean Society leased part of the house from 1827 until 1857, when it moved to Old Burlington House. The subsequent tenants, including the Hospital for Diseases of the Heart and a firm of decorators, made many alterations, but the fine ceilings and an exquisite overmantel and fireplace were reminders of its original beauty. Banks's magnificent collections were housed there under the able care of the botanist-librarians Solander, Dryander and Robert Brown. Banks bequeathed his collections to Brown, who transferred them to the British Museum, remaining in charge of them until his death in 1858.

A National Industrial Health Service

THE Medical Research Council, with the Industrial Health Research Board as well as the various colleges and schools of the universities, are occupied with research work which has, either directly or potentially, an industrial application; the time-lag, however, in applying or testing the results of such research work is usually too long. Some large organizations provide a full-time medical service, but there are many which have not yet realized that there is any need for such a service, and the smaller organizations cannot afford this. Even when a medical officer is appointed, his previous education has not trained him to recognize, or to deal adequately with a number of problems he meets, nor does he know where to get the required knowledge which, unknown to him, may exist. With the rapid development of new processes utilizing new products, it is necessary that their physiological and toxicological properties should be studied: also the medical officer will find himself confronted by a number of psychological problems concerning which he knows little or nothing. Discussions of the problem of making practically effective in industry the results of research work of medical importance have appeared in *Industrial Welfare* of December 15 and the *British Medical Journal* of December 5. Since it seems impracticable to add anything to the curriculum of the medical student, a post-graduate course is suggested. The works' doctor must be able to ascertain that (*a*) the workers taken on for certain jobs are reasonably fit to carry them out from the health point of view, and (*b*), in co-operation with works' engineers and others, that the conditions under which the employees are required to work are not prejudicial to their health.

SINCE small organizations cannot afford to give the medical services possible to the larger ones, some way of providing them must be considered. One way would be for a number of small organizations to be served by one medical officer; there are, of course, difficulties in the way, but they need not be insuperable. Who shall pay for these services must also be considered. Shall the organizations or the State? It is suggested that a National Industrial Health Service should be formed, which should include not only a medically qualified personnel, but also a number of engineers who have been trained in the study of works' practice from the physiological point of view, physiologists and medical-industrial psychologists. Not only would the curative aspect of industrial medical practice be dealt with but also the preventive, and this would involve the study of the conditions of work and the total environment of the employees. It would also be the business of this service to keep in touch with existent research work and bring it to the notice of those concerned. There should also be some arrangement whereby the application of a particular piece of research or investigation could be considered: for this a special committee or board is needed, comprising representatives of the State, the industry concerned, the trade union or unions representing the particular industry, and the research worker or organization responsible.

Supply of Vitamins in Soviet Russia

PROF. P. V. GOLOVIN, president of the Vitamins Council of the Soviet Commissariat of the Food Industry, has recently stated that whereas the anti-scurvy vitamin C used previously to be manufactured from conifers, it is now being made from the sweet briar rose. Vitamin C is mainly used by people living in the north and in the Arctic. In 1935 three million doses of this vitamin were manufactured in Soviet Russia, and in 1936 thirteen million doses would be turned out. Confectionery factories are now producing caramels, sugar plums and jellied sweets containing vitamin C. Two vitamin factories have been constructed in Leningrad and Schnelkovo. In the latter place a vitamin combine is being built which would produce vitamin A in addition to vitamin C. In Moscow a factory has been built for the manufacture of anti-rickets vitamin D obtained from yeast.

Announcements

SIR ALBERT SEWARD, formerly professor of botany in the University of Cambridge, was elected an honorary member of the New York Academy of Sciences at its annual meeting held on December 21.

LORD SWINTON, Secretary of State for Air, has appointed Dr. D. R. Pye to be director of scientific research in the Department of the Air Member for Research and Development, Air Ministry, on the retirement of Mr. H. E. Wimperis, and Mr. W. S. Farren to be deputy director of scientific research in succession to Dr. Pye

DR. E. NEAVERSON has been awarded the Medal of the Liverpool Geological Society. Dr. Neaverson, who is senior lecturer (palæontology) in the Department of Geology of the University of Liverpool, is well known for his work on the Carboniferous rocks of North Wales and the Quaternary beds of the Rhyl district. Farther afield, he has carried out research on the bottom-deposits collected on the voyages of the R.R.S. *Discovery*. He is a past president of the Liverpool Geological Society.

THE following appointments have recently been made to the Colonial Service: A. C. E. Callan, produce inspector, Agricultural Department, Zanzibar; W. K. Hubble, principal, Kadoorie Arab Agricultural School, Tulkarm, Palestine; G. F. Clay, (deputy director of agriculture, Uganda), assistant director of agriculture, Nigeria; W. F. Jepson, (Phytalus investigator), entomologist, Agricultural Department, Mauritius; H. Macluskie (agricultural superintendent, British Guiana), agricultural officer, Sierra Leone.

IT is announced in *Science* that, following the Harvard tercentenary, the French Government has conferred membership in the Legion of Honour with the rank of commander on President J. B. Conant. Prof. George D. Birkhoff, Prof. Julian L. Coolidge, Prof. James B. Munn and Jerome D. Green, director of the tercentenary, have been promoted from the rank of chevalier to that of officer of the legion. The rank of chevalier has been conferred on Profs. Bliss Perry, Edward B. Hill, Edward W. Forbes, Roger Bigelow Merriman, Ralph Barton Perry, Edward A. Whitney, Kenneth J. Conant and George H. Edgell.

THE one hundredth and fifth annual meeting of the British Medical Association will be held in Belfast, commencing on July 16. The president-elect is Prof. R. J. Johnstone, professor of gynæcology in Queen's University, Belfast.

THE Faraday Society will hold a general discussion on "The Properties and Functions of Membranes, Natural and Artificial", on April 22–24, at University College, Gower Street, London, W.C.1. Another discussion on "Reaction Kinetics" will be held in the University of Manchester on September 13–15. As is usual at these general discussions, contributions will be made by a number of foreign men of science. Further information can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, W.C.1.

A SERIES of eight lectures on "The Economic Problem and World Peace" to be given in the Essex Hall, Strand, London, W.C.1, during February and March has been arranged by the National Peace Council. The first lecture, on February 8, was given by Graham Hutton on "The Continental Western Democracies". Subsequent lectures cover "The Small Countries of Central and South-Eastern Europe" (T. Balogh); Germany (B. Thomas); Italy (H. Fines); the Soviet Union (L. Segal); Japan and China (F. Utley); the United States (H. Quigley) and the British Empire (H. V. Hodson). The lectures are to be given on Mondays at 6.15 and tickets (4*s*. for the course) and other particulars can be obtained from Mr. G. Bailey, National Peace Council, 39 Victoria Street, S.W.1.

THE Rockefeller Foundation has recently given 9,000 Swiss francs to the University Psychiatric Clinic at Bern for the erection of a laboratory for investigation of the anatomy of the brain.

NORWAY has introduced a regulation by which no professional motor-driver may consume any alcoholic beverage while driving or during the previous eight hours. In suspected cases a blood test is carried out, when, if the blood has an alcohol content of more than 0·5 per mille, the law will be considered to have been broken.

IN the letter entitled "Equivalent Particle Observers" by Prof. Leigh Page in NATURE of January 16, p. 111, the first sentence of the second paragraph should read: "My approach to the relativistic kinematics differs from Milne's in that I employ the concept of equivalence to establish reference systems consisting of dense aggregates of synchronous particle-observers relatively at rest".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 290.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nature of the Causative Agent of the Rous Fowl Sarcoma

THE opinions of workers in the field of Rous sarcoma are divided into two schools, one of which uses as a working hypothesis the suggestion of Fraenkel[1] that the agent is a pure chemical substance or a 'virus-enzyme', while the other considers it to be a particle resembling a virus. These opinions are represented by two quotations from recent publications. Murphy[2] states that "Without proof that normal tissues harbour the cancer virus, a fantastic conception and one difficult of experimental test, the virus theory for the etiology of cancer appears untenable. The only proved relationship is that a virus may act as a carcinogenic agent in initiating changes leading to malignancy, but has no part in the formal genesis of neoplasms." Against this may be set the contention of Amies[3] that "The total evidence seems, therefore, sufficiently strong to justify the conclusion that the tumour agents exist in the form of elementary bodies similar to but somewhat smaller than those which represent the causal agents of such typical virus diseases as Vaccinia and Fowl-Pox".

We have confirmed the fact that it is possible to deposit the agent from extracts of Rous sarcoma by centrifugation at 15,000 r.p.m., but we have been unable to obtain satisfactory correlation between the number of elementary bodies in different active preparations and the infectivity of the extracts. The supernatant after centrifugation is usually much less active and contains many fewer ultra-microscopic particles than the original extracts, but the infectivity of material concentrated many times on the centrifuge is seldom so active as would be suggested by the enormous numbers of elementary bodies present. An example will make this point clear :

Material injected	Minimum volume required to give tumour	Ultra-microscopic appearance
Original Extract	0·005 c.c.	Very large number of particles
Supernatant after centrifuging for 1 hour at 15,000 r.p.m.	0·50 c.c	Very few particles
Deposit made up in 1/45 of original volume	0·20 c c.	Very large number of particles

This observation was confirmed by the use of eluates prepared from the deposit obtained by adsorption of tumour extracts on to Willstatter's alumina[5]. In such eluates we have often observed very few elementary bodies, and yet they had an activity comparable with that of the original extract. Our impression is that the tumour-producing activity of Rous extracts is associated with material which can be deposited at 15,000 r.p.m., but we believe that only a small proportion of the elementary bodies visible in the extract can be associated with that activity, and we would emphasize that the possibility that the active agent is adsorbed on the surface of such particles cannot be excluded. Particles with similar optical properties can be obtained from normal tissues or glycogen solution by fractional centrifugation. Such a process in itself ensures uniformity of optical properties in the product, so that if all the particles in a preparation are similar in appearance, this gives little information as to uniformity in their chemical or biological properties.

The hypothesis of a purely chemical agent of the Rous sarcoma seemed to be confirmed when Jobling and Sproul[6] claimed that repeated injections of an acetone extract of fresh Rous sarcoma tissue would produce similar tumours. They stated further that if the residue from extraction was extracted again with acetone, the extract would only produce tumours if incubated with an extract of 'normal' tissue obtained by the injection of kieselguhr into the breast muscle of normal fowls. Tumours could also be obtained with carbon tetrachloride extracts of dried sarcoma powder if treated in the same way with 'normal' tissue extract.

We have attempted to repeat this work using acetone extracts of fresh tumour and dried sarcoma powder. We have kept our material as free from oxygen as possible throughout the experiment, and acetone extracts have always been thoroughly centrifuged at 3,500 r.p.m. and filtered through paper before removal of the solvent. Material was prepared for injection by dissolving in a little acetone and pouring into Ringer solution. Fine suspensions obtained in this way were injected alone or after incubation with 'normal' tissue extract, as described by Jobling and Sproul. We have also incubated the inoculum with embryo extract and with residues left after extraction, but we have never obtained a tumour by any of these means. We have, however, obtained tumours by injection of the residue left after acetone extraction of dried sarcoma powder, in agreement with the observation of Claude[7], but no activity has been observed in the residue left from acetone extraction of fresh sarcoma tissue.

Unless our technique has differed in some way we have not appreciated from that of Jobling and Sproul, we must conclude that their results were due to fine suspensions of active material in their solvents, and this possibility is enhanced by the fact that in our experiments with dried powders the activity remained in the residue after extraction. This conclusion is disappointing from the point of view of the 'chemical' hypothesis, but it does not exclude the conception suggested by the phrase 'virus-enzyme', as such a substance might be expected to be insoluble in acetone.

E. M. FRAENKEL.
C. A. MAWSON.
John Burford Carlill Laboratories,
Westminster Hospital Medical School,
London, S.W.1.
Jan. 19.

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[2] Murphy, J. B., *Proc. Staff Meetings, Mayo Clinic*, **11**, 789 (1936).

[3] Amies, C. R., *Ann. Rep. Brit. Emp. Cancer Campaign*, 281 (1936).

[4] Fraenkel, E. M., and Mawson, C. A., *Rep. Intern. Cong. against Cancer* (Brussels, 1936).

[5] Fraenkel, E. M., and Mawson, C. A., *Brit. J. Exp. Path*, **16**, 416 (1935)

[6] Jobling, J. W., and Sproul, E. E., *Science*, **84**, 229 (1936).

[7] Claude, A., *J. Exp. Med.*, **61**, 41 (1935).

Measurements of Oxide Films on Copper and Iron

RECENT letters from Dobinski[1] and Nelson[2] report the rapid appearance of oxide upon unheated copper and iron on exposure to air. This oxide, which doubtless causes the rapid change in the behaviour of these metals to silver and copper nitrates respectively[3], can be estimated by measuring the number of millicoulombs needed for its cathodic reduction. The principle was formerly used to measure silver iodide films[4], and gave numbers agreeing with both gravimetric and iodometric methods. For oxide films it has yielded results in reasonable accord with optical[5] and gravimetric methods (see accompanying table), and consistent with early chemical determinations made on the films after stripping[6]. Former disagreement between gravimetric and optical methods has been largely due to neglect of invisible films, or to different meanings attached to the term 'thickness' as applied to a non-uniform film on an uneven surface.

THICKNESS (MEAN GENERAL INTERCEPTS*) OF OXIDE-FILMS.

Iron tinted to:	Electrical (New)	Optical (Constable)	Gravimetric† (New)
Straw	440A.	460A.	390A.
Reddish yellow	530	520	470
Red brown	560	580	500
Purple	625	630	560
Violet	695	680	625
Blue	725	720	650

Copper tinted to:	Electrical (New)	Optical (Constable)
1st Order		
Dark brown	370	380
Red brown	410	420
Purple	460	450
Violet	485	480
Blue	520	500
Silvery green	800	880
2nd order		
Yellow	940	980
Orange	1,170	1,200
Red	1,240	1,260

* We believe that both electrical and optical methods give the mean of the intercepts made by normals to the *general* plane of the surface. Some authorities prefer to use the word 'thickness' as denoting the mean intercept made by the *local* normals; if so, it is necessary to divide by the specific surface.

† The invisible oxide present on the surface during the first weighing must be determined electrically; the effect of *embedded* oxide will be considered in the Carnegie Scholarship Memoirs, vol. 25.

Having thus been tested on films of the interference colour range, the method has been applied to measure the invisible oxide produced on copper in a desiccator at 18° or in a furnace at 62° C. The points on Fig. 1 (each the mean of at least four determinations) may all be affected by a constant 'zero-error', due to eutectic oxide or other causes; this will not influence the shapes of the curves.

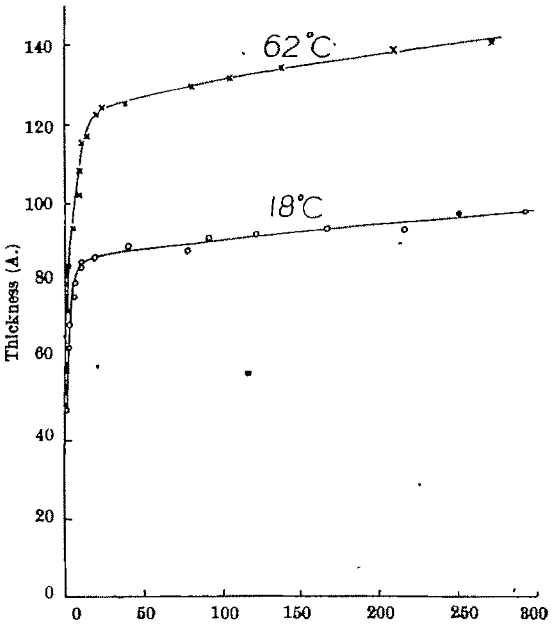

Fig. 1.

Additional results on iron will appear later in the Carnegie Scholarship Memoirs, vol. 25.

U. R. EVANS.
H. A. MILEY.
Metallurgical Laboratories,
University, Cambridge.
Jan. 18.

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[1] Dobinski, S., NATURE, **138**, 31 (1936).

[2] Nelson, H. R., NATURE, **139**, 30 (1937). Nelson considers the low-temperature oxide to be Fe_3O_4; the authors incline to γ-Fe_2O_3.

[3] Evans, U. R, *J. Chem. Soc.*, 2491 (1925); 1030 (1927); 101 (1929). Possibly the further development of the oxidation explains the slowly increasing resistance to a polluted atmosphere established by Vernon, W. H. J., *J. Chem Soc*, 2279 (1926); *Trans. Faraday Soc.*, **23**, 127, 164 (1927).

[4] Evans, U. R., and Bannister, L. C., *Proc. Roy. Soc*, A, **125**, 378 (1929)

[5] Constable, F. H., *Proc. Roy. Soc.*, A, **117**, 376, 385 (1927–28).

[6] Evans, U. R., and Stockdale, J., *J. Chem. Soc.*, 2656 (1929).

Exchange Reactions of Iodine Compounds

JULIUSBURGER, Topley and Weiss[1] found by the artificial radioactive indicator method that an exchange takes place between sodium iodide (*c.* $0{\cdot}5M$) and methyl iodide (*c.* $2M$) in alcoholic solution at room temperature; the exchange is complete in a minute or two. Under similar conditions, allyl iodide exchanges with sodium iodide, but ethyl, propyl, isopropyl and methylene iodides do not; nor does iodoform exchange in acetone solution. Further, Gluckauf and Fay's[2] successful concentration of active iodine from methyl iodide after neutron bombardment shows that no appreciable exchange occurs between iodine and methyl iodide in the absence of a solvent.

I have confirmed and extended these results (with the exception of the allyl iodide exchange). The technique for alcohol and acetone solutions was essentially the same as that of Juliusburger, Topley and Weiss, namely, a separation of the organic iodide by adding water; the activities of these compounds were, however, measured directly on the Geiger-Muller counter, which was adapted to measure liquids as well as solids.

In the experiments involving free iodine the separation was effected by shaking with mercury and decanting off from the mercury iodides formed.

The methyl iodide-sodium iodide exchange was carried out in both directions, that is, first starting with active sodium iodide and then starting with active methyl iodide (prepared by exchange with active sodium iodide). (There is no reason to suppose that the other reactions mentioned here could not also be carried out in both directions.) This was done both in alcohol and acetone solution—the latter to give a better comparison with the iodoform experiment—and the exchange starting with active sodium iodide was also done in amyl alcohol solution. The exchange was, moreover, successfully carried out in alcohol in the presence of sulphur dioxide, which shows that it is not dependent on the presence of traces of free iodine.

The methyl iodide-iodine exchange was also tested in the reverse direction, using active methyl iodide prepared as described above and separating the iodine by passing in sulphur dioxide and thus obtaining it in the form of an aqueous iodide solution, from which silver iodide was precipitated; no exchange was found. No exchange was found in carbon tetrachloride, carbon disulphide, or ether solution.

Although methyl iodide is the only alkyl iodide which exchanges with sodium iodide in dissociating solvents at room temperature, an exchange was established for ethyl, propyl, isopropyl, butyl and isoamyl iodides at 100° C.; the experiments were done in sealed tubes. The reaction was approximately complete after 15 minutes in all cases. In the case of ethyl iodide it was shown that the exchange is nearly complete after 15 minutes at 50°–55° C. Methylene iodide and iodoform also exchange with sodium iodide at 100° C. in alcoholic solution. The addition of a few drops of concentrated hydrochloric acid failed to make ethyl iodide or iodoform exchange at room temperature.

Some aromatic compounds, namely, phenyl iodide, *p*-nitroiodobenzene, and *p*-iodoaniline, were tested under similar conditions at 100° C. but failed to exchange.

Iodoacetic acid exchanges with sodium iodide in aqueous solution at room temperature, but β-iodopropionic acid does not. The acids were separated by adding sodium sulphate and extracting with ether. *m*- and *p*-Iodobenzoic acids also failed to exchange with sodium iodide in acetone solution (separation by adding water).

Further experiments, including kinetic measurements, are in hand.

I wish to express my thanks to Prof. G. Hevesy for his very valuable advice and suggestions.

Note added in proof.—The methyl iodide - iodine exchange takes place in 15 minutes at 100° C., but not in 2–3 minutes at room temperature in alcoholic solution; at 100° C. the reaction was tested in both directions. No reaction was observed at 100° C. in the absence of a solvent, starting with active methyl iodide. (Separation, starting with active sodium iodide, by adding water and passing in sulphur dioxide; starting with active methyl iodide, by shaking well with sodium iodide solution—with which the iodine exchanged—washing the iodide solution with chloroform, and precipitating silver iodide.) It may be concluded that iodine ions are necessary for the exchange.

β-Iodopropionic acid and sodium iodide exchange nearly completely in aqueous solution on warming to the boiling point for a minute or two.

H. A. C. McKay.

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Jan. 23.

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[1] *J. Chem. Phys.*, 3, 437 (1935).

[2] *J. Chem. Soc.*, 390 (1936).

A Relation between the Lyotropic Series and Free Energies

Many physical-chemical properties and reactions of solutions, such as hydration of ions, flocculation of sols, swelling and liquefaction of gels and surface tensions, are influenced by the presence of ions the order of effectiveness of which is often expressed as the lyotropic or Hofmeister series. The order is not invariable and, whilst factors such as hydrogen ion concentration, valency and activity are of much importance[1], the series appears still to embody some fundamental property. It is of much interest, therefore, that the order of the anions arranged in the lyotropic series runs closely parallel with the order of the (Gibbsian) standard free energies of formation from their elements (see accompanying table).

STANDARD FREE ENERGIES OF ANIONS RELATIVE TO $\Delta F^\circ_{H^+} = 0$.

Anions Conventional Lyotropic Series	Others	$\Delta F^\circ_{298 \cdot 1}$ kgm. cal./gm.-ion
Tartrate		?
Citrate		?
SO_4''		− 176·5
	Oxalate	− 158
	Fumarate	− 144·6
	HSO_3'	− 123·9
	SO_3''	− 116·7
Acetate		− 89·7
F'		− 65·7
	IO_3''	− 31·6
Cl'		− 31·3
NO_3'		− 26·5
Br'		− 24·6
	CNO'	− 23·8
I'		− 12·3
	ClO_4'	− 10·9
	NO_2'	− 8·5
	ClO_3'	− 0·3
SCN'		?
	BrO_3'	+ 2·3
	HS'	+ 2·9
	CN'	+ 39·4

The halides are spaced as one would expect, and the bromide-nitrate pair, which have similar lyotropic properties, have also similar free energies. The second column includes ions less often investigated, and shows the position forecast for them if the general thesis is true. Except for the chlorate ion, this order agrees with such scattered records as have been found. Furthermore, when the free energy of formation of the thiocyanate ion becomes known, one would expect it to be around zero or positive.

Although a fundamental relationship between the lyotropic series and some change or other in free energy might well be anticipated, it is not obvious (except perhaps for the halides) why the free energy of formation of ions from their constituent elements should show such a close apparent relationship, since complete disintegration of oxy-acids is not in question. The free energies of formation of the halide ions are proportional to their standard electrode potentials, so that for these an explanation of the lyotropic series may perhaps be sought in their relative readiness to engage in electron transfer.

It is suggested, therefore, that a more quantitative study of the series from the thermodynamic and electrode potential points of view at equal concentrations of hydrogen ions may well lead to results of great interest.

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[1] Cf. Loeb, J., "Proteins and the Theory of Colloidal Behavior" (New York, 1922), chapter v.

A Photochemical Antagonism of Radiations

THE chemical action of light of different wavelengths on a thermal oxidation-reduction equilibrium of the following type:

$$A + BH_2 \rightleftarrows AH_2 + B$$

may, under certain conditions, in the absence of oxygen, lead to displacements in opposite directions. Suppose that the hydrogen acceptors A and B have each an absorption band in different parts of the visible spectral region, A absorbing mainly the longer waves ($\lambda \sim 700$–500 mμ) and B the shorter ones ($\lambda \sim 500$–400 mμ). Then light of longer waves may drive the equilibrium to the right and that of the shorter waves to the left. A good example of such an equilibrium in a liquid system is constituted of the two oxidation reduction systems: methylene blue (A)—leucomethylene blue (AH_2) and phenylhydrazine-sulphonate (BH_2)—benzenediazosulphonate (B) in diluted acid solutions[1].

The following qualitative experiment shows the light-effects very well. A dark-equilibrium mixture of the reaction components in 0·01 molar hydrochloric acid, the concentrations of B and BH_2 being about 0·01 molar and that of methylene blue about 0·0001 molar, is divided between two test tubes. The first tube stands in a tartrazine solution absorbing the radiation of shorter wave-lengths (blue, violet and near ultra-violet); the second in a saturated copper sulphate solution, chiefly absorbing in the red and yellow spectral region. Exposure to sunlight will give a more or less rapid bleaching of the dyestuff in the first tube, but an increased concentration of dyestuff in the second. A stationary state is reached, regulated by the light intensity and the thermal reactions, the velocity of which is increased with the temperature to about double for an increase of about ten degrees. The thermal reaction: $A + BH_2 \rightarrow AH_2 + B$ also shows a very prominent dependence on the hydrogen ion concentration, increasing rapidly with the latter. On the reverse reaction, $B + AH_2 \rightarrow BH_2 + A$, the acidity has no such marked influence. After the cessation of illumination, the original equilibrium is restored by the thermal reactions.

On the other hand, the photo-active absorption of the two hydrogen donators, AH_2 and BH_2, are situated in the near ultra-violet (AH_2) and in the middle ultra-violet (BH_2). The spectra are characterized by a marked predissociation: both components are dissociated adiabatically by the absorbed radiation into an activated acceptor-molecule and gaseous hydrogen. In the presence of a suitable catalyst absorbing hydrogen, such as platinum black, the reverse recombination process goes on after completed illumination. The energies of dissociation may be preliminarily discussed on the basis of Franck's postulate from the equivalent energies of radiation on the absorption thresholds or maxima, and the calculated values are in an approximate agreement with the results obtained from electrometrical measurements (about 30 kcal./mol.).

According to J. Weiss[2], the quenching of dyestuff fluorescence by ferrous ions and SH-compounds is connected with photo-reactions in which the light quantum is transferred from the excited dyestuff molecule to the quenching component (hydrogen donator) by a collision of the second kind. Thus the dyestuff, activated by the visible radiation, replaces a light quantum of higher frequency, splitting the hydrogen donator directly. The same mechanism may be valid here.

A complete investigation of the photo-reactions is going on, and will be published elsewhere.

G. HOLST.

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[1] Holst, G., *Z. phys. Chem*, A, **169**, 1–19 (1934); **175**, 99–126 (1935).

[2] Weiss, J., NATURE, **136**, 794 (1935). Weiss, J., and Fischgold, H., NATURE, **137**, 71 (1936); *Z. phys. Chem.*, B, **32**, 135 (1936).

Gradients in Wool Growth

THE purpose of this letter is to suggest a possible fundamental and common interpretation of results derived by various investigators, including myself, from fleece analyses and from experiments concerned with the effects of diet and abnormal conditions on fleece and fibre characteristics. A recent paper by Swart[1] is one account of this kind of experimentation. Work of a different kind and concerning fibre-type arrays is described in a stimulating paper by Dr. Galpin[2]: it appears to be possible to link together results from such apparently different types of work.

Dr. Galpin states that in the New Zealand Romney lamb there is a main gradient in fibre-type arrays from britch to poll. Recent investigations of my own[3,4] point to a main gradient of a similar kind in mean fibre fineness: one fleece, for example, exhibited mean diameter at the shoulder region of 31·4μ and this gradually increased to 33·3μ at the britch.

Generally the finer parts of the fleece occur anterodorsally. Admitting general embryological evidence and results of studies on the fœtal development of the sheep[5], one must, I think, accept the idea of a physiological skin activity greater in the forward parts of the body than it is in the britch region. Assuming this, there is thus the apparent contradiction that where the activity is *greater*, the fibres are generally *finer*. This may be explained in the following way. The greater activity anteriorly is not expressed by the production of coarser fibres, but often by *a greater number of fibres*, that is, a fleece density which is greater anteriorly than posteriorly. General evidence for this view is supplied by analysis from three different breeds. In Suffolk, Cheviot, and Welsh Mountain fleeces examined, there appears to be a main antero-posterior gradient in number of fibres per unit area. In a Welsh Mountain fleece, density decreased from 7,960 fibres per 4 sq. cm., at the shoulder, to 6,770 in the britch region. Additional evidence is furnished by a study of coat development in the fœtus. In all stages the follicles are very much greater in number over the neck and shoulder than elsewhere, diminishing in number more posteriorly and ventrally. There is here a definite gradient in number of follicles. Incidentally, although high density may later cause the production of fine fibres, it is difficult to appreciate Dr. Galpin's point of view that even some differences between arrays are the results of 'overcrowding' at such an early stage as the trio-stage.

It has been stated that there are no gradients in fibre fineness, because relatively large variations occur over small areas of the fleece, and what has been named 'spotted' or short-period variation is evident. I think this is a narrow view. Main trends do occur over the fleece, certainly more evident in the less uniform fleeces, and about these trends occurs the short-period variation. Often the practical necessity of taking relatively few samples for measurement has served only to demonstrate the short-period variation, which has masked any possible indications of gradients which exist. In very uniform fleeces gradients are more difficult to demonstrate, but they are manifest in other types and in the coats of lambs.

Another possible expression of greater activity forward is in the greater length of fibre. Swart states that a ration increased from sub-normal caused increased fibre-length, and the effect was more marked on the back than on the britch and belly. Results of a few analyses I have made, especially on the Welsh Mountain fleece, tend to indicate that there is a main antero-posterior gradient in straight-length of fibre, one fleece, for example, having mean values between 13·6 cm. at shoulder and 12·4 cm. in the britch region.

Many investigations are required to demonstrate subsidiary gradients and to substantiate or disprove these possible explanations. Such suggestions as those I have made are only tentative and arise from a desire to apply a coherent and unifying significance to the mass of results being published.

A. BLAKEY WILDMAN.

Wool Industries Research
Association, Leeds.
Jan. 8.

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[1] Swart, J. C., *Z. Züchtung.*, **36**, Hft. 2, 197 (1936).

[2] Galpin, Nancy, *Emp. J. Exp. Agric.*, (4), **14**, 116 (1936); NATURE, **137**, 586 (Oct. 3, 1936).

[3] Wildman, A. B., *J. Text. Inst.*, **27**, *P*181–*P*196 (1936)

[4] Wildman, A. B., unpublished data.

[5] Wildman, A. B., *Proc. Zool Soc.*, Pt. 2, 257 (1932)

Effect of Vitamin E Deficiency on the Thyroid

SINGER[1] found that vitamin E deficiency produced hypoplasia of the thyroid in rats. I have noticed what appears to be cretinism in the young of vitamin E-deficient rats. Female rats kept on an E-free diet usually have an initial fertility and produce a litter of living young before becoming absolutely sterile; the litters of such rats or of rats which have been proved sterile and have then been given a small dose of vitamin E concentrate, just sufficient to produce a litter of two or three, show definite signs of thyroid deficiency.

In one case a rat which had been maintained on a vitamin E-free diet for ten months had a litter of three, all of which appeared normal at birth, but which failed to grow, in spite of the fact that the mother was lactating freely. The appearance of the litter became increasingly cretinous; the head was large, the fur sparse and the nose upturned. The forepaws of one animal were abnormal, one foot being much larger than the other. The animals moved slowly and seemed to be of subnormal intelligence; they lived 17, 22 and 30 days respectively.

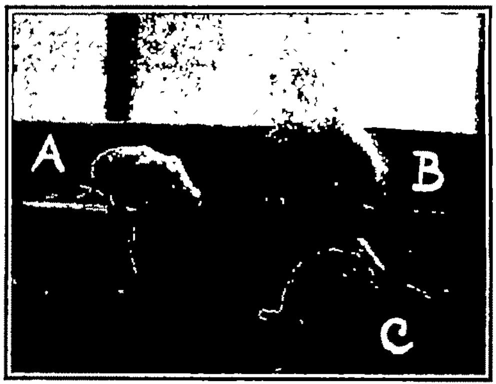

Fig. 1.

The second example was that of a litter of a rat which had been proved sterile and then dosed with a very small quantity of vitamin E concentrate. Again, three young were born, one died within the first few days and the other two gradually became cretinous, one dying at three and the other at four weeks of age. In one of the animals the feet were deformed, there being definite clubbing of the toes. One animal was very much smaller than the others, and post-mortem examination revealed two pink bodies in the position of the thyroid, but these showed no typical thyroid structure. The head was very large, and the fontanelles still widely open.

Fig. 1 shows a cretinous rat *C*, aged 21 days, and weighing 18·5 gm. with a normal rat *B* of 21 days, weighing 40 gm., and a normal rat *A* also weighing 18·5 gm. but aged only 10 days.

This complication of vitamin E deficiency is being investigated in greater detail, and will be fully reported in due course.

M. M. O. BARRIE.

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Jan. 8.

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[1] *J. Physiol.*, **87**, 287 (1936).

Protein Digestion of Wood-boring Insects

THE nitrogen supply of wood-boring insects has never been investigated. Ripper[1] assumes that it is derived directly from the wood. Mansour and Mansour-Bek[2] arrive at the same conclusion, and since their summary has been published, Parkin[3] has found a proteolytic enzyme in *Lyctus*, which supports this view.

During an investigation into the nutrition of the ash bark-beetle, *Hylesinus fraxini* Panz., which I am carrying out, I examined its protein digestion, and found it necessary to compare it with that of wood-boring beetles of different habitat. For this purpose a number of infested samples of wood was examined, and a comparative analysis of frass and wood carried out. The result is expressed in the accompanying table (numbers being percentages of dry weight of material):

Insect	Sample	Total N	Non-protein N	Protein N	Protein
Hylesinus fraxini Panz.	ash bark	0·54	0·08	0·46	2·88
	frass of larva	0·41	0·182	0·288	1·43
	frass of adult	0·68	0·326	0·354	2·21
Lyctus sp.	English oak sapwood	0·207	neglig.	0·207	1·30
	frass of larva	0·176	0·149	0·027	0·169
Anobium punctatum Geer.	Oak(?) heartwood	0·51	0·237	0·273	1·70
	frass of larva	0·345	0·170	0·175	1·09

The assimilation of nitrogen is really greater than appears here, as a considerable loss of weight occurs during the passage of material through the insect gut.

The frass of the *Hylesinus* larvæ consists of particles about the size of sand grains, and it is very probable that the gastric juices have thus no access to a large part of the protein, and so leave it unchanged. This applies to an even greater extent to the frass of the adult, which is much coarser, and only part of which passes through the gut at all. The rest, falling from the mouthparts, is, of course, altogether unattacked by gastric juices.

It is particularly interesting that the frass of the adult contains more nitrogen than the unattacked bark. The adult is therefore continuously decreasing its nitrogenous substance. This follows from the fact that the loss of weight by the conversion of wood into frass is very low and the increase of non-protein nitrogen is very large. This result is surprising in view of the fact that I found in the *Hylesinus* imago quite a strong trypsin and erepsin.

The *Lyctus* frass is exceedingly fine, and it is therefore not surprising that the protein is almost entirely broken down while passing through the gut.

In the case of the wood sample infested by *Anobium*, the high percentage of non-protein nitrogen is surprising. The reason for this is not known, but it can scarcely be connected with natural growth. Why such a high percentage of the protein remains here unattacked I cannot say, but I suspect that not all the chewed up material actually passes through the gut. Nothing is known about the presence and strength of proteolytic enzymes in this case.

Each of the values above is an average from a series of estimations. The numbers must still be regarded with reserve, as there is a considerable fluctuation in the different stages of the life-history, a question demanding further investigation.

I have also examined a sample taken from a deal chest, probably wood of *Abies* sp., infested by the Cerambycid *Hylotrupes bajulus* L. I had too little material to give definite results, but it seems that the original protein content of the wood is in the neighbourhood of 1·28 per cent, and that about 25 per cent of the nitrogen has disappeared in the frass.

The nature of the nitrogen compounds excreted seems to offer a wide scope for further investigations. Only in *Anobium* does uric acid play the main part. Though this compound is also present in the others, it does not account for all the protein broken down. In *Hylesinus*, a considerable amount of ammonia was found in the excretions, which has possibly been derived from uric acid by bacterial action. On the whole, the problem of excretion in the wood-feeding insects remains still entirely unsolved.

Department of Zoology,
Imperial College, S.W.7.
Jan. 13.
H. S. HOPF.

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[1] Ripper, *Z. vergl. Physiol.*, 13 (1930).

[2] Mansour and Mansour-Bek, *Biol. Rev.*, 9 (1934).

[3] Parkin, *Ann. App. Biol*, 23 (1936).

Jan Swammerdam

SINCE writing the sketch of Swammerdam which appeared in NATURE of February 6, p. 218, I have received some notes on the Dutch naturalist from that learned enthusiast Dr. H. Engel, of Amsterdam, which I hope he will publish in full in his forthcoming paper on the same subject. When I wrote my own contribution, I had not succeeded in obtaining a copy of the oration delivered by Prof. B. J. Stokvis at the celebration of the bicentenary of the death of Swammerdam held at Amsterdam in 1880. From this publication, and from Dr. Engel, I now learn that Swammerdam's grandfather was Jacob Dirksz. (= Jacob the son of Dirk, *ang.* Theodore or Richard), who was a wood merchant living in the village of Swammerdam, and it was he who migrated to Amsterdam and there adopted the name by which the great naturalist is known. Swammerdam's father, the apothecary, was therefore Jan or Johan Jacobsz. (= Jan the son of Jacob), and Swammerdam himself was baptized at the Oude Walenkerk of Amsterdam on Sunday, February 15, 1637, as Jan the son of Jan Jacobsz. Swammerdam and Baerta Jans Corvers. According to Harting, as quoted by Stokvis, Swammerdam's scientific career extended over twelve years only, from 1663 until 1675. It is improbable that he ever practised medicine. When he died, he was nearly forgotten, and it was the "magician" Boerhaave who brought to light his lost MSS. which gave immortality to the "sleeping beauty".

The statement so often made that Swammerdam's emotional obsessions were due to the influence of Anthoinette Bourignon seems to be an exaggeration. His friendship with her was the result, and not the occasion, of his deep interest in religion. The Dutch edition of the "Ephemeri Vita" testifies to his own innate and meticulous piety. Never was a sermon more deeply underlined or more laboriously justified. A scriptural basis for almost every word proclaims at once a profound knowledge of the Bible and an ingenuous belief in the literal interpretation of isolated texts.

Dr. Engel has found in Amsterdam an edition of the "Ephemeri Vita" published in Utrecht in 1699, a copy of which apparently does not exist in England. I also learn from him that the house where Swammerdam worked is still standing, and may be identified by a tablet erected during the celebrations of 1880. It remained in the possession of the family until 1716.

The decennial 'Swammerdam Medaille', also instituted in 1880, has been awarded to Siebold (1880), Haeckel (1890), Gegenbaur (1900), de Vries (1910), Max Weber (1920) and Spemann (1930).

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F. J. COLE.

Potential Constants of Tetrachlorethylene

G. B. B. M. Sutherland and D. M. Dennison[1] have deduced the relations between the parallel frequencies and the potential constants of the ethylene molecule from a given potential function; the following deals with the extension of these relations to a similar type of molecule, namely, that of tetrachlorethylene.

If from the data on Raman and infra-red spectra[2] we assume for the frequencies (Sutherland's notations):

$\nu_1 = 913$ cm.$^{-1}$; $\nu_2 = 445$ cm.$^{-1}$; $\nu_3 = 345$ cm.$^{-1}$; $\nu_4 = 1569$ cm.$^{-1}$; $\nu_8 = 236$ cm.$^{-1}$

and substitute these values in equation (*a*)

$$\nu_1^2 + \nu_2^2 + \frac{M+2m}{M} \; \frac{\nu_2^2 \; \nu_4^2 \; \nu_8^2}{\nu_1^2 \; \nu_3^2} = \nu_2^2 + \nu_4^2 + \nu_8^2$$

which has been deduced from the potential function, we obtain satisfactory agreement.

However, before computing the potential constants, it is necessary to modify the experimental values of the frequencies in order to satisfy equation (*a*) exactly.

A least square solution gave:

$\nu_1^* = 913$ cm.$^{-1}$; $\nu_2^* = 442$ cm.$^{-1}$; $\nu_3^* = 345$ cm.$^{-1}$; $\nu_4^* = 1569$ cm.$^{-1}$; $\nu_8^* = 230$ cm.$^{-1}$.

The smallness of the change of the experimental frequencies sufficient to verify equation (*a*) exactly should be noted.

Finally we find:

$a = 4{\cdot}59 \times 10^5$ dynes/cm.; $b = 1{\cdot}89 \times 10^5$ dynes/cm.
$c = 6{\cdot}15 \times 10^5$ dynes/cm.; $d = \pm 1{\cdot}52$ dynes/cm.

a, *b*, *c*, *d* being the potential constants.

The difference between my value of *c* (C–C bond) and Sutherland and Dennison's value for ethylene ($9{\cdot}79 \times 10^5$ dynes/cm.) is very remarkable. For this reason, I also used the Delfosse potential function[3], which is absolutely independent of Sutherland and Dennison's. Furthermore, I used only the three Raman frequencies ν_2, ν_4, ν_8, which are much more certain than the ν_1 and ν_3 necessary in Sutherland and Dennison's theory. This ought to give more weight to the following results.

We find:

$F = 6{\cdot}25 \times 10^5$ dynes/cm.; $\gamma = 2{\cdot}24 \times 10^5$ dynes/cm.; $f = 1{\cdot}28 \times 10^5$ dynes/cm.

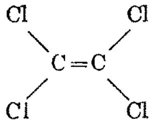
f and *F* are respectively proportional to the C–Cl and C–C distances; γ is a force proportional to the angle variation Cl–C–Cl.

The agreement between the two values of the C–C strength bond is very striking. It should be noted that the value γ is greater than *f*. This is contrary to ordinary chemical conceptions. The difference between the C–C value for ethylene and tetrachlorethylene agrees qualitatively with Badger's formula[4]

$$r_e = (C_{ij}/k_e)^{1/3} + d_{ij},$$

which shows a very definite relation between the force constant k_e for a particular bond and the internuclear distance r_e associated with that bond. Consequently, if the force constant is smaller in C_2Cl_4 than in C_2H_4, the C–C distance should be larger in C_2Cl_4 than in C_2H_4. Electronic diffraction and spectroscopic measurements do not invalidate this deduction. L. O. Brockway[5] gives 1·38 A. for tetrachlorethylene, W. Scheib and P. Lueg[6] 1·34 A. for ethylene. The C–C distance deduced from Badger's formula is too small. However, Penney and Sutherland[7] have shown that considerable divergences exist from the formula in other compounds.

If the force constant is real, its variation might be due to the fact that tetrachlorethylene is a combination of molecules showing quite different structures, as for example:



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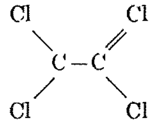

In that case, the C–C value would be a sort of resonance between the double and single bonds.

These considerations do not, however, exclude the possibility that this molecule cannot be treated in the same way as C_2H_4.

In the preparation of this note, I am especially indebted to Prof. V. Henri for his personal attention, and to Dr. G. B. B. M. Sutherland for correspondence.

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Raman Spectra of Oxonium Compounds

The study of the Raman spectra of oxonium compounds is of interest for the elucidation of the nature of the oxonium bond. Such a study was made by Briegleb and Lauppe[1], who investigated the spectra of mixtures of ethyl ether with hydrogen bromide and stannic chloride. However, their work does not give a clear and unequivocal answer to the question of the nature of such compounds. We have undertaken the study of the oxonium molecule $(CH_3)_2O.HCl$, which is known to exist even in the gaseous state. The equilibrium between methyl ether and hydrogen chloride has been studied in the vapour state with sufficient exactness[2]. It cannot be doubted, therefore, that $(CH_3)_2O.HCl$ exists as an individual molecule. We have obtained for $(CH_3)_2O$ in the liquid state, at 280° K., the following frequencies: 408 (2) (*e,k*); 921 (6*d*) (*e,k,i*); 1095 (1) (*k*); 1448 (2*d*) (*e,k*); 2813 (10) (*e,k,q,p*); 2868 (3) (*e,k,i*); 2908 (3) (*e,k,q*); 2947 (2) (*e,k,q*); 2988 (6) (*e,k,q,p*).

These data agree well with the results of Kohlrausch[3]. We have investigated the spectra of equimolecular mixtures of methyl ether, $(CH_3)_2O$, and hydrogen chloride at 280° K. in the liquid state. We obtained the following frequencies: 418 (3) (*k*); 891 (4*d*) (*e,k*); 1081 (1) (*k*); 1449 (1*d*) (*e,k*); 2829 (7) (*e,k,q*); 2875 (2) (*e,k*); 2923 (2) (*e,k,q,p*); 2953 (2*d*) (*e,k,i*); 3003 (5*d*) (*e,k,q*).

The same mixture was investigated at low temperatures down to 220° K. No shift at all could be observed in comparison with the spectra at 280° K. The comparison of the spectra of $(CH_3)_2O.HCl$ with the spectra of $(CH_3)_2O$ shows the absence of new lines. It may, however, be stated that displacements were noticed in a series of frequencies that were greater than the error of the experiments (~ 5 cm.$^{-1}$). Of the greatest interest is the decrease of the frequency

$\nu(\pi)$ of $(CH_3)_2O$ from 921 cm.$^{-1}$ to 891 cm.$^{-1}$. Evidently it is caused by the bond between the ether oxygen with HCl. Our results contradict the supposition that the valency of the oxygen is increased; since in this case the molecular model would be changed, which would change the number and magnitude of the fundamental frequencies. It may be supposed that the bond between the ether oxygen with HCl belongs to the hydrogen bond type[4], that is, we do not have the usual O–H bond with a distance of 1 A. and corresponding frequency 3600 cm.$^{-1}$ but rather a bond of an intermediate type between the chemical and the Van der Waals forces with a distance of the order of 1·3 A. between O and H.

The dispersion of our spectrograph is too small to distinguish between the proper frequency of HCl and the very close frequencies of the CH_3 group[5]. However, a detailed study of the photometric curve obtained with a Zeiss microphotometer did not show any change which could be attributed to the line of HCl. Its absence apparently indicates the strengthening of the heteropolarity of HCl, which can make this line forbidden, in the Raman spectra.

The measurements of specific electric conductivity of a mixture of 0·41 molar hydrogen chloride and 0·59 molar ether at 253° K. gives 0·0034 Ω^{-1}. This indicates insignificant dissociation.

Besides the compound described above, we have investigated the complex $(C_2H_5)_2O.HCl$, in the spectra of which we were unable to find any change in comparison with the spectra of $(C_2H_5)_2O$. We also studied $(CH_3)_2O.HBr$, but it was impossible to obtain the spectra of the oxonium compound because of a very fast reaction with the formation of CH_3Br.

The detailed account of this work will be published in the *Acta Physicochimica U.R.S.S.*

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Jan. 8.

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Factors influencing the Height of the Combustion Levels attained in Flame Gases

DURING the past seven years, many hundreds of measurements of the combustion levels[1] in flames and explosions have been made. They range from 70 to 99 per cent of the heat of combustion, and without exception they fit into the following analysis of the factors which tend to heighten or lower them.

For convenience of presentation, the inflammable mixtures selected for purposes of illustration are those which after combustion yield a theoretical temperature of 1,900° C. when calculated upon the basis of the quantum specific heats.

(1) *Influence of the nature of the combustible gas.* Temperature measurements in flame gases after combination at constant atmospheric pressure yield the following combustion levels[2]:

CO-air	CH_4-air	C_2H_2-air
80 per cent	83·5 per cent	85 per cent

So far as our experiments have gone, the highest combustion level is attained in C_2H_2-air mixtures.

(2) *Influence of the nature of the diluent gases.* The flame temperatures were measured after combination at constant atmospheric pressure. Attention is directed to the low combustion level attained with argon as the diluent gas.

CO-O_2-A	CO-O_2-CO_2	CO-air
72 per cent	77 per cent	80 per cent

(3) *Influence of small quantities of diluent gases in certain cases.* The mixtures carbon monoxide-oxygen-nitrogen and carbon monoxide-oxygen-argon, in which carbon monoxide and oxygen are present in combining proportions, yield lower combustion levels than similar mixtures in which a small quantity of the nitrogen or argon is replaced by oxygen.

As a result of a discovery by Wohl and von Elbe, it has been found that there is an appreciable raising of the combustion level in hydrogen-air explosions by the addition of a small quantity of water vapour[3]. Additions of water vapour to carbon monoxide-air mixtures, while they speeded up the explosions, had no very large influence upon the combustion levels attained.

(4) *Influence of pressure at which constant pressure combustion takes place.* The following combustion levels were measured in carbon monoxide-air mixtures burning at pressures of 1 atmosphere and 5 atmospheres:

1 atmosphere	5 atmospheres
80 per cent	86·5 per cent

The increase with pressure of the combustion level in methane-air mixtures was not nearly so marked as in the case of carbon monoxide-air and acetylene-air mixtures[4].

(5) *Influence of the instantaneous pressure in the flame front.* It was shown in a recent letter to NATURE[5] that from an examination of the intensity of the after-glow resulting from the passage of flame through a long open tube, it appeared that the combustion level increased with distance of flame travel and therefore with the instantaneous pressure in the flame front. The flame gases in which the measurements referred to in (1), (2) and (4) were made corresponded to those left behind the initial slow flame movement. The combustion levels measured are therefore probably the lowest attainable in the mixtures.

(6) *Combustion levels in large vessel explosions.* The explosions were made in a large spherical vessel fitted with electrodes for central ignition. During the initial slow movement of the flame after the passage of the spark, the flame gases have combustion levels as given in (1), (2) and (4). Later, the instantaneous pressure in the spherical flame front begins to increase and the combustion level in the gases left behind becomes greater and greater. The flame gases in the central portion constitute only a small proportion of the total gases and it is therefore clear that the combustion level averaged over the whole of the exploded gases must be high. In an over-rich carbon monoxide-oxygen mixture initially at 3 atmospheres pressure, the combustion level averaged over the whole of the exploded gases was found to be as high as 99 per cent. In low density explosions it is considerably less[6].

It will be clear that the combustion level in any given mixture may be raised by increasing the pressure of the gases before combustion or by arranging for high instantaneous pressure in the flame front, or both—as in high-density explosions and in internal combustion engines. Interesting possibilities also are suggested by the fact that a little water vapour increases the combustion level in hydrogen explosions.

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University,
Leeds. Jan. 18.

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[2] *Phil. Mag.*, 21, 280 (1936).
[3] *Phil. Mag.*, 18, 311 (1934).
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[6] *Phil. Mag.*, 22, 513 (1936).

Physical Constants and some Curious Coincidences

Many comments have been made on the nearness of a certain constant in modern physics to the number 137, but I have seen no comments on the following coincidence.

The velocity of light *in vacuo* is $2 \cdot 99774 \times 10^{10}$ cm. a second, and the gravitation constant is $6 \cdot 670 \times 10^{-8}$ in C.G.S. units; the first of these is therefore just a little less than 3×10^{10} and the second just a little greater than $\frac{2}{3} \times 10^{-7}$, both interesting coincidences with simple numbers in themselves, but the product of those numbers is 1,999·5, a remarkably close approach to 2,000. The product is, however, not a 'mere number' and the coincidence must therefore depend upon the relative magnitudes of the C.G.S. units.

Curiously enough, if both the above physical 'constants' are expressed in English units, the product is 1·05, a very near approach to unity—another coincidence.

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Points from Foregoing Letters

Prof. E. M. Fraenkel and Dr. C. A. Mawson report that although they are able to deposit the agent of the Rous fowl sarcoma by centrifugation at 15,000 r.p.m., they are unable to correlate the cancer-producing activity of the extracts and concentrates with the number of ultra-microscopic particles present, and suggest that only a fraction of the visible particles are associated with carcinogenic activity. They have been unable to obtain tumours by injection of acetone extracts of fresh or dried tumour tissue, but the residue left after the extraction of dried powder retains its carcinogenic properties.

New electrical measurements of the oxide films responsible for interference colours on copper and iron, announced by Drs. U. R. Evans and H. A. Miley, show satisfactory agreement with three other methods. Thus tested, the method has been used to study the rapid growth of invisible oxide on copper at 18° and 62° C. The results accord well with recent electron diffraction work by Dobinski.

The exchange of iodine atoms between organic compounds containing such atoms and sodium iodide or iodine itself, at a temperature of 100° C. in various solvents, has been investigated by H. A. C. McKay, by utilizing radioactive iodine as indicator. The author describes the behaviour of the higher alkyl iodides, (ethyl, propyl, isopropyl, butyl and isoamyl iodides), iodoacetic acid, β-iodopropionic acids and of some aromatic compounds (phenyl iodide, *p*-nitroiodobenzene, *p*-iodoaniline and *p*-iodobenzoic acids).

A table is submitted by Dr. L. H. N. Cooper, showing that the order in which acidic ions are arranged in the Hofmeister (lyotropic) series, which indicates their effectiveness in the swelling of gels, flocculation of sols, etc., runs parallel to the order of their (Gibbsian) standard free energies of formation from their elements. The free energies of formation of the halide ions are proportional to their electrode potentials, so that the effect may possibly be explained by the relative readiness of the ions to part with their electrons.

An example of the power of light of different wave-lengths (near and middle ultra-violet) to shift in opposite directions the equilibrium of a thermal oxidation-reduction reaction is described and discussed by G. Holst. The system considered consists of methylene blue (A)—leucomethylene blue (AH_2) and phenylhydrazinesulphonate (BH_2)—benzenediazosulphonate in dilute acid solutions, the photo-active absorption of AH_2 being situated in the near ultra-violet, and that of BH_2 in the middle ultra-violet.

Dr. A. B. Wildman states that many fleece analyses indicate the existence of gradients over the fleece in mean fineness and fleece density. Such results are consistent with the idea of increased physiological activity in the skin anteriorly, and form evidence in addition to that of Dr. Galpin's for the existence of a main antero-posterior gradient in wool growth.

Symptoms of cretinism, a disease associated with the absence of the thyroid gland, are described by Miss M. M. O. Barrie in young rats deficient in vitamin E.

H. S. Hopf compares the nitrogen contents of the frass of wood-boring insects with that in the wood on which the insects feed. The results indicate that the larvæ retain much of the nitrogen from the wood, but the adult of the ash bark-beetle appears to be continuously decreasing its nitrogenous substance.

Jules Duchesne compares the values of the parallel frequencies calculated from the Raman and infra-red spectra of tetrachlorethylene, with those necessary to satisfy the relation deduced from the 'potential function' by applying the formula of Sutherland and Dennison. The author calculates the forces linking different atom groupings in the C_2Cl_4 molecule and finds the result at variance with the ordinary chemical conception of its structure.

From a study of the Raman spectra of ethyl ether and hydrochloric acids in equimolecular proportions, M. Wolkenstein and Prof. J. K. Syrkin conclude that the valency of oxygen in the oxonium molecule is not increased. The bond between the ether oxygen and HCl is of a type intermediate between the chemical and the Van der Waals forces, with a distance of the order of 1·3 A. between the oxygen and hydrogen atoms.

Various factors influencing the 'combustion level' (ratio of maximum observed temperature to the theoretical temperature) in flames and explosions are discussed by Prof. W. T. David. These include the influence of the nature of the combustion gases, of the diluent gases, size of vessel, etc. The combustion level may be raised by increasing the pressure of the gases before combustion or by arranging for high instantaneous pressure in the flame front.

Research Items

Homo modjokertensis

DR. E. DUBOIS, in a recent communication to the Koninklijke Akademie van Wetenschappen te Amsterdam (*Proceedings*, 39, 10), sets out his reasons for regarding this skull, found in February 1936 in the early Pleistocene deposits of Modjokerto, Java, as an infantile form of the same race as that found at Ngandong, to which the specific name *soloensis* has been given. The striking fact about the skulls of Solo man is the low brain capacity, which in the largest male has been calculated at 1,295 c.c., barely equalling the male Australian, while the largest female (probable) is put at 1,095 c.c. The adult of Modjokerto cannot have been more than *Sinanthropus* I, which is 915 c.c. The Modjokerto skull itself probably has a capacity of 650 c.c., agreeing with a Papuan child of two years, which would give a capacity in the adult of 900 c.c., approximating to *Sinanthropus*. This and other facts bring together *pekinensis* and *soloensis*. As to the racial identity of Solo man and Modjokerto man, there can be no doubt. In both there are peculiarities due to the necessity of poising the head on the vertebral column. The similarity in the brain of Peking man and of Solo man is striking. The contour lines in norma lateralis nearly coincide. The conclusive proof, however, is in the unique morphology of the tympanic portion of the temporal bone. The meatus acusticus externus is not directed forward, as in all the modern races, and Neanderthal and Rhodesian man, but transversely and somewhat backward. The tympanic plate is exceedingly thick and strong, the forward part being more or less convex, and not concave as in the modern. The border of the porus acusticus externus shows a peculiar re-entering, which in *Sinanthropus* is continued in a roundly terminating fissure, strikingly resembling such a fissure in a young, probably less than one year old, Papuan child. Finally, if Modjokerto and *pekinensis* are both early Pleistocene, may not Solo man also be early Pleistocene? The evidence for late Pleistocene is unsubstantial.

Fauna of Singapore

THE *Bulletin* of the Raffles Museum, Singapore, Straits Settlements, No. 12, May 1936 (issued December 1936) contains much that is interesting relating to the fauna of Singapore and adjacent waters. A list of the fishes in the collection of the Raffles Museum is given by the curator, Mr. M. W. F. Tweedie, and eleven new species from the Malay Peninsula are described and illustrated by Mr. W. P. T. Hesse. The fishes of this district are of great interest; not only are there many new species to be found, but also it may be considered as a halfway point between the Red Sea and the east coast of Africa, and the isles of Polynesia. The fishes of China and India commingle and, as the author's recent collections show, many fishes hitherto known only in the Philippines also occur on the reefs and in the creeks of Singapore and Johore. The migratory fishes of the Indo-Pacific pass Singapore, and its reefs swarm with a rich and varied fish fauna. There are several papers dealing with the Crustacea, especially freshwater decapods, and with marine crabs of the family Grapsidæ mainly collected in the mangrove swamps. Among the freshwater decapods is *Palæmon* (*Parap.*) *trompi* de Man subsp. *armatus* n. subsp. from Johore, which hitherto was only known from Borneo, and which lives in the same waters as *Palæmon pilimanus* de Man. The eggs are large and few in number, but apparently nothing is known of its life-history. Among the other contributions are two papers on "Nidification of some Javan Birds" by A. Hoogenwerf, and "The Nidification of some Malayan Birds" by G. C. Madoc. Both contain much original observation, and the first is illustrated with very beautiful photographs.

Chemical Carcinogenic Agents

AN extremely valuable summary of the last three years work on chemical compounds as carcinogenic agents by J. W. Cook, G. A. D. Haslewood C. L. Hewett, I. Hieger, E. L. Kennaway and W. V. Mayneord ("Reports of the Second International Congress of Scientific and Social Campaign against Cancer"; Brussels, 1936) shows that there is a large number of pure chemical compounds which produce cancer in animals. The most active compounds, such as methylcholanthrene, cholanthrene and 3 : 4-benzpyrene, produce epitheliomata of the skin when painted on mice and sarcomata when injected subcutaneously in either rats or mice. Reference is made to the discovery by Sasaki and Yoshida of the action of amino-azo-toluene, which produces cancer of the liver and bladder when fed to animals. Amino-azo-toluene is a commercial orange dye used for varnishes, fats, margarine and leather. It has also been recommended for medicinal use to promote the growth of skin on wounds. Carcinogenic hydrocarbons are fat-soluble; but water-soluble carcinogenic compounds have been described. The sodium salt of 1 : 2 : 5 : 6-dibenzanthracene-9 : 10-endo-$\alpha\beta$-succinic acid, produced by combination of 1 : 2 : 5 : 6-dibenzanthracene with maleic anhydride, produces sarcomata on injection in mice, and some of these sarcomata are accompanied by leucocytosis in the blood. A water-soluble quinoline styryl compound which was originally tested for trypanocidal action was found by Prof. C. H. Browning to cause the development of cancer in mice whether the mice are infected with trypanosomes or not. The natural female sex hormone œstrin induces cancer of the mamma and adenoma of the pituitary, although not of the skin when it is painted on mice. The mechanism of carcinogenesis is still not clear, but such work as has been done to increase understanding of the process emphasizes the importance of the species, strain and sex of the animals employed.

The Asparagus Fly

THE asparagus fly (*Platyparea pœciloptera* Schr.) is a native of central and southern Europe, but it appears to be moving slowly westward, and since the beginning of this century has become a serious pest in the valley of the Seine. It was first reported in Holland in 1931, and four years later it appeared in England. In view of the possibility of its further spread, the illustrated account of the life-history of the fly with recommendations for its control given by A. S. Buckhurst (*J. Min. Agric.*, 43, No. 10) will be useful to both the private and commercial grower of asparagus. The damage is done by the larvæ which tunnel in the stems, so that either the young edible shoots are spoilt or the later growth weakened according to the time of emergence of the flies. The latter is considerably earlier on the Continent than in England, but the period during which the flies are on the wing extends to about six weeks in both cases. There is only one generation in the year, the pupæ over-wintering in the stems at or below ground-level. So far, no entirely successful method of control has been found, as traps are only partially effective and spraying is not an economic proposition. To remove and burn all distorted stems as early as possible in the autumn, taking care to cut as near the crown as possible, is the best method at present known for reducing the trouble, but even then many of the pupæ escape destruction. Experiments are in progress with the view of finding a soil insecticide which will eradicate the pest more thoroughly, but although small-scale trials are giving promising results, no definite recommendations can as yet be made.

The Cape Crawfish

LITTLE was known of the development of this crustacean, although much has been written on its anatomy. Dr. C. von Bonde in his recent work "The Reproduction, Embryology and Metamorphosis of the Cape Crawfish (*Jasus lalandi*) (Milne Edwards) Ortmann" (Department of Commerce and Industries. Fisheries and Marine Biological Survey Division. Investigational Report. No. 6. Union of South Africa, Government Printer, Pretoria, 1936) now gives us a good account of the reproductive and developmental stages, which are described in detail, and at the same time certain facts relating to the post-ovum stages in the description set forth previously by Gilchrist are substantiated or corrected. Part 1, on reproduction, deals with sexual differences and reproductive organs, sperm cells and ova, period of sexual maturity, frequency of spawning, mating, preparation for egg laying, fertilization of the eggs and attachment of eggs to the abdomen. Part 2, on embryology, deals with the maturation and segmentation of the ovum and later embryological stages. Part 3 deals with metamorphosis and subsequent growth and Part 4 with technique. The author has in preparation a further paper on the phyllosoma stages obtained by artificial hatching and rearing, but in the present work it is shown that the larva hatches at a stage still younger than that described by Gilchrist (1913) as the nauplisoma. Stage III is a true phyllosoma, and numerous stages occur between those of 3·8 mm. and 24 mm. to be described later. At 35 mm. the last phyllosoma changes to the puerulus stage of 22 mm. "which appears in all essentials to be like a small adult and the appendages including the pereipods (but excluding the pleopods) are adult-like in form". The stage immediately following the puerulus resembles the adult still more, and this may be regarded as the youngest stage of the fully-formed crawfish. The paper is illustrated by photographs and by two coloured plates of the developing embryo

Nerve Fibres in Cephalopods and Crustaceans

THE structure of the nerve fibres in cephalopods and a crustacean, *Maia*, has been investigated by J. Z. Young (*Proc. Roy. Soc.*, B, Dec. 1936). In the former, each axial fibre is furnished with a nucleated sheath of a collagenous nature. Faint longitudinal striation is visible in both living and fixed fibres, but no neurofibrils are present. Indeed, if a giant nerve fibre is cut, the axoplasm flows out from the sheath, showing it to be a viscous fluid. The volume of the sheath is in general only about two thirds that of axoplasm. In *Maia*, each axon is surrounded by a connective tissue sheath which contains a certain amount of fat, but it is not similar histologically to the medullated sheath of the vertebrate nerve, although this has previously been stated to be the case. The sheath is slightly thicker relative to the axon than in the cephalopods.

Endemic Flowering Plants of the British Isles

A CONSIDERABLE number of floral units—mostly sub-specific—are now recognized as endemic to the British Isles. In a discussion of the problems which they present, Wilmott (*South-Eastern Naturalist and Antiquary*, 41; 1936) suggests that hybridization is a probable cause of the origin of endemism in some groups. Thus, the numerous endemic mossy saxifrages of western Ireland may have arisen through original crosses between the Arctic *S. cæspitosa* and the Atlantic *S. hypnoides*, which were brought together as a result of migrations imposed by the glacial period. Evidence is adduced to show that other Irish endemics are pre-glacial survivors, but in the case of the Hiberno-American *Spiranthes*, it is difficult to believe that whilst the southern Irish plant is a survivor its very close ally in the north is a recent immigrant, as is suggested. As regards British endemics, a correlation is attempted between their distribution in relation to areas of glaciation. It is shown that whilst some occur in areas which were not glaciated, others, for example, *Sorbus* spp. and *Helianthemum Breweri*, grow on cliffs which might be presumed to be free from ice in the summer, and the view is expressed that they also represent relatively ancient elements of the flora.

Production of Polyploid Plants

THE subject of polyploidy in plants has grown so rapidly and has become of such importance in connexion with plant genetics that the recently issued bulletin of the Imperial Bureau of Plant Genetics on "The Experimental Production of Haploids and Polyploids" will be very useful for plant breeders (Imperial Bureau of Plant Genetics for Crops other than Herbage. The Experimental Production of Haploids and Polyploids. Pp. 28. Cambridge: School of Agriculture, 1936. 5*s*.). The production of allo- and autopolyploids is one of the most important methods of producing new basic types of economic plants. The bulletin briefly summarizes the cases of polyploidy in somatic cells and the production of polyploid cells by changes in temperature, the use of X-rays, chemicals, centrifuging, tumours and shoots from callus. Polyploid gametes have been produced by similar methods including fumigants, attack of pests, puncturing the buds and virus mosaic. Polyploidy resulting from hybridization is recorded in a large variety of plants, with a long list of cases especially in wheat and tobacco. It is probable that the experimental production of haploids and polyploids will become a matter simply of selecting the best technique for each case. The bibliography, while merely representative, comprises nearly 300 entries including certain references to non-economic plants.

Resistance of Cotton to the Wilt Fungus

A SHORT paper by Dr. B. B. Mundkur (*Proc. Ind. Acad. Sci.*, **3**, No. 6, Sec. B., 1936) gives the results of some experiments on the resistance of Indo-American and Indian varieties of the cotton plant, *Gossypium hirsutum*, to the fungus causing wilt disease (*Fusarium vasinfectum*). Two forms of the fungus evidently occur, an Indian and an American strain. Indo-American cottons are immune to the American strain in India, but susceptible in America, whilst the Indian form of the fungus parasitizes Indian cottons strongly in India, but only slightly in America. It seems as though the fungus had developed one geographical strain capable of parasitizing the host when grown on the sandy and acid American soils, and another strain to fit the particular physiology of the cotton plant when cultivated upon the heavy alkaline soils of India.

Low Temperature Thermometry

WHILE the practical methods of making measurements of temperature which approximate closely to the standard thermodynamic scale are now quite accurate enough for industrial purposes, it is still necessary for scientific purposes to secure greater accuracy in the region in which helium is liquid. At the Congrès International du Froid held at Amsterdam in June last, Prof. Keesom gave an account of the present position of the problem, which has now appeared as Supplement No. 80 of *Communications from the Kamerlingh Onnes Laboratory* of the University of Leyden. In NATURE of December 5, p. 977, the Leyden value of the pressure coefficient of helium, 0·0036611, and the absolute zero to which it leads, − 273·14° C., were given. Between 0° and − 190° C., the platinum resistance thermometer is correct to 0·05° C., but for greater accuracy it will have to be replaced by some other metal, possibly gold. For the range − 190° C. to − 259° C., a formula of correction secures an accuracy of 0·07° C. Temperatures below this down to about 2° K. are measured by the vapour pressure of liquid helium, and lower still by the resistance of a phosphor bronze wire containing 2 per cent tin and 0·05 per cent lead. This, however, becomes unsuitable in magnetic fields, and further research is necessary to find an alloy less influenced by such fields.

Entropy of Sulphur

THE determination of the heat capacities of rhombic and monoclinic sulphur at low temperatures, leading by graphical integration to the entropies of the two forms, is of interest as a check on the third law of thermodynamics. E. D. Eastman and W. C. McGavock (*J. Amer. Chem. Soc.*, **59**, 145; 1937) have redetermined the heat capacities over the range 15°–375° K. and have calculated the entropies. The values of C_v for rhombic sulphur may be represented approximately up to $C_v = 3{\cdot}0$ by the function $f\,(T/\theta)^n$, proposed by Lewis and Gibson, if $\log \theta = 1{\cdot}992$ and $n = 0{\cdot}5025$. From previous determinations of the heat of transition the authors select the value 0·258 ± 0·027 e.u. at the transition point. From the entropies now determined, the value 0·215 ± 0·05 at the same temperature is calculated. The conclusion is drawn that the third law is accurately applicable, without complications of the types that sometimes occur, to the sulphur transition. The uncertainty of 0·05–0·10 e.u. in this test of the law is stated to be smaller than that in many others, and it is claimed that the experimental basis of the third law, as supported by the sulphur transition, is strengthened by the new results.

Deuterium Content of Normal Water

THE ratio of deuterium and protium, D/H, in normal water has been given between the rather wide limits of 1 : 5600 and 1 : 8900. J. L. Gabbard and M. Dole (*J. Amer. Chem. Soc.*, **59**, 181; 1937) have prepared deuterium-free hydrogen by electrolysis of water to which sodium peroxide had been added, and combined it with atmospheric oxygen by passing over heated copper with the hydrogen always slightly in excess to prevent fractionation of the oxygen isotopes. The resulting water was 9 p.p.m. lighter than Lake Michigan water. When 6·4 p.p.m. are added to 9 p.p.m. to correct for the difference in atomic weight of atmospheric oxygen and aqueous oxygen, the density of D-free water containing normal oxygen is 15·4 p.p.m. lighter than normal water. From this the ratio D : H (atoms) in Lake Michigan water is calculated as 1 : 6900. The authors conclude that the commonly accepted ratio is too high, and the revision downward should be somewhat more than that recommended by N. F. Hall and T. O. Jones (1936).

Velocities of Meteor Streams

IN a paper published early last year (*Mon. Not. Roy. Astro. Soc.*, **96**, 7; May 1936) Mr. R. A. McIntosh described a method of determining the velocities of meteors by measurement of the displacement of the radiant as observed in northern and southern latitudes. He provided two tables to facilitate the computations, and the method presents certain attractive features. In the November issue of the same journal (**97**, 1; 1936), Dr. M. Davidson shows that there is a serious error in the method of compilation of the first of Mr. McIntosh's tables, and that this renders the whole process useless.

Internal Constitution of Eclipsing Binaries

IN *Mon. Not. Roy. Astro. Soc.*, **96**, 9, Supplementary Number, October 1936, there is a paper with the above title by Zděnek Kopal, the object of the research being the determination of the density concentration in the interior of stars, starting with eclipsing binaries as material. The ellipticities of the components were used by Walters, but an unfortunate error vitiated some of his quantitative results, as pointed out by Kopal. He deals with the problem very fully, and concludes that the density concentration depends on the age of the system, the components of a new-born binary being nearly homogeneous. The density concentration becomes appreciable in the course of the evolution of the system, until finally both components come close to the model requiring a high density concentration. With advancing spectral type there is an increase in the density concentration, and here we may find something of fundamental physical significance. If it be assumed that stellar energy originates in the formation of heavy elements out of simple ones, we must expect an increase in the number of heavy atoms as the star ages, and these will sink to the centre. If future investigation should confirm this view, there will be some evidence in favour of the theory of the transmutation of elements in stellar interiors. It is suggested that the results may be generalized for spectroscopic binaries.

Early Man in Java

A COMMUNICATION by Dr. P. V. van Stein Callenfels to the Royal Anthropological Institute, which appears in summary form in *Man* of December, urges the desirability of reconsidering the age and standing of *Pithecanthropus*. Dr. Callenfels has classified the fossil fauna of the Java Pleistocene into three groups—early, middle and late Pleistocene. Among those of the early Pleistocene are *Stegodon cf. præcursor* (between Tertiary *præcursor* and Middle Pleistocene *trigonocephalus*), *Hippopotamus antiquus*, *Leptobos*, three antelopes and marine molluscs, of which at least 30 per cent are extinct; Middle Pleistocene *Stegodon trigonocephalus*, *Hippopotamus namadicus*, *Bos* (*Bubalus*) *bubalis palæokarabau*, *Axis axis lydekkeri* (abundant), *Duboisia* (antelope); Late Pleistocene *Stegodon trigonocephalus*, *Hippopotamus namadicus*, *Bos* (*Bubalus*) *Axis axis lydekkeri* (very rare), *Axis axis javanicus* (abundant).

By the associated fauna *Pithecanthropus* belongs to the Middle Pleistocene and Solo man to the late Pleistocene. In February last, however, a fossil skull of a child between one and three years was found at Modjokerto, which belongs somewhere in the line of human development. It may have been an infant *Pithecanthropus*. It belongs to the oldest Pleistocene. The discovery of a skull of this age necessitates raising the whole *Pithecanthropus* problem. No fossil fauna of the oldest Pleistocene survives into the Middle Pleistocene and it is, therefore, unlikely that the hominoid only should have survived. The Middle and Late Pleistocene have most of the animals in common, so that Solo man, known from one site only, may have existed in Middle Pleistocene times.

The records of the discovery of the femur of *Pithecanthropus*, which was made by Dubois himself, are known; but of the discovery of the skull-cap, which was made by a sergeant, the record has not been preserved. It is possible that the skull-cap is older than the femur. It may belong to the same stratum as the infant skull, while the femur is that of Solo man. The stone and bone artefacts discovered with Solo man clearly must belong to late Pleistocene; but implements recently discovered at Patjitan by Dr. G. R. H. von Kœnigswald, identical with Chellean and Clactonian, are so different as to suggest that they cannot have been made by the same type of man.

In this connexion attention may also be directed to a discussion by Prof. E. Dubois of *Pithecanthropus* and other early forms of man from Java which appears in *Man* of January. Prof. Dubois proceeds by setting out two propositions which he supports by argument.

Proposition I. Homo soloensis is human and proto-Australian, forming with Rhodesian man, who closely resembles Solo man, a proto-Australian group representing the most primitive type of *Homo sapiens* and distinct from *Homo neanderthalensis*, the other human species.

Wadjak man is also proto-Australian, and was described as such so long ago as 1920, though its character was recognized when it was first discovered in 1890. The distinguishing characters which determine this classification of Rhodesian man, notwithstanding its gorilloid qualities, are the pulp cavities of the teeth, the slender limb bones, the peculiar nuchal plane of the occipital bone, and the low cranial capacity, the size of the brain approaching but not quite equalling that of the Australian. The form of the *torus supraorbitalis* in Rhodesian man is of the type of the supraorbital ridge of the Australian rather than of the torus of Neanderthal man. The resemblance of Solo man to Rhodesian man is most striking.

H. soloensis and *H. rhodesiensis* then, with *Sinanthropus*, are the most important of all known fossil men, as representing the most primitive type of *H. sapiens*. The Australian aborigine has conserved much of the primitive somatic character, especially the fundamental and, therefore, most distinctive quality of the mammalian organism, the characteristic brain volume. In the Australian (male) this may be taken as averaging 1,295 c.c. The cubic capacity of the brain of Rhodesian man has been calculated as 1,280 c.c., and for Solo man in the skull Ngandong I as approximately 1,200 c.c. The proto-Australian of Ngandong and the proto-Australian of Rhodesia both had brains which were a little smaller than the brain of the Australian of to-day.

In regard to age, a very recent age is to be attributed to the deposit in which Rhodesian man was found, while fossil Solo man is of post Trinil geological age.

Proposition II. Pithecanthropus was not a man, but a gigantic genus allied to the gibbons, superior to its relatives on account of its exceedingly large brain volume, and distinguished at the same time by its erect attitude.

Decisive evidence in support is afforded by the four new femora which were recognized in the Trinil collection in 1932. Corrosion in these, by removing the superficial or periosteal bone layer, has laid bare the internal structure of the shaft wall. This deeper shaft structure is entirely different from the human, and betrays a muscular function and a locomotion, which though facultatively erect and human-like on the ground, was also arboreal, and perhaps on uneven ground a perfection of the semi-erect gait of the gibbon. Thus this new evidence of the morphological and functional distinctness of *Pithecanthropus* furnishes proof at the same time of its close affinity with the gibbon group of anthropoid apes.

The gibbon-like appearance of *Pithecanthropus* is evident from the general form and many morphological details of the skull. It is evident, for example, that the gravitational centre of the head was a considerable distance in front of the condyles, and hence there was no parietal vertex of the brain, a distinctive character of man. Here *Pithecanthropus* agrees with chimpanzee and gibbon. The head was not poised on the vertebral column. The mandible most resembles that of the gibbon, so far as its features are anthropoid, while the strongest evidence is that given by the volume of the cerebrum, which on the law worked out by Prof. Dubois, regulating cerebral quantity in mammals, entirely confirms this second proposition.

Prof. Dubois adds a postscript dealing with the fossil child's skull discovered in February 1936, and described under the name of *Homo modjokertensis*. In another context it has been called "the oldest datable human fossil". In the opinion of Prof. Dubois, however, it is a child of *Homo soloensis*, the proof of identity being the similarity of the peculiar tympanum (see also p. 291).

The Lochaber Water Power Scheme

AN article on "The Lochaber Hydro-Electric Power Undertaking", in NATURE of November 29, 1930 (126, 848–849), described the first and main portion of an engineering scheme of considerable magnitude by which water from a catchment area of 303 square miles in Inverness-shire is being collected and led to a power station at Fort William, near the foot of Ben Nevis, which will have an ultimate capacity of 120,000 horse-power—by far the largest installation of its kind in Great Britain. The first instalment of the undertaking, costing about three million sterling, utilized the natural reservoir in Loch Treig by means of a tunnel pipe line to Fort William, and was completed in 1930. The second in the sequence of three stages of development was commenced shortly thereafter and completed in 1934, at a cost of another million. It forms the subject of a paper read on December 15 before the Institution of Civil Engineers by Mr. A. H. Naylor, who was chief assistant engineer to Mr. B. N. Peach, the resident engineer for the undertaking under Messrs. C. S. Meik and Halcrow of Westminster, the consulting engineers responsible for the design and supervision of the works from their inception. The following information of interest is extracted from Mr. Naylor's paper. Reference should be made to the map of the district which appeared in the issue of NATURE mentioned above.

The second stage comprises essentially the collection of the discharges from the Loch Laggan and Loch Ossian catchment areas into a reservoir formed by the construction of a dam at the western end of the former and the diversion of the impounded water through a tunnel to Loch Treig, with the provision of further storage through the construction of a dam at the northern end of Loch Treig. Loch Treig is the main storage reservoir of the system, and the construction of the dam raises the overflow level from the original height of +784 ft. O.D. to +819 ft. O.D., a capacity of 7,838 million cub. ft. being obtained above the lowest level (+695 ft. O.D.) to which it can be drawn down. By arranging that the Loch Laggan reservoir should be capable of being drawn down to +804 ft. O.D. and should spill at +820 ft. O.D., a further storage capacity of 1,480 million cub. ft. is rendered available. The tunnel connecting the two lochs, constructed almost entirely through rock of good quality, has a fall of 15 ft. in its length of 2¾ miles. The cross sectional outline is made up of circular segments, giving a width inside the concrete lining of 14¼ ft. and a height of 13½ ft. Three streams passing over the tunnel are diverted into shafts leading into the tunnel.

The Laggan dam is noteworthy as representing the first instance in Great Britain of the embodiment of a large siphon spillway in the design. Six siphon units are installed having shaft diameters of 4 ft. 6 in., fitted with jet dispersers at their outer extremities, the intakes being 3 ft. high by 6 ft. 10 in. wide. By inclining the outlets at 30° above the horizontal, it is calculated that the issuing jet will strike the river bed at about a maximum distance from the toe of the dam and reduce to a minimum the danger to the dam from vibration or undermining.

For the third and final stage of development it is contemplated to divert the waters of the upper Spey westward into the River Pattack which flows into Loch Laggan, so that, whereas originally the River Spean flowed into the River Spey to discharge into the North Sea, under the projected scheme, the Spey will flow into the Spean and discharge into the Atlantic Ocean.

BRYSSON CUNNINGHAM.

Forestry Research in the Malay Peninsula

THE annual report for 1935 of the Forest Research Institute of the Malay Forest Department has been recently issued, as also the Programme of Research for 1936 (Kuala Lumpur: Forest Department, 1936). Owing to financial difficulties, these reports are reproduced from typescript.

The Institute has been under Mr. J. G. Watson and Mr. E. J. Strugnell during the year. The cost of maintenance is a charge on the budget of the Forest Department, and this in recent years of financial depression has necessitated considerable economies. It is said that the funds available for apparatus and travelling have been limited, and it has been impossible to provide technical subordinates, to whom a great deal of the routine which has fallen on the shoulders of the senior staff could have been entrusted.

The curtailment of research work has been taking place in many parts of the British Empire; but it is a short-sighted policy where existing unworked and only partially known tropical and subtropical forests are concerned, which represent a part of the capital assets of the country containing them. It is this want of recognition that the large forest tracts in so many of the Dependencies and Colonies of the British Empire represent an undeveloped capital of considerable potential value upon which funds must be put out if it is to be developed (as in the case of the primary development of a gold or other mines) which is delaying progress; whilst in many cases the forest capital is deteriorating in value under the current and injurious practices of the users.

The report deals with the work of the various branches of the Institute—sylviculture, botany, wood technology, timber mechanics, seasoning and wood working, timber preservation and durability, and the investigations carried out in the chemical and entomological branches. A brief description of the education work carried out at the Forest School is appended to the report.

The work described for the year indicates the wide field which is now being covered by the research officers, and a careful study of the report proves that research work of the very highest value, not only to the Department concerned but also to the country as a whole, is being carried out.

The programme of research for 1936 indicates the lines of work to be undertaken under the different branches; but in some cases it is noted that suggested work must be postponed until there is an officer available to undertake it.

In the *Malayan Forest Records*, No 12 (Malay States Govt. Caxton Press, Ltd., Kuala Lumpur, 1936), Mr. H. E. Desch, wood technologist, discusses "Commercial Timbers of the Malay Peninsula. No. 1, The Genus *Shorea*", botanical notes being contributed by the forest botanist, Mr. C. F. Symington. Mr. Desch had started a series of articles on Malayan timbers in the *Malayan Forester* but gave them up in order to concentrate on the production of this record, as a new method of treatment had become necessary.

"Further investigation disclosed," says the author, "that the then-accepted groups, in the case of timbers of the genus *Shorea* particularly, were arbitrary and unworkable. For example, having described the timber of *nemesu* (S. pauciflora), it was found that the description fitted timbers of the *meranti tembaga* (S. leprosula) type in most essential respects, while the timbers of species allotted, at that time, to the *meranti bakau* group were not really dissimilar. It was apparent that the attempt to set up divisions in a group of timbers so similar to one another was impracticable, while the assumption that differences did exist was responsible for some of the prevailing misconceptions and might well lead to further inaccuracies." Mr. Desch therefore decided to classify the timbers of a genus on their anatomical structure, general appearance and physical properties, irrespective of existing conceptions of classification. The first genus to be so treated was *Shorea*, the most important source of timber in the Peninsula, and it has been found that the classification of species conformed closely with Mr. C. F. Symington's parallel botanical studies.

Concentrating on the more salient features of groups of species, 47 species have been dealt with in six more or less natural divisions, but repetition has not been entirely eliminated. This overlapping was felt to be unavoidable until features of specific significance are better understood.

The treatment of his subject is both useful and instructive and although, as Mr. Desch says, the publication is a compromise in an endeavour to cater for those interested in the scientific study of wood. and those engaged in the practical utilization of timber, it is none the less interesting for that reason.

Education in England and Wales*

THE report of the Board of Education for the year 1935, published under the title "Education in 1935", is, in the main, like those of previous years. The volume is, as usual, a compendium of facts and figures duly arranged in successive chapters, dealing all too briefly with subjects which range from the elementary school to adult education, as well as the museums at South Kensington and Bethnal Green which are financed out of the Board's vote, and the whole miscellany is supplemented by tables of statistics, of which it may safely be said that they are more detailed and elaborate than those which are supplied by the Ministry of Education of any other European country. It is, in fact, not so much an account of 'Education in 1935' as a bare record, with little by way of comment or suggestion to relieve it, of the Board's administration during the year in question.

In one respect, the report makes a welcome new departure. The year of King George V jubilee has provided an occasion in an opening chapter for an interesting survey of education since the King's accession in 1910, a period which has witnessed "a more conscious recognition of the claims of the individual and a greater emphasis on the development of each child according to his bent and capacity". Though there is no room for complacency, it will scarcely be denied that there has been marked progress over the whole field. The abolition of half-time attendance at elementary schools, and of exemptions before fourteen years of age, has resulted in an increase of 87 per cent in the number of children over thirteen in these schools; out of 20,854 schools, 4,760 are new or have been extensively enlarged; the education given in the schools is less bookish and more practical, the percentage of schools for children over 11 which make provision for handicraft having risen from 23 in 1910 to 65 to-day: lastly, the re-organization of the elementary system with its provision for "advanced instruction", as adumbrated in the Hadow Report, though long overdue and still incomplete, has at least gone so far that 55 per cent of the older children are in reorganized schools.

The developments in technical education include the establishment of grouped courses and of the scheme of examinations for National Certificates. The provision in the Act of 1918 for a system of part-time day continuation classes for adolescents of 14–18 years is discreetly referred to as "a plan which would . . . have had a profound influence on the system of Technical Education and the relations of the schools with industry and commerce". This is an understatement. It would, we think, be true to say that this provision of the 1918 Act, had it been implemented, would have had social and educational results not less important than those which have followed from the Act of 1902; and the failure of successive Governments to tackle the problem of adolescent education is one of the most lamentable omissions of post-War statesmanship.

As for secondary education, the years from 1910 to 1935 cover nearly the whole period during which secondary schools have existed as an integral part of the State system of education. The growth in the number, size and efficiency of these schools, in which the elementary school teacher of to-day will usually have been educated and from which the technical schools and colleges now derive a large proportion of their students, may justly be regarded as the most notable educational advance of King George V's reign. The extent of that advance can only be measured by comparison with conditions in pre-War days, when teachers were ill-paid and too often ill-qualified for their important tasks, when the pupils came late and left early—the average length of school-life being less than three years—when nothing had been done to co-ordinate examinations or to reduce their number, when sixth form work was ill-developed and the flow of secondary school pupils to the universities was in some areas a mere trickle and in a large number of schools non-existent. For information as to the conditions which exist to-day the report must be consulted.

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* Education in 1935, being the Report of the Board of Education and the Statistics of Public Education for England and Wales. (London: His Majesty's Stationery Office, 1936.) 3*s*. 6*d*. net.

In regard to the output to the universities, Table 48 shows that 36 per cent of all the entrants in 1934–35 entered direct from State-aided secondary schools, and this figure does not take account of those who entered after an interval. The figures given on page 49 of the report show that 53 per cent of the open scholarships and exhibitions awarded at Oxford and Cambridge were won by pupils from the State-aided schools, and that in 1935 candidates from these schools gained 56 per cent of the first classes in the final honours schools and triposes (Part II) awarded to candidates from all schools in England and Wales. The flow of pupils to the universities has been encouraged by the institution of State scholarships, which will in future be open to candidates from 'public schools' as well. As to the after careers of the State scholars, it would appear that, in the period 1929–34, 50 per cent of these scholars (men 34 per cent, women 70 per cent) took up teaching, 20 per cent entered other professions and 13 per cent engaged in research. These figures, compared with corresponding figures for the previous five years, show a decrease of 8 per cent in those who entered teaching, an increase of 6 per cent in those entering other professions and 5 per cent in those who took up research work.

It may well be asked whether the report has anything to tell us as to what is actually going on in the class-rooms, practical rooms and science laboratories of the schools with which it deals. The answer must be in the negative. The scientific reader who wants, for example, to know what steps are being taken to devise a general syllabus of elementary science and whether biology is now receiving the attention it deserves, will find no answer to his question in the volume under review. Containing as it does much information which those engaged in educational administration will be glad to have at hand and, in its initial chapter, a valuable survey which the general reader may study with profit, it tells us scarcely anything of the actual work of the schools. Statutory requirements no doubt determine the form of the Board's report, and may to some extent limit its contents; but it is permissible to suggest that if the omission to which we have directed attention could in a measure be made good, the Board's annual reports would be of more general interest and incidentally secure a wider publicity.

F. B. STEAD.

Immunity of Plants to Disease

THE third International Congress on Comparative Pathology met at Athens on April 15–18, 1936, and there were three main sections, namely, human medicine, veterinary medicine, and plant pathology. Reports of the various deliberations are now being published, and the first volume, from the Section of Plant Pathology, deals with plant immunity against disease-producing agents*.

Dr. E. J. Butler reviewed the problem, and after insisting upon the relatively local reactions of plant tissue, through absence of any circulatory system, he recognized five types of immunity, namely, (1) that following a previous infection and affecting the whole plant, (2) resistance to further local infection in the immediate region of a previous attack, (3) immunity by 'vaccination' with a less virulent strain of the pathogen or of substances formed in diseased tissues, (4) intracellular acquired immunity, and (5) symbiosis, which might vary towards immunity with changing conditions.

Dr. J. Dufrenoy considered the role of amino acids and phenolic compounds in susceptibility or resistance of plants. He showed that resistance is due, not so much to the pre-existence of phenolic compounds in healthy plants before attack, as to the ability of the host to produce such substances when under the stimulus of the entering fungus. Several plant diseases exhibit zones of cells rich in anthocyanin or phenolic compounds. around the point of fungal attack. In *Vitis* hybrids, many concentric zones follow attack by mildew, each made during a dry period. The intervening green zones indicate moist intervals.

Several interesting comparisons between animal and plant pathology were drawn by Prof. Ernst Gäumann. Animal immunity is more active than plant immunity, since animal parasites are introduced passively into an active host, whilst plant parasites must themselves gain entrance to a relatively passive victim. Prof. Domenico Carbone agreed with many speakers at the Congress, that there is no evidence for the formation of definite antibodies in plants; but described the diffusion of defensive substances from pieces of plant tissue kept in solutions, or gels, *in vitro*. Dr. J. Magrou maintained that phenomena which might be termed phagocytosis appear in the plant kingdom. Mycelial masses of the symbiotic mycorrhiza of orchids are, for example, often digested by the host.

Prof. Jean Politis directed attention to the part played by certain substances in the struggle of the plant against a parasite. He stressed the fact that the vacuoles containing such substances are derived from the cell nucleus, and are therefore under the same hereditary influences as the nucleus. The degree of hydration of the vacuole determines the susceptibility or resistance of the host, according to Prof. H. S. Reed, who also proceeded to review the influence of nutritive relations upon host-parasite reactions. Prof. A. J. Riker had a short but interesting paper on "Biochemical and Physical-Chemical Studies on the Bacteria which stimulate Atypical and Pathological Multiplication of Plant Cells".

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*IIIme. Congrès Internat. de Path. Comparée, Athènes. Tome premier, Rapports, 2me Partie, Section de Path. Végétale, "L'Immunité Chez les Végétaux". (Athenes: Editions "Flamma", 1936.)

Much light can be thrown on the problem of immunity by a study of the resistance of plants to non-living poisons and alkalis. Dr. Winifred E. Brenchley considered the effect of excess mineral nutrients, of inorganic and organic poisons, of gases and sprays, and in the section on resistance to alkalis reviewed much recent work on the plants of chalky soil, and on chlorosis. Prof. F. T. Brooks discussed the resistance of trees to ligneous fungi, and Dr. Tewfik Fahmy described the production of cotton plants immune to the fungus ***Fusarium vasinfectum*** var. ***Egypticum***, by breeding and selection.

Prof. L. W. Rischkow reviewed the conditions where resistance of the host was shown towards virus diseases, and Dr. R. N. Salaman dealt with the same subject, but from a different point of view. He showed that a plant could be rendered immune from attack by a virulent form of virus 'X', if it were previously vaccinated with a non-virulent strain of the same virus. Dr. Kenneth Smith and Mr. J. P. Doncaster had a paper on "The Particle Size of Plant Viruses".

Immunity against bacterial plant pathogens was treated in an encyclopædic manner by Prof. Tr. Săvulescu, who claimed that the use of vaccines or bacteriophage, in plant therapy, is understood in theory, but is not yet of practical utility. A very extensive bibliography appears at the end of Prof. Săvulescu's paper. Two very informative papers on "The Nature of Resistance of Cereals to Rust", by Dr. E. C. Stakman and Miss Helen Hart, and "The Development of Disease-Resistant Plants", by Dr. H. B. Humphrey, end the volume.

The teacher of mycology, and those plant pathologists who were not fortunate enough to attend the Congress, cannot but be grateful for this volume of reports. It is a welcome gathering of knowledge from many, and often conflicting, points of view, which do not appear so conflicting when tempered by the international atmosphere of the conference, and when bound within the confines of one volume. With the exception of one paper in Italian, all the communications are in English, French or German, and with the provision of a French summary to each article, the contents will be available to most students.

Science News a Century Ago

Prof. Edward Turner (1798-1837)

On February 13, 1837, Prof. Edward Turner died at Hampstead at the age of thirty-nine years through inflammation of the lungs. He had been appointed professor of chemistry at University College, London, in 1828, and his death was regarded as a severe loss not only to the College, but also to many scientific societies in the Empire. Born in Jamaica in 1798, he was taken to Edinburgh at an early age and was educated there, graduating M.D. in 1819. After a period of study under Stromeyer at Göttingen, he began to lecture in Edinburgh and published his "Introduction to the Study and Laws of Chemical Combination", which he afterwards worked into his "Elements of Chemistry", 1827, one of the standard text-books of the time.

At University College, Turner had a large class and his lectures were remarkable for their lucidity. Speaking of his work to the Chemical Society in 1900, Sir Edward Thorpe said he was "an excellent manipulator and his analytical and determination work was of a high order. He is specially to be remembered for his determination of the atomic weights of lead, chlorine, silver, barium, mercury, nitrogen and sulphur; they were the first atomic weights to be measured by a British chemist and are worthy to be ranked with those of Berzelius". In the course of his work, Turner pointed out that the atomic weights hitherto commonly used by British chemists had been adopted without due inquiry and that several of the most important ones were erroneous, and that the hypothesis that all equivalents are multiples of a whole number of the equivalent of hydrogen was inconsistent with the state of chemical knowledge at the time, being at variance with experiment. His work led to the rejection of Prout's theory, and the position he arrived at was precisely that to which Stas arrived half a century later."

Turner was buried in Kensal Green Cemetery. A marble bust of him was placed in University College by his pupils. He was succeeded by Thomas Graham.

Claude-Pierre Molard (1758-1837)

By the death on February 13, 1837, of Claude-Pierre Molard, the French nation lost a distinguished mechanician who had been one of the most active founders of the National Conservatoire des Arts et Métiers in Paris and its director from 1801 until 1816. When he died, he was president of the Section of Mechanics of the Paris Academy of Sciences. Molard was the elder brother of another well-known mechanician, Emmanuel-François Molard (died 1829), and was born near St. Claude, Jura, on June 6, 1758. Though the son of poor parents he was able to attend schools at St. Claude and Lyons and became a draughtsman, his ability as such attracting the attention of Jacques de Vaucanson (1709-82), who had formed a collection of machines which he left to the nation, and which eventually formed the nucleus of the collections at the Conservatoire.

In 1785, Molard went to Paris to work under Vandermonde, who was in charge of Vaucanson's collections, and he was made a member of the commission appointed by a decree of February 11, 1794, to report on the preservation of monuments and works of art. To this commission belonged Lamarck, Berthollet, Vauquelin, Monge, Prony and other men of science, and it was through them the decree of 19 vendémiare an III. (October 10, 1794) was passed which led to the foundation of the Conservatoire.

Skey on Muscular Fibre

At a meeting of the Royal Society on February 16, 1837, a paper was read by Frederic Skey entitled "On the Elementary Structure of Muscular Fibre of Animal and Organic Life". The author, said the report, concludes from his microscopic examination of the structures of muscular fibres that those subservient to the functions of animal life have, in man, an average diameter of one 400th of an inch, and are surrounded by transverse circular striæ varying in thickness and in the number contained in a given space. Each of these muscular fibres is divisible into bands or fibrillæ, each of which again is subdivisible into about one hundred tubular filaments, arranged parallel to one another, in a longitudinal direction around the axis of the tubular fibre which they compose, and which contains in its centre a soluble gluten. The diameter of each filament is one 16,000th of an inch.

Frederic Carpenter Skey (1798–1872) was a pupil of Abernethy and became successively assistant-surgeon, lecturer on anatomy and surgeon at St. Bartholomew's Hospital. He was elected F.R.S. in 1837 and in 1863 served as president of the Royal College of Surgeons.

Royal College of Surgeons

THE *London Medical Gazette* of February 18 contains the following eulogy of the Royal College of Surgeons:

"Of the existing institutions connected with the medical profession the College of Surgeons is in various respects by far the most important. The building is worthy of the great national establishment; the library is a magnificent addition, which has grown up of late years; the museum is a monument worthy of the name it bears, and creditable to the nation. Nor do the names of many among its present members reflect less honour upon English surgery than the greatest of their predecessors, while of the existing Council it is but justice to add that they have shown their determination to keep pace with the march of intellect and the improvement of the times. In these respects—we mean setting aside ancient prejudices—in gathering wisdom from passing events—and in rendering their institution available to great national objects—we must say they have far outstript their elder brethren in Pall Mall, and accordingly are their character and influence as a public body proportionately greater. It is in Lincoln's Inn Fields that the battle between the new and the old race of practitioners must be fought. . . ."

University Events

CAMBRIDGE.—Prof. J. Proudman will give a course of six lectures on dynamical oceanography in the Zoological Lecture Theatre at 5 p.m. on Mondays, Wednesdays and Fridays, commencing on Monday, February 15.

The following have been approved for the degree of Sc.D.: D. A. Bannerman, of Pembroke College, and E A. Guggenheim, of Gonville and Caius College. Miss Frances Mary Hamer, of Girton College, has been approved for the title of the degree of Sc.D.

EDINBURGH.—The Cameron Prize for 1937 has been awarded by the Senatus to Prof. J. Bertram Collip, professor of biochemistry in McGill University, Montreal, in recognition of his many contributions to endocrine therapy and in particular his work on the parathyroid gland.

At a meeting of the University Court on January 25, an offer was received from the University Grants Committee of a non-recurrent capital grant up to a maximum of £15,000 towards the cost of a building for a Students' Union for men and women on the King's Building site at West Mains Road, the building to include a refectory and a gymnasium. The total cost, exclusive of furnishings, is estimated at £20,000, and the Committee has offered the grant on condition that the remainder of the cost be obtained from other sources, and that the scheme should be proceeded with as soon as possible, and in any case within two years from the date of the offer.

Societies and Academies

London

Royal Society, February 4.

R. A. WATSON WATT, A. F. WILKINS and E. G. BOWEN: The return of radio waves from the middle atmosphere. Observations spread over a year from May 1935 have established the existence of sustained stratified electrification, persisting for several days, of such ionization density and gradient as to return radio waves of frequency 6–12 Mc./sec. at vertical incidence, at such heights as 8·5, 9·3, 10·3, 10·75 and 13·5 km. with reflection coefficients of the order of 0·7, giving measurable echoes up to the tenth order, beyond which they are not readily distinguished from ionospheric echoes. Apparently independent stratification at 45–50 km., with a reflection coefficient of 0·3 for 6 Mc./sec. waves, and the *D* region at and above 60 km. are also recorded. Reflections from all these regions are obtained at and above the frequencies proposed for television services. The ionization does not fall to very low values at night, and has no seasonal variation of large amplitude. Evidence is given of replenishment around the 20–30 km. levels by local thunderstorms.

H. J. BHABHA and W. HEITLER: The passage of fast electrons and the theory of cosmic showers. Relativistic quantum mechanics have been used to calculate the number of secondary positive and negative electrons produced by a fast primary electron with energy E_0 passing through a layer of matter of thickness l. The primary electron in the field of a nucleus has a large probability of emitting a hard light quantum which creates a pair. The pair electrons emit again light quanta which create pairs, and so on. The number of secondaries increases rapidly with E_0. If an electron of 10^{11} e-volts passes through a lead plate of 5 cm. thickness the number of particles emerging from the plate amounts to 1,000 or more. Thus showers can be explained by the ordinary quantum theory. Comparison with experiments shows that Rossi's transition curve and Regener's absorption curve in the atmosphere can be understood on this theory. The penetrating power of fast electrons appears to be very much greater than a straightforward consideration of the energy loss would indicate. The absorption coefficient of the radiation found at a depth of 100 metres of water cannot, however, be understood on the basis of this theory if this radiation is due to primary electrons.

Paris

Academy of Sciences, January 11 (*C.R.*, 204, 77–160).

MARCEL GODCHOT and MLLE. GERMAINE CAUQUIL: The action of hydrocyanic acid on 4-methylcyclohexanone and the preparation of the two stereoisomeric 4-methylhexanol carboxylic acids.

PAUL LÉVY: The arithmetic of the laws of probability.

MARC COURTAND: *Gauche* curves of the third order.

PAUL VINCENSINI: Bodies of constant width in space of three dimensions.

ANDRÉ MARCHAUD: The contingent and paratingent at a point of a simple Jordan surface.

MICHEL GHERMANESCU: Homofocal quadrics.

LOUIS THIBAUDIER: The Poncelet polygons inscribed and circumscribed in two conics.

MAX EGER: The canonical systems of an algebraical variety.

DÉMÉTER MANGERON: Certain boundary problems for a class of partial differential equations of higher order.

NATAN ARONSZAJN and ALEXANDRE WEINSTEIN: The convergence of a variational method of approximation in the theory of encased plates.

ALEX GARDEDIEU: Heterogeneous fluid masses in rotation.

NICOLAS SLIOSKINE: The oscillations of rotation of an unlimited cylinder filled with a viscous liquid.

JACQUES VALENSI: Measurement of the circulation along various sections of a wing.

RENÉ SWYNGEDAUW: The position of the neutral line in homogeneous belts.

JEAN LAGRULA: Measurements of the intensity of gravity carried out in northern Africa during the year 1936.

MME. MARIE ANTOINETTE TONNELAT-BAUDOT: The linearization of the density of energy and of the action function with the assistance of complex vectors.

LOUIS LEPRINCE-RINGUET and JEAN CRUSSARD: Study of the particles of high energy in the cosmic radiation in the magnetic field of the Bellevue electromagnet. In this work a Wilson chamber was placed between the poles of the large electromagnet at Bellevue, giving a field of 13,000 gauss. About five hundred trajectories have been measured and an analysis of the results obtained is given.

MME. NELICIA MAYER: The oxido-reduction potential of reductinic acid.

ARAKEL TCHAKIRIAN: The electrolysis of germanochloroform or germanohydrochloric acid. The experimental results furnish a further proof of the existence of the complex ion $Ge^{+II}Cl^3$, in agreement with the theory of G. Urbain.

LOUIS BRÚNINGHAUS: A new fluorometer. A modification of the Gaviola instrument, the Kerr cells being replaced by piezoelectric quartz.

GEORGES ALBERT BOUTRY: A new type of photoemissive cell. Discussion of the causes of the errors of the usual type of photo-cell and suggestions for eliminating them.

MLLE. YVETTE CAUCHOIS: The L absorption spectrum, and the characteristic levels of mercury.

ALBERT PORTEVIN and LOUIS GUITTON: Contribution to the study of the role of inclusions in the corrosion of steels.

CHARLES DUFRAISSE and ROBERT PRIOU: Dissociable organic oxides. The photo-oxide of mesodimethoxyanthracene, $C_{16}H_{14}O_4$. Photo-oxydimethoxyanthracene was prepared and, contrary to the authors' expectation, was not dissociable.

RAYMOND QUELET and JEAN ALLARD: The synthetic preparation of ethoxy-methylbenzyl alcohols.

JULES JARROUSSE: Diphenylpyruvic acid. Preparation of the phenylbenzylsuccinic acids.

RENÉ JACQUEMAIN and ALFRED MOSKOVITS: Some compounds obtained with the aid of iodoargentonitrobenzoic complex compounds.

L. CAPDECOMME and G. JOURAVSKY: The indicators of reflective powers of slightly absorbent crystals.

GÉRARD WATERLOT: The structure of the Cambrian massif of Rocroi.

L. PETITJEAN: The comparative variation of the anomalies of barometric pressure and the solar activity. Over the interval 1884–92, the polar air was more active than the tropical air when the number of sunspots presented a more rapid diminution or a slower increase.

ALEXANDRE DAUVILLIER and ANATOLE ROGOZINSKI: The reality of Hoffmann shocks. From the experiments described, the authors conclude that the Hoffmann shocks do not represent a special accidental form of discharge in gases, but they measure effectively the energy of the particles associated with cosmic radiation.

RENÉ SOUÈGES: The embryogeny of the Primulaceæ. The development of the embryo in *Samolus Valerandi* (brook-weed).

JEAN LE CALVEZ: The schizogonic process in the foraminifer *Planorbulina mediterranensis*.

MAURICE ROSE and MLLE. M. HAMON: The dehiscence of some spermatophores of decapod crustaceans.

RAYMOND TURPIN and ALEXANDRE CARATZALI: The influence of twin births and of maternal age on the proportion of the sexes.

JACQUES RABATÉ: Gaultherioside (ethylprimeveroside). Its biological synthesis. In a previous communication, a new heteroside, gaultherioside, was described as obtained from the leaves of *Gaultheria procumbens* (winter-green). It is now found to be formed from primeverose and the alcohol used for the extraction, and probably does not exist in the leaves.

JEAN ROCHE and RENÉ COMBETTE: The osmotic pressure and molecular weight of various erythrocruorins (invertebrate hæmoglobins).

DENIS BACH: The destruction of the dehydrogenases of the yellow *Staphylococcus* by heat. The protective action of the substrate.

Moscow

Academy of Sciences (*C.R.*, 4, No. 3; 1936).

V. S. IGNATOVSKIJ: The Laplacian transformation (3).

S. LECHNICKIJ: The strains in an endless anisotropic plate weakened by an elliptical hole.

P. A. WALTHER: Pressure on wings, and its momentum at high velocities.

J. WEICHHERZ and B. GOUGUELL: A new equation expressing the state of matter.

M. B. NEUMANN and P. M. TUTAKIN: The transition of a cold flame into a hot one at low-temperature auto-ignition of butane.

V. ŠARONOV: Determination of the light-extinction factor and of the field of vision by the data obtained with an apparatus for measuring the haziness of air.

M. A. ROSENBERG, K. E. AVALIANI and F. B. JURKOVSKAJA: Dissolution of the 'vacuum films' of metals in acids. (1) Dissolution of chromium in sulphuric acid.

V. V. TIŠČENKO and M. D. RYDALEVSKAYA: An attempt at the chemical investigation of the humic acids of different soil types.

B. N. FORSCH: Geochemical composition of oceanic and of continental water (the water of Lake Baikal).

A. TARANETZ: Description of three new species of the genus *Icelus* Kroyer (Pisces, Cottidæ) from the Sea of Japan and from the Okhotsk Sea.

E. P. SLASTENENKO: Species of the genus *Tripterygion* found in the Black Sea (Pisces, Clinidæ).

G. Streich and E. Svetosarov: Significance of temperature and of the sexual hormone in the moulting process of birds.

E. Svetosarov and G. Streich: Factors determining the sexual and the seasonal dimorphism in ducks.

Erratum.—The title of the paper by S. Sobolev (Nature, Jan. 2, 1937, p. 40) should read: The fundamental boundary problem for polyharmonic equations in a domain with degenerated contour.

Prague

Czech Academy of Sciences and Arts, January 17, 1936.

Jar. Petrbok: Molluscs from the travertine of the Slovak karst formation, from Janovce and its neighbourhood, Spiš and Rušbach.

B. Němec, J. Babička, A. Oborský: Occurrence of gold in horse-tails. *Equisetum palustre* (having more than sixty per cent SiO_2 in the ash) accumulates gold from soil with 0·2 gm. gold per ton so that its ashes contain 610 gm. per ton. The soil consists of decomposed andesite and rhyolite.

J. Milbauer: The associated phenomena of catalysis. Pairs of catalysts like Pd, SeO_2, $HgSO_4$, Ag_2SO_4, $CuSO_4$ are much more efficient in the oxidation of carbon monoxide by hot concentrated sulphuric acid than single catalysts.

F. Valentin: On 3.6-anhydromannite.

March 20.

Z. Bažant: The precise solution of the walls of cylinders.

E. Votoček and S. Malachta: New transitions from the series of the sugars to those of the pyranes and pyrrols. Methyl-*iso*-pyromucic acid.

J. Komárek: Can the larvæ of food pests produce intestinal diseases?

J. H. Křepelka and V. Švarc: Contribution to the extraction and identification of veronal and luminal.

J. Bašta: Theory of the fatigue of materials, especially in engineering structures.

L. Borovanský: Sexual dimorphism of the human skull.

F. Němejc: Palæobotanical research on the travertine deposits of the Slovak karst.

V. H. Matula: The preparation of an accurate emanation standard from pitchblende. This is dissolved in hydrochloric acid, silica is separated and decomposed by hydrochloric acid; any residue is dissolved in nitric acid and added to the solution.

May 29.

J. Milbauer: (1) Study of carbonyl sulphide. This substance decomposes in concentrated sulphuric acid already at 150° C. In the presence of palladium as catalyst, it reacts at 90° C.; other catalysts show decreasing effects in the series SeO_2, Pt, Ag_2SO_4, $CuSO_4$, V_2O_5, $HgSO_4$, TeO_2, SnO_2, Sb_2O_3. (2) Remarks on the author's work on catalysts.

K. Kavina: Allogony of *Salix caprea* L.

V. Janda: Colour change of transplanted skin, and artificially united body fragments of *Dixippus morosus*.

R. Brdička: Dependence of the polarographic reaction of proteins on hydrogen ion concentration. The catalytic polarographic protein reaction giving a characteristic 'wave' on current-voltage curves is shown not only in the presence of ammonium chloride and ammonia, but also in any buffered solution. The 'wave' depends on the concentration of protein, on the hydrogen ion concentration of the solution, and on the quality and capacity of the buffer.

F. Němejc: Contribution to the recognition of Permo-Carboniferous flora in the coal deposits of the foot of the north-east slope of Velebit (Jugoslavia).

A. Vančura and V. Sutnar: The chronological development and pathogenesis of the syndromes inside and exterior to the kidneys in acute nephritis following angina.

B. Bouček: Graptolites of the Bohemian lower Ludlow.

A. Říha: The new bellerophontids of the Czech Palæozoic.

October 23.

B. Němec, J. Babička and A. Oborský: New analysis of plant ashes from auriferous ground. The content of gold found in the ashes of plants is in *Equisetum arvense* 576, *Mentha arvensis* 300, *Clematis vitalba* 110 gm. per ton. In *Fagus sylvatica*, *Carpinus Betulus*, *Salix caprea*, *Polyporus fomentarius* only traces. In seeds more gold than in wood; the gold content increases with the silica content.

E. Votoček and Z. Allan: The rotation of certain sugar hydrazones with respect to the α-configuration of carbon.

E. Votoček and J. Wichterle: The connexion between the rotation of sugar hydrazones and the α-configuration of carbon.

E. Votoček, F. Valentin and J. Bulíř: The constituents of mullein-seed oil.

J. Milbauer: The minimum quantities of catalysts having maximum effect in concentrated sulphuric acid. In the oxidation of gases by concentrated sulphuric acid at 250° C., homogeneous catalysts (like copper, mercury and silver sulphates) give a maximum effect when their solubility is reached. Heterogeneous catalysts (like the platinum metals) act most through their dissolved portion. Ruthenium, rhodium and palladium are more efficient than osmium, iridium and platinum.

V. Hlavatý: The system of Weyl connexions.

J. Bašta: Preliminary contribution to the mechanical theory of the equation of state.

P. Pachner: Sexual dimorphism of the human pelvis, and mutual relations of pelvic measurements.

V. Hovorka: Separation of lead from sulphuric acid, and determination of lead by means of *o*-hydroxyquinoline.

O. Pankraz: Two integral equations.

Vrat. Velich: Agar and saponin from malt as a preferential culture base for mycoderms.

V. Kryštofek: The problem of simultaneity and the theory of relativity.

November 27.

B. Bouček: Silurian stratigraphy in the Daleje valley.

F. Němejc: (1) The seed cones of *Discinites* K.F. (2) A revision of the Carboniferous and Permian flora of the Central Bohemian coal basin.

O. Pankraz: A special condition for the stationary circulation of economic goods.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, February 15

Royal College of Surgeons of England, at 4.—Prof. G. E. Gask: "John Hunter in the Campaign in Portugal, 1762–1763".

Royal Geographical Society, at 5.—H. P. Smolka: "The Economic Development of the Soviet Arctic".

Imperial College—Royal College of Science, London, at 5.30.—Prof. W. L. Bragg, F.R.S: "The Structure of Alloys".*

Tuesday, February 16

Institution of Civil Engineers, at 6.—Sir Noel Ashbridge: "Modern Developments in Broadcasting Radio Transmission and Television".

Wednesday, February 17

Royal Meteorological Society, at 5.—Dr. C. E. P. Brooks: "Meteorological Circumstances of the Floods in the United States of America".

University of London Institute of Education, at 5.30.—Dr. W. G. Adams: "Adult Education in England" (John Adams Lecture).*

Institute of Chemistry (London and South Eastern Counties Section), at 7.30.—Prof. J. F. Thorpe, F.R.S: "The Past and Future of the Institute".

Royal Society of Arts, at 8.15.—Dr. R C. Fisher: "Recent Work on Wood-destroying Insects".

Thursday, February 18

London Mathematical Society, at 5—(in the rooms of the Royal Astronomical Society, Burlington House, W.1). Prof. G. H. Hardy, F.R.S.: "Ramanujan and the Theory of Primes".

Friday, February 19

Geological Society of London, at 3. Annual General Meeting.

International Society of Leather Trades' Chemists, February 19–20. A symposium on "Scientific and Technical Aspects of Wetting and Detergency" to be held in the Mathematics Lecture Theatre, Imperial College of Science, South Kensington, S.W.7.*

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned

Assistant Lecturer in Civil Engineering in the City and Guilds College—The Secretary, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7 (February 16)

Principal of Willesden Technical College—The Secretary, H M. Walton (T), 10 Great George Street, Westminster, S W 1 (February 16)

Head of the Engineering Department of the North Staffordshire Technical College—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (February 17).

Lecturer or Assistant Lecturer in Mathematics in Westfield College, London, N.W.3—The Principal's Secretary (February 19).

Assistant Lecturer in Mechanical Engineering in the County Technical College and School of Art, Newark-on-Trent—The Principal (February 20).

Assistant Secretary at the Institution of Petroleum Technologists, Aldine House, Bedford Street, London, W.C.2—The Secretary (February 20).

Lecturer in Agriculture (Biology and Chemistry) in the School of Agriculture, Plumpton—The Director of Agriculture, County Hall, Lewes, Sussex (February 21).

War Department Chemists—The Under-Secretary of State (C.5), The War Office, S.W 1 (Quote Appts./19) (February 23).

Physicist on the staff of the Northern Coke Research Committee, Armstrong College, Newcastle-upon-Tyne—The Secretary (February 27).

Professor of Applied Mathematics in the University of Birmingham—The Secretary (March 1).

Musgrave Professor of Pathology in the Queen's University of Belfast—The Secretary (March 19).

Chemist in the R N Cordite Factory, Holton Heath—The Secretary of the Admiralty (C E. Branch), London, S.W.1. (Quote C.E. 77/1937.)

Official Publications Received

Great Britain and Ireland

The New Commonwealth. Series F, No. 3: The Functions of an International Equity Tribunal. Pp. 19. (London: The New Commonwealth.) 6*d*. [151

Seventh Annual Reports of the National Radium Trust and Radium Commission, 1935–1936, including a Statistical Report. (Cmd. 5342.) Pp 91. (London · H.M. Stationery Office) 1*s*. 6*d* net. [161

"Defence" that is no Defence. By C E M. Joad. Pp 8 (London: National Peace Council.) 1*d*. [201

The Manchester Museum: The University of Manchester. Museum Publication 112 · Report of the Museum Committee for the Year 1935–36. Pp 18 (Manchester · Manchester Museum) 6*d* net. [211

The National Council for the Unmarried Mother and her Child. Eighteenth Annual Report, 30th September 1936. Pp 41 (London National Council for the Unmarried Mother and her Child.) 4*d*. [251

Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research, for the Year 1935 Pp vi+176+16 plates (London H M. Stationery Office) 3*s* 6*d* net. [251

St. Thomas's Hospital Reports. Second Series, Vol. 1 Edito[illegible] Prof O. L. V. S. De Wesselow, C. Max Page, assisted by N R. Barr[illegible] Dr. J St. C. Elkington, Dr A. J. Wrigley. Pp. 199+13 plat[illegible] (London: St Thomas's Hospital.) 10*s*. [25[illegible]

Other Countries

State of Illinois · Department of Registration and Education · Division of the Natural History Survey. Bulletin, Vol 21, Article I: The Effect of Petroleum-oil Sprays on Insects and Plants By M. D. Farrar. Pp. vi+32. (Urbana, Ill : Natural History Survey.) [201

Proceedings of the United States National Museum. Vol. 84, No 3001 · Revision of the North American Beetles of the Staphylinid Subfamily Tachyporinæ, Part 1 · Genus *Tachyporus* Gravenhorst. By Richard E Blackwelder. Pp. 39–54. (Washington, D.C.: Government Printing Office) [201

Mémoires du Musée Royal d'Histoire Naturelle de Belgique Deuxième Série, Fasc. 4 Le thorax et ses appendices chez les vrais et chez les faux Gryllotalpides Par F. Carpentier Pp. 86+1 plate Deuxième Série, Fasc. 5: The Katanga Skull By Dr. Matthew Young. Pp. 25 Deuxième Série, Fasc 6. Les Hydræna de la péninsule Ibérique. Par A. d'Orchymont. Pp. 48+2 plates. Deuxième Série, Fasc 7: Revision des "Cœlostoma" (S Str) non Américains Par A. d'Orchymont Pp 38. Mémoire No. 74 Copepoda parasitica from the Belgian Coast, II (including some Habitats in the North-Sea). By J H Schuurmans Stekhoven, Jr. Pp. 20+5 plates Mémoire No 75 Revision des tabulés dévoniens décrits par Goldfuss. Par Dr M. Lecompte Pp. 112+14 plates Mémoire No 76: Végétaux éocènes des environs de Bruxelles. Par Dr F Stockmans Pp. 57+3 plates. Mémoire No. 77 · La Faune des schistes de Matagne (frasnien supérieur). Par Eug Maillieux. Pp. 75+1 plate Mémoire No 78 Faune malacologique des sables de Wemmel. 1: Pélécypodes Par Maxime Glibert. Pp. 242+7 plates (Bruxelles . Musée Royal d'Histoire Naturelle.) [201

Proceedings of the United States National Museum. Vol. 84, No 3002 Revision of the Fishes of the Family Microdesmidæ, with Description of a New Species By Earl D. Reid. Pp. 55–72. (Washington, D.C. Government Printing Office.) [211

The Cawthron Institute, Nelson, New Zealand. Tracing the Dawn of Life further Backwards. By Dr. R. J. Tillyard. (Cawthron Lecture, 1935) Pp. 37+7 plates. (Nelson: Cawthron Institute) [211

University of California · Publications in American Archæology and Ethnology. Vol. 37, No 2: Culture Element Distributions, 2 · Yana. By E. W. Gifford and Stanislaw Klimek. Pp iii+71–100 35 cents 1*s* 6*d* net. Vol. 37, No. 3. Culture Element Distributions, 3 Area and Climax. By A L. Krœber. Pp ii+101–115 25 cents, 1*s* 3*d*. net. (Berkeley, Calif · University of California Press; London: Cambridge University Press.) [221

Astrophysica Norvegica. Vol. 2, No. 4: On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Applications to the Theory of Cosmic Radiation, 6. By Carl Størmer Pp. 193–248. (Oslo: Jacob Dybwad.) [221

Catalogues

View Point · Colour Photography and Printing. Pp. 12. (London and Bradford . Percy Lund, Humphries and Co., Ltd)

Archaeologie, Numismatik der Griechen und Römer. (Antiquariats-Katalog Nr. 710) Pp 154. (Leipzig: Gustav Fock G.m b H)

A Pictorial Record of a British Achievement. Pp. 32. (Potton, Beds: COPO (Cox's Orange Pippin Orchards), Ltd.)

Sale List of Physical Apparatus. (GT 1181). Pp. 8. (London. Griffin and Tatlock, Ltd.)

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No. 3512 SATURDAY, FEBRUARY 20, 1937 Vol. 139

Oxford and Present Needs in Science

FOR some time, the University of Oxford has been faced with the task of finding £500,000 for pressing needs, largely connected with the extension of Bodley's library and prospective science and other buildings. It recently launched an appeal for help to its friends in Great Britain, in the Dominions and in the United States. The sum it is hoped to collect is about £1,000,000. Great trouble has been taken privately to make the need known to those capable of helping, and there is good hope that industry (now flourishing as rarely before), the surtax-payer, and the ordinary individual, between them, will find this large amount.

While it is true that those who contribute jointly the last £50,000 are most blessed of all, it is good that already the first three hundred thousand pounds have been given or are in sight. It is hoped that as much as £150,000 will come from North America, despite the damage due to the Mississippi floods, which rightly makes a first claim on much of American generosity. The needs for this appeal are, of course, quite independent of those so handsomely met by Lord Nuffield last year for the school of clinical research. They are very different needs and needs of long standing ; they cannot even indirectly be met out of the £2,000,000 provided by him. Lord Nuffield has recognized this point by generously subscribing a separate £100,000 to the present appeal.

The money received is to be administered by a trust, so that it will be guarded from inroads for 'general purposes', and devoted to the needs set out in the appeal. The extension of the Bodleian library will be the first charge on the fund ; the alteration or erection of buildings, mainly science buildings, will be the second. The rest of the money is to be used as capital or interest for developing research in any subject at all that looks promising, except such part of it as may have been earmarked at the wish of contributors. Oxford, while still highly cherished in our affections, is a changed place from the old days. It is now largely a University for the hard-working, middle-class student. Higher study and research have never been more ardently pursued over a wide field. In pure science for many years Oxford has done a large quantity of excellent work. With increased endowments for material in the physical sciences, and for men in the biological sciences, it could do much more without attempting to become a second Cambridge.

The most urgent of the scientific needs is a new physics building for Prof. F. A. Lindemann. His department has grown rapidly of recent years and latterly has become almost intolerable in the Clarendon Laboratory, now more than seventy years old. Within the next three or four years it is proposed to erect nearby in the Parks a new physics institute, equipped for the studies now being prosecuted there, and to adapt the vacated building for the Department of Geology. That department has had to exist in cramped quarters within the University Museum, which dates from 1860, and has suffered in recent years from the lack of leadership of its late head, who was in office until he was nearly ninety years of age. In the ampler space of the Clarendon Laboratory, with increased endowment, and with a new professor to be elected this term, this department should again take its rightful place in the University.

The second great need is for a University Institute of Physical Chemistry. There is at present no such place. For years the whole of the teaching and most of the research in this subject has been done in the college laboratories and cellars of Balliol, Trinity and Jesus Colleges. A fine spirit has been shown there and excellent work done—more, perhaps, than in many a university department with proper staff and ungrudged grants for material. But college laboratories are now at best makeshifts, rich only in improvisation. They are neither well endowed nor well equipped. They are small; not everyone is free to enter them and work there.

A new University building properly equipped and endowed is imperative, and it is fitting that Prof. C. N. Hinshelwood, who has succeeded Prof. Frederick Soddy as Dr. Lee's professor of inorganic and physical chemistry and is a leader of physical chemistry, should have as his place a proper official laboratory in which scattered researchers in this subject, collected from various parts of college and University buildings, may find a home. It is proposed to put up the building in the next four or five years in the Parks next to the Organic Chemistry Laboratory, if funds earmarked for it are forthcoming.

These are the immediate needs. Next comes that of the Physiology Laboratory, which some day must be rebuilt. It was originally put up in 1884, and the recent growth of the medical school must soon make change in it very desirable. Something also should be done to endow the Museum of the History of Science. A donor who might jib at seeing his comparatively modest contribution swallowed up in the general total might like to individualize it by helping this institution, which does good work on an exiguous income. It saves for the studies of future generations apparatus and other objects of historical value which might easily be lost in the midst of change.

Mention must also be made of the need for an extension of the Ashmolean Museum and for funds for archæological research, and, what is likely to be of far-reaching significance in the future, for research in the study of human society, social studies and allied subjects such as anthropology.

It is announced that the appeal has already produced a response averaging £2,000 a day. The promotion of the welfare and influence of the University of Oxford is worthy of the support of all who are concerned for the progress of learning in the present somewhat distracted state of world affairs.

Inter-Imperial Co-operation in Scientific Research

As already pointed out in the leading article in NATURE of November 7 last (p. 777), the proceedings of the British Commonwealth Scientific Conference were mainly concerned with inter-Imperial co-operation in supplying bibliographical information on the sciences relating to agriculture. Co-operative research in certain subjects was, however, suggested by various delegations from the countries represented. Sections of the report of the proceedings recently issued (Cmd. 5341. London: H.M. Stationery Office, 1937. 1*s.* 3*d.* net) deal briefly with such subjects of wide Empire interest as the transport and storage of foodstuffs, the control of insect infestation of stored products, the properties and utilization of wool, the collection and maintenance of plant material for crop improvement, and the control of damage by termites.

The Conference recommends that the contributions of overseas Governments to the Food Investigation Board of the United Kingdom should continue to be a matter for arrangement between the individual Governments interested in the transport and storage of foodstuffs, and that Governments should continue, pending further consideration, the payments they are making for work on wool at the Wool Industries Research Association's station at Torridon, Leeds. It also recommends that the Farnham House Laboratory of the Imperial Institute of Entomology be continued on an inter-Imperial basis by the countries interested in the control of insect pests by the use of parasites of these pests (so-called 'biologic control'), so as to maintain a small nucleus staff. Additional staff to deal with specific problems will be paid for by fees as occasion arises. Though stating that this method of controlling insect pests is still in its infancy, no reference is made to the need for research into it; the aim is to bring the cost of maintaining the Laboratory into close relation to the specific (applied) services demanded of it.

Similarly, in considering the work—largely pioneer work—on the control of insect infestation of stored produce carried out at Slough at the Stored Products Research Laboratory of the Imperial College of Science and Technology, the Conference, while recording its appreciation of the work, notes that in future the contributions from Empire countries towards general expenses will cease, and special inquiries will be paid for by fees; no inter-Imperial finance for research on this subject is suggested. No recommendations for financial co-operation on the various other subjects of wide interest discussed were made, beyond those included in the provision of bibliographical services and in the identification work of the Institutes of Entomology and Mycology.

Co-operation in scientific research, jointly financed on an inter-Imperial scale is, at the moment, in abeyance. It seems likely to remain so until its scope can be more clearly defined by the men of science concerned, and its planning entrusted to them.

Birds of the Greek Classics

A Glossary of Greek Birds

By D'Arcy Wentworth Thompson. (St. Andrews University Publications, No. 39.) New edition. Pp. viii+342. (London: Oxford University Press, 1936.) 12*s*. 6*d*. net.

THE first edition of this book was published forty years ago, and the author tells us that it is fully fifty since he began to write it. It is the work of a Greek scholar of wide knowledge and immense reading, as well as an expert naturalist. More, much more, than fifty years ago, he says in his preface, his father taught him that many a Greek word or name of a hero was foreign to Aryan speech. The merchant and the mariner had brought strange words home from overseas, and many a beast and bird and hill and river had kept its pre-hellenic name. Many old names of birds and fish are recorded by Italian scholars from the rich dialects of Italy, and new light is thrown hereby on obscure Greek and Latin words.

The author quotes in his preface a series of names of birds with strange non-Greek (probably Phœnician) names which, save one exception, it is difficult to identify with their present modern Greek names, or even to prove by their actual existence. What is, for example, σελευκὶς, τίτυγξ, σοῦσφα or τὰνταλος? Ὄρτυξ however, and πέρδιξ, differ very little from their present names and the foreign traveller who would designate them, as many of the other Greek birds, by their ancient name to a Greek peasant would be easily understood by him—unless the pronunciation was the Erasmian one or his accent too foreign.

So far as I can judge, the glossary of the names of birds in the book seems to be very complete, and the reader is amazed by the profusion of quotations from ancient authors—naturalists, historians, or poets, representing the reading and filing of a whole lifetime indeed. The mention of the corresponding names in the modern Greek language is extremely accurate, except in a few cases, where Prof. D'Arcy Thompson has been led into error by foreign observers describing Greek birds. For example, the neutral in modern Greek does not use the terminal syllable ον of earlier forms (ancient Greek of Byzantine), so that the modern name cannot be ὀρτύκιον or παγώνιον but is ὀρτῦκι and παγῶνι. Heldreich, from whom the author quotes, was a naturalized German, and was influenced by the ancient grammatical forms, or he heard the names from Greek purists who thought it probably more elegant to use classical forms instead of the popular ones, especially when informing foreigners. Such lapses, however, are rare and unimportant, and the correct forms are also mentioned by the author.

Ancient Greek literature, descriptive as well as imaginative, is luxuriously rich in its references to birds. Prof. D'Arcy Thompson borrowed lavishly from it, and I think that no quotation worthy of being referred to has been missed. Thus we have in the book a real treasure of quotations, which can be enjoyed by the naturalist as well as the scholar or the ordinary reader. Since the first edition of the book, the author has been able even to enlarge and to complete them. The whole romance of the life of Greek birds is displayed here in the etymology of their names (sometimes unknown, disputed or obscure), in epithets and phrases from authors or poets, in their description, nesting and migration, or with reference to mythical and legendary traditions connected with them. Some of the latter are really fascinating, and it is interesting to see them sometimes perpetuated to-day among the Greek people.

One of the most captivating chapters of the book is the long one devoted to the swallow, the bird of the returning spring, or as Sappho sings, "who brings again the new beauty". Superstitions are still connected with the bird. Modern Greeks are not reputed as bird-loving people, and it is probable that some of the species mentioned in the glossary have disappeared from the country. The swallow, however, remains the favourite bird Lucky is the house chosen by it for nesting when the spring comes ! It is a good omen. A daughter will marry during the year, or the mother will give birth to a male child—female ones being not generally welcome in Greek families, owing, I suppose, to the dowry to be paid when they are of age to be married. It would be curious to verify whether the swallow ever stays, as recorded by Pausanias, to nest in Daulis (now Davlia), the country of Tereus.

The hoopoe or hoope-bird, which persecutes the swallows (the Ἔποψ of ancient Greeks), plays an important part in the Aristophanean play and boasts there that he and his companions live "by grazing in the gardens on the white sesame, the myrtle, the poppy, and the mint". There are in the very obscure Tereus myth, as Prof. Thompson remarks, frequent indications of confusion between hoopoe and cuckoo, and the 'metamorphosis' is in part connected with the resemblance between the cuckoo and the hawk. In spite of confusions, the modern Greek τσαλαπετεινὸς is to be identified with Ἔποψ and is top the ἀγριοκὸκορας, found on Mount Taygetus.

To revert to the swallow, as I mentioned in an article on "Classical Aspects in Modern Greece" in the October issue of the *Quarterly Review*, I cannot affirm from personal experience that the charming and ever-young song of the swallow, preserved by Athenæus, survives until to-day, but reliable witnesses report that children in villages still sing it, scarcely altered, as they carry round a wooden swallow to announce the coming of spring.

Modern Greeks are not at all respectful of the sacred bird of the goddess patron of Athens, symbolizing her wisdom. Not only has the beautiful ancient word γλαὺξ, so strikingly reminiscent of the blue-eyed daughter of Zeus, been succeeded by the cacophonous κουκουβὰγια, evidently derived from the resemblance of the ululations of the owl to the call of the cuckoo (Md. Gr. κοῦκκος), but also they consider a visit from the Athenian bird to the roof of a house, flying there from its usual haunts on the slopes of the Acropolis, as a definite ill-omen. Somebody will die in the house so visited, and the superstition, more widespread in Athens than elsewhere, is confirmed by striking coincidences.

The nightingale, on the contrary, is most welcome and much cherished among Greek birds. Nightingales delight by their melodious concerts the tardy walkers wandering around the Royal Gardens during the summer in Athens, seeking some relief from the canicular heat of the day. As a matter of fact, nightingales amply justify the ancient epithet "deprived of sleep" attributed to them.

As people believe firmly that nightingales once captured and locked in a cage cannot survive but for a short time, the bird is generally respected and free, among trees and groves ; and it charms with its harmonious modulations the life of humble folk in the country as well as that of the opulent citizen enjoying the blessing of a private garden.

The

> Τιὸ, τιὸ, τιὸ, τιὸ, τιὸ, τιὸ, τιὸ, τιὸ, τιὸ,
> τριοτὸ, τριοτὸ, τοτοβρὶξ

of the nightingale is really spread over all in the most democratic way.

Colonus alas ! is no more the beautiful wooded hill, where according to the immortal Sophoclean song

> " . . . the clear voiced Nightingale
> Who hid in her bower, among
> The wine-dark ivy that wreathes the vale,
> Trilleth her ceaseless song" ;

but nightingales may be heard now even there.

It is interesting to note that in spite of the popularity of the nightingale, sweethearts are never referred in Greek folk-songs as ἀηδὸνι μου. This appellation applies, in a satirical mood, to prolix orators in the Agora or elsewhere. As for terms of endearment, comparisons used in the Greek folk-songs and even in daily life, are confined to partridges (=περδικά μου), pigeons (=περιστὲρα or περιστὲρι μου) and turtle-doves (=τρυγὸνα μου). I must say, however, that the names of these birds in Greek have a poetical flavour unknown in the corresponding names in Western languages. Or am I influenced in this belief by the frequent use of the words in Greek folk-poetry ?

The production of the new edition of "Greek Birds" by the Oxford University Press enhances the reputation of this famous printing-house—although I should prefer for the Greek text the new beautiful Greek type designed some time ago by Mr. Victor Scholderer and freely used now by the University Press. The author acknowledges gratefully the contributions made by the Carnegie Trust for the Universities of Scotland and his own University of St. Andrews for the production of the book, published by Mr. Humphrey Milford for the latter. To make easier for laymen the identification of birds mentioned in the glossary, the drawings of many of them figure in the text, and the innovation is most welcome.

DEMETRIUS CACLAMANOS.

Natural History of Glamorgan

Glamorgan County History
Vol. 1: Natural History. Edited by Prof. W. M Tattersall. Pp. xix+444+39 plates. (Cardiff: William Lewis (Printers), Ltd., 1936). 25*s*. net.

THIS handsome and well-produced volume is the first instalment of a projected history of the county of Glamorgan which was initiated in 1930 by the Lord Lieutenant of the County, the Earl of Plymouth. It is intended to cover the scientific interest of the county, and includes sections on the geology, climate and meteorology, soils, botany and zoology, written by voluntary workers, the whole being edited by Prof. W. M. Tattersall, professor of zoology and comparative anatomy in University College, Cardiff. This volume is to be followed by five others covering the industries, archæology, and ecclesiastical, political, economic and parochial history of Glamorgan. The scheme adopted is more or less that of the "Victoria County History", but the material of future volumes will be treated chronologically as a whole, and not as separate sections.

The first volume now published deals with the "natural environment of the county as a background to the history of man", and Prof. Tattersall is to be complimented upon setting a standard which, if followed in subsequent volumes, and in neighbouring counties, will result in an imposing contribution to the topographical history of Wales. In Glamorgan, the geological history has an important economic aspect owing to the material resources of the county, and this practical side is not forgotten in the biological sections, which include chapters on ornamental trees and shrubs under cultivation, and an account of the parasitic diseases to which cultivated plants and domesticated animals are subject.

In this connexion, attention may be specially directed to the section which discusses liver-rot in sheep. The distribution of four species of the primary host, *Lymnæa*, has been plotted during a period of ten years, and also the areas in which *L. truncatula*, the only important species economically, does not occur. The conditions favourable and unfavourable to this species, and its methods of migration, have been investigated. Ecological research of this character has significant bearings on the incidence of an important epizootic disease. Similarly, the survey of the soils of the area, accompanied by soil maps, is a useful contribution to the solution of the problem of soil classification. The greater part of the history, however, is devoted to the fauna and flora of the district—the work of various specialists. Besides the usual lists of species, ecological and historical notes are included, which add considerably to the usefulness of the records. This section of the work is valuable as a first attempt to assemble in print the fauna and flora of the county, but an inspection of the lists suggests that considerable additions have still to be made to them.

The volume is beautifully printed and illustrated, and there is a good index. It is to be hoped that the reasonable price which the Committee has wisely decided to adopt will ensure a wide circulation for the series.

F. J. C.

Another Dimension in Films

Colour Cinematography
By Major Adrian Bernard Klein. Pp. xi+350+29 plates. (London: Chapman and Hall, Ltd., 1936.) 25*s* net.

NOT all books are written by experts, in the sense that their authors know not only their special corner of their field but also what everyone else has done in that field and over a historical period of time. The present author complies with this definition for he gives valuable data respecting the system of colour cinematography in which he is most interested, and also collects and criticizes the entire range of systems and processes tried and developed up to date.

Major Klein is right in his contention that the release colour print must be used in standard projectors without any modification of the latter, beyond the obvious necessity of using specific carbons. It may never be assumed that the projectionist will carry out arbitrary instructions, precisely and time without number; such procedure will always break down and discredit the colour system. The remarkable freedom from breakdown in cinemas has been won by adhering to the limit of standardization. It follows that additive systems of colour cinematography are thereby ruled out, likewise two-colour systems, since not all shades can be objectively realized with a primary omission. We are left with Technicolor, Kodachrome, and Gasparcolor, the second being in use for 16 mm. film only, but has possibilities in simplifying the others for 35 mm.

The history of colour films is remarkable for the millions of pounds which has been expended on development; much of it, according to the author's contention, uselessly because of disregard of fundamental engineering limitations. The exquisite Technicolor, with its elegant, though yet secret, methods of imbibition printing, is criticized for using a key print and so causing some desaturation. The author's analysis of the complete problem, from the original lighting, colour, design, emulsions, processing, to final projection and the reproducing light, is clear and balanced, while his knowledge of patents and other people's work is impressive.

As an extension from technicalities, the author has wisdom to offer film directors in their use of mobile colours in their work, and some pungent ideas in cutting down existing production expenses to balance the greatly increased cost of film, lighting and the colour experts which are to come. His æsthetic pronouncements are derived from years of experience with colour-music, which did not fascinate the public. In the world of art, he suggests that Rembrandt was colour-blind and that the colour-film will be perfected when the colour is so natural as not to be noticed.

L. E. C. H.

Humanistic History

A History of English Life, Political and Social
By Amabel Williams-Ellis and F. J. Fisher. Pp. xvii + 120 + 132 + 163 + 160 + xviii + xxxii + 5 plates. (London: Methuen and Co., Ltd., 1936.) 8*s*. 6*d*. net.

We have so often in these pages deplored the absence of the scientific, popular and progressive spirit in the presentation of history, especially for educational purposes, that we hasten to welcome a new and most successful effort in the right direction. The book by Mrs. Williams-Ellis and F. J. Fisher has everything to commend it. The publishers' account on its 'jacket' does not exaggerate in the least.

The book is delightful and racily written; it gives the necessary outline of political development—all the kings and their dates are there—with a really good account of the progress of science and of the arts of living. It is most admirably and suggestively illustrated by all sorts of coloured sketches and diagrams, as well as prints and photographs. But it has more than all this, and something of still greater moment. It is inspired throughout by an intense sympathy for the life of the common people—the poor who have been at all times in history the vast majority of the population. The authors constantly insist on this, but they do it in no sense of despondency or of a desire for violent revolt. They see quite truly that the lot of the masses, which must be the main criterion of human progress, has improved immeasurably in the time and country which they review, mainly through science. They estimate England kindly but not excessively, and introduce at every suitable place the European or world-connexions and contrasts.

It is only practised writers who can do all this so deftly. Mrs. Williams-Ellis is a novelist, and the success of the present book is another proof of what has so often been proved before, namely, that the mere possession of a mass of knowledge is not in itself any guarantee of the power of presenting it effectively to others; and that for this particular purpose—and many others—a woman has special qualities not generally possessed by men—sympathy, tact and a knack of story-telling which in this case is combined with a very unusual and truly philosophic grasp of the hang of all the parts of the great theme. The authors thus show government, industry, science and social life bound together as they really are, and they do not entirely neglect—though this is undoubtedly the minor interest—the arts of beautiful expression. It is not too much to say that the authors have done in this book for English history much the same service which Arabella Buckley did in the last generation for science, in her "Fairy Land of Science".

It would be an interesting task to pick out a few specimens of the happy sayings and picturesque figures with which the book is full. The changes which 'Old Parr' would have witnessed in his life of more than a hundred and fifty years are a good example. But we have only space to deal with the one overwhelming question which will face teachers and scholars who will turn over its pages with delight. Will it enable the pupil to pass the School Certificate Examination? The answer must be, "Probably not". But could any interesting all-round presentation of the subject, in reasonable compass, ever hope to make its way through that barbed-wire entanglement in which our education is now confined ? The final answer must be some drastic change in the system.

Everyone should know the things which are here set out with so much charm, clarity of expression, humane tendency and fair balance of interest. That might well be required from all completing a course of general education by the age of sixteen years. For the rest, encouragement should be given to scholars with special interest to pursue further the study of special branches of history. This is the sphere to which diplomatic relations, constitutional details, plans of campaign and colonization properly belong. There also the progress of science and of technical inventions should find a leading place. F. S. MARVIN.

Absorption from the Intestine

Absorption from the Intestine
By Prof. F. Verzár, assisted by Dr. E. J. McDougall. (Monographs on Physiology.) Pp. xii + 294 + 12 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 21*s*. net.

THE Monographs on Physiology, published by Messrs. Longmans, Green and Co., Ltd., have performed a useful service in providing competent reviews of different aspects of a rapidly advancing subject. It is good to see that the series is to be continued under the editorship of Prof. Lovatt Evans, and it is hoped that these monographs will now appear more frequently.

Prof. F. Verzár of Basle has made many important contributions, during the last ten years, to our knowledge of absorption from the intestine. He writes with the authority of experience on nearly all aspects of this subject, and his book is fascinating to read. The first five chapters are devoted to a general discussion of the anatomy of the intestine, methods of research, and the physical and chemical forces involved. The remaining seventeen chapters are each devoted to a discussion of the absorption of one class of substance.

The author has tried to explain all the facts in terms of physico-chemical laws. In many cases he has been successful in finding plausible explanations; and in all cases he has made it clear that there is no necessity at present to invoke vitalism. The water in the intestine is in free communication with the body water; if heavy water is placed in the intestine it becomes diluted, within an hour, by an amount corresponding with the total water content of the body. The membrane is also freely permeable to crystalloids. It is practically impermeable to colloids, although minute quantities of unsplit proteins, or even visible particles, may occasionally be absorbed, probably through an accidental fault in the membrane. Absorption is controlled by diffusion and osmosis, and in the large intestine the hydrostatic pressure may be such that filtration is also an effective factor. The pumping movements of the intestinal villi may help to mix the intestinal contents, but it is probable that their main function is to pump absorbed fat into the large lymphatic vessels.

Hydrotropy plays an important part in the absorption of water-insoluble substances such as fat and calcium salts. This is defined as the property of some asymmetric, strongly surface-active, water-soluble organic substances of disintegrating water-insoluble substances to molecular complexes in which the hydrotropic molecules surround the insoluble molecule, and render it soluble and diffusible. Bile acids have this effect.

The rapid absorption of substances, such as glucose, which are useful foodstuffs, compared with similar substances, such as xylose, which are not, has seemed in the past to suggest that the intestinal mucous membrane is endowed with intelligence, and has provided a prop for vitalism. When the cells are killed they lose their power of discrimination. Prof. Verzár attributes these observations to the fact that glucose is rapidly phosphorylated in the cells of the living mucous membrane, while xylose is not. The diffusion gradient is therefore greater in the case of glucose than in the case of xylose. When phosphorylation is inhibited by monoiodacetic acid, the cells lose their power of discrimination. Similar explanations can be applied to the absorption of fats and other substances. This work has led to interesting experiments with the suprarenal cortex, which is known to affect the phosphorylation of sugars. Adrenalectomy destroys the selective absorption of glucose and fats; the injection of eucortone restores it. These facts are easily explained on the theory discussed above.

The theoretical and practical importance of this work is obvious. Prof. Verzár and Dr. McDougall have performed an important service to physiology in writing an authoritative account of work that is not so well known as it deserves to be.

Change of Life in Men and Women

By Dr. Marie Carmichael Stopes. Pp. xv+282. (London: Putnam and Co., Ltd., 1936.) 6s. net.

THIS book, like most others of the author, is popular in style and easy to understand. Moreover, it contains much common sense and a great deal of the advice given is thoroughly sound. For example, no physician would quarrel with the recommendation to avoid constipation. There are many other practical suggestions, and Dr. Stopes has done good service in directing attention to the help to be obtained from the work of the distinguished Spanish gynæcologist, Prof. Gregorio Marañón.

It is in dealing with the male climacteric that Dr. Stopes claims most originality, and though every medical man will agree with her as to the importance of studying this subject, serious doubts will be expressed as to the value of some of her advice and the accuracy of some of her statements. It is surely an extreme view to hold that "in the general physiology of man the testicles share their pre-eminent place with the prostate gland", and it is by no means certain that "the spermatozoa are stimulated to activity" by the alkalinity of the prostatic secretion. Again, it is doubtful what action the prostatic hormone possesses, or indeed whether there is a true hormone secreted by the prostate at all. Yet Dr. Stopes recommends the use of prostatic extracts to reduce the enlargement to which the prostate is subject. It is stated, further, that these and other extracts should be taken orally and not injected, the fact being ignored that most hormones (but not thyroid) are destroyed in the alimentary canal and never enter the circulation of the patient. In view of recent researches on the testicular hormones, it may confidently be predicted that in course of time, and probably in the near future, prostatic enlargement will be successfully treated, but Dr. Stopes does not allude to testicular extracts; and in any event further experimental data are required before definite recommendations can be safely made in a book addressed to the general public.

Isles of the Seven Seas

By Collingwood Ingram. Pp. 283+31 plates. (London: Hutchinson and Co (Publishers), Ltd., 1936.) 18s. net.

THE author is well known among horticulturists as an enthusiastic collector of cherries, and one who has also contributed to our knowledge of the genus *Gladiolus*. Furthermore, all his life he has been an observer of birds. Equipped with the twin lore of botany and ornithology, he has travelled widely, collecting and noting. For the purpose of this book, he has made a selection from his copious material, confining himself to islands he has visited. We leap from Tahiti to Coll and back to Sumatra, to Corsica, New Zealand, Ushant, and not least to Little Tobago; and if we have a feeling that Mr. Ingram is rather self-consciously trying to avoid the too smooth day-to-day narrative of orthodox travel literature, the device has its charm. Wisely he rivets our interest at the start by taking us to the South Seas.

Where the author has, if not quite beaten out the track himself, at least helped to widen it—and nowhere does he follow the crowd—he writes interestingly, and with real insight. His account of his father's experiment in introducing a very rare bird of paradise from the Aru Islands into Little Tobago is fascinating. Occasionally he imports scientific words into narrative in a slightly pretentious way; it would indeed be surprising if the moonlight even in Tahiti, where we expect everything to be glamorous, is really 'glaucous'! Such mannerism is the only blemish in an otherwise pleasant style.

The book is a record of personal impressions by a man of considerable feeling and knowledge, trained to observe accurately; a scholarly but not technical book for the lover of Nature.

Eisen- und Stahllegierungen: Patentsammlung

Erganzungsheft 1. Von A. Grutzner. Zugleich Anhang zur Metallurgie des Eisens in "Gmelins Handbuch der anorganischen Chemie", achte vollig neu bearbeitete Auflage herausgegeben von der Deutschen Chemischen Gesellschaft. Pp. v+425. (Berlin: Verlag Chemie G.m.b.H., 1935.) 44 gold marks.

THE publication in 1932 of a special volume containing in tabular form a list of patent specifications relating to iron and steel has proved to be so useful to research workers engaged in this industry that it has been necessary to prepare supplements of this collection on similar lines. The comprehensive nature of these tables, which cover the patent specifications of Germany, England, France, Austria, Switzerland and the United States, will be gathered from the fact that the present issue deals only with the interval between March 1932 and December 1934, and furthermore another special supplement to Part A of the volume on iron is being devoted to "Mechanical Properties of Steels", and will contain a complete bibliography extending over a very considerable period of time.

Epitome de Culturologia

Por el Dr. Imbelloni. (Humanior: Biblioteca del Americanista Moderno, Serie A, Tomo 1.) Pp. 320+8 plates. (Buenos Aires: José Anesi, 1936.) n.p.

THE series, of which this is the first volume, might well be symbolized by an inverted cone. The volumes of which it will be composed are classified into sections, beginning with general surveys of the various branches of the study of man, and narrowing and intensifying with each successive section, until in the sixth and last, attention is focused on the cultural history and ethnology of Argentina. This conception of a gradual intensification of interest as a basis of regional study, if execution does not fall behind, is wholly admirable. Dr. Imbelloni has given the series a good send-off in his survey of the study of culture and the methods of investigation by cultural distributions. Several examples of the study of areas of cultural distribution in relation to specific cultural traits are given in appendixes.

Geography and Economic Theory*

By Sir Josiah Stamp, G.C.B., G.B.E., F.B.A.

THOSE who are interested in geography as a subject to be expounded educationally must welcome every approach to it which may add to its effective rationalization and bond it into the main structure of knowledge. This is not a mere teaching device, for it may make teaching more difficult, if it is to make it more effective. It makes teaching more difficult if we have to go beyond the immediate neighbour in causation, to reach basic causation and fundamental reasons. To explain a geographical condition by an economic condition is immediate, but not fundamental. Some theory of economic action is implied, though it may be conveniently left unexamined and unexpressed—taken for granted. All such single economico-geographic couplets of facts taken together must ultimately conform to some theoretic principle, and have some common thread. If they do *not*, then there is no uniformity of causation, and no economic, still less geographical science. An economic explanation of a geographic fact is then no 'explanation' at all. The kind of theory which geography may involve, or which may aid geographic understanding, and help to make geography, already culturally basic to so many mental disciplines, a fully rounded science, is therefore the subject of this address.

Geography in recent decades has multiplied its descriptive classification or titles in a rather opportunist manner. No one bothers much about keeping or making the boundaries—they seem to be sufficiently well understood. Yet at the outset I find some uncertainty as to the true scope and purpose of 'economic geography'. Economic history is certainly not the history of economics, but quite clearly the selection of those facts in history which are of economic importance, or which can be accounted for only by economic tendencies and principles. But I am not sure whether economic geography is confined to describing the geographical aspects of physical and spatial facts which are of interest to the economist, providing him, so to speak, the bricks to build with, but quite indifferent to the use he makes of them. If so, how far does the economist really use them ? To what extent in constructing an edifice of economic principle does he rely on geographical material ? To what extent does he overhaul and recast principles to cover the wealth of material, with differences and similarities, which the economic geographer continually presents to him ? How far does he merely use this material by selection, to illustrate his point, or does he feel a responsibility for subsuming and accounting for the whole of it ? Is a geographical fact *ever* the awkward fact that kills the happy economic theory ? But perhaps the economic geographer thinks it is his own task to account for facts, for the presence or absence of features, for similarities and differences, by applying economic principles and tests. Perhaps he learns what facts to register and elaborate, by economic theories and differentials. Or am I again an idealist ? What, in fact, is the functional relationship between the two disciplines ? Whose task is it to do the work of establishing causation, in either direction ?

Economic geography must *begin* with physical environment, because these natural controls are dominant. So its first contributor is pure geography. But this is only the first of three classes. Variations of labour and capital are also important and these are covered by economic history and economics proper, not by geography. Thus complementary productions, in seasons or in female labour, are not factors derived from geography. The persistence of a factor through an early start comes from economic history. The data provided by Nature have to be handled by man, and therefore human motives are involved ; so the balance of marginal cost to himself of the effort and of marginal utility to himself of the product, or its market equivalent, must be made. Utility and value and psychic considerations have entered.

Geographers have been as active in adopting the term 'economic' without doing much distinctive with it, as economists have been inactive in using the term 'geography' for their basic data. In the composite volume, "The Trend of Economics", Prof. Weld has a section on "Regional Comparison and Economic Progress", in which he refers to the three trends now becoming clear : first, realistic studies as opposed to abstract analysis ; secondly, statistical presentation ; and thirdly, regional comparison. In elaborating the last, he details Mill's five canons of method applied to inter-regional data. "The economist of today finds himself face to face with the problem of the inequalities of standards of living in different regions. For example, India and China have not participated in the economic progress which has become conspicuous in some of the Western countries. Many explanations have been offered for the economic backwardness of regions in Asia, Africa and South America. Which explanation is nearest the truth? We do not know. It is time we were finding out. Scientific comparison seems the most obvious method. What is required is a thoroughgoing search for the *causes* of the differences in the separate regions." Surely this is economic geography in the truest sense, yet he never once uses the term 'geography'. The word geography does not appear in the indexes to the first forty years of the *Economic Journal*. The "Encyclopædia Britannica", 14th edition, has no mention of economic geography in its index. Palgrave's "Dictionary of Political Economy" (1896) includes an article on "Commercial Geography", which is for a large part economic history, but contains no reference to *causal* geography in the economic sense, except the conventional reference to England's natural advantages. It is very much the same story when we look in geography literature for economic theory. The index to the *Geographical Review* over a long period of years contains scarcely any reference to economics in its analytical or theoretical sense. Probably the nearest that it gets to it is in an article by Chisholm on "World Unity", where he postulates the tendency towards the equalization of economic development throughout the world in capital, in population density and in skill—an important economic generalization akin to the second law of thermodynamics and fraught with vital consequences in the field of foreign trade and also in the extent to which natural resources will be fully developed. But it is a generalization of his own which does not base itself on any recognized economic field. Modern works on realistic economics contain much geographical matter, and those on commercial geography, important summaries of economic factors. Thus a chapter in Seligman's "Principles of Economics" and one in Dr. Dudley Stamp's "Commercial Geography", dealing with the localization of industry, might even be changed over, without doing any real violence to the balance or trend of either work.

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* Abstract of the presidential address to the Geographical Association, delivered at the London School of Economics on January 6

We may classify geographical explanations of economic facts, which are thus also quite often reversible as economic explanations of geographic facts, first as the simple static; second, as the simple dynamic; third, as the inductive static and fourth, as the inductive dynamic; and fifth, beings the most rare, as theory inductive and illustrative. The first, the simple or direct static, is the type best known to us, filling our commercial geographies and our realistic economic text-books. Its method is to account for one fact or set of facts by another set, not indeed in a connexion obvious until it is pointed out, but when stated, requiring or securing no supporting argument, no discrimination from other possible causes or connexions, and certainly involving no analytic and theoretic body of economic principles either to verify it or in itself to form an illustration. These often involve a certain element of history. In general, this class includes such statements as that a given port owes its prosperity to the fact that it lies on the trade routes between two wealthy or populous areas. "The completion of the Erie Canal in 1815 gave to New York, then a city of secondary importance, a position of undisputed pre-eminence" (Chisholm).

The second, or simple dynamic, class accounts for a *changing* set of facts by another set *changing* with it. Accounting for an important part of the grain trade of St. Louis, Chisholm says: "Here reside the merchants who handle a large part of the grain grown in the region to the west, including eastern Kansas and Nebraska. The nearest ports for that grain are Galveston and Houston. If the railways to these ports become congested, and are consequently disposed to charge too high rates, the merchants can apply for rates by rail or river to New Orleans, by rail to Baltimore or some other eastern port, or partly by water by the route here spoken of to New York" (p. 631). This is economic geography, but not economic theory. To provide economics with a problem for analysis, details of the change in traffic passing in different directions at different levels of freight rates and their fluctuations would be necessary. Or perhaps lessons in equilibrium between two types of transport, with different ratios of working costs to total costs, might be obtained therefrom. Chisholm provides a factual dwelling, but the economist is not yet dwelling therein.

The third, or inductive static class, draws lessons from a *number* of instances of the first class—for example, cases in which transport is involved. "With the increase of facilities and lowering of costs, geographical situation is yielding to the facts of artificially created location" (Seligman, p. 45). Similarly, population densities provide material for comparable generalizations.

The fourth, or inductive dynamic class, draws lessons from a number of instances of *changing* facts in sets or pairs with their correlations. This obviously is getting nearer to help for economic theory than any of the foregoing.

The fifth class goes further than the fourth if it brings the general principle that emerges into relation with analytic work, and perhaps produces generalizations which will 'work' as prophecies or further explanations. But I cannot find many clear examples in recent work. J. E. Orchard advanced along this line when he claimed that the geographic study of minerals is certain to involve economic theory and to make contributions to it. He illustrated by a geographic explanation of the agitation for the nationalization of mineral resources. Pressure comes through a demand for higher wages or lower prices. The emergence of a period of abundance in particular countries has the basis of different economic conceptions of property rights, and the threat of future scarcity in particular places has a like differential in the property concept. The period of abundance lay behind the *laissez faire* theory, and the current concept of property right is differentially distributed with scarce or abundant minerals.

Now, in the present state of economic geography, it seems to me that most progress is naturally being made in the third class. The photographs, so to speak, being taken in the first class, are being brought together for induction under the third. But as time goes on, new photographs will be taken of the same physical locations under the first class, and the endeavour to relate the old and the new will call for measurement and explanation of the change, and bring them under the second class. The accumulation of instances under the second class will then provide masses of material for induction under the fourth class. Here economic theory fully emerges, but not before. The economic theory is not based on static conditions—it is essentially related to incremental changes of cause and effect, or related effects; and only as geography registers changes over time can it be of full advantage to economic theory.

Turning to the geographical ideas of well-known economists, Adam Smith's "Wealth of Nations" was not so much a piece of abstract reasoning, as a systematic induction from history and geography, in what was really a piece of political propaganda of high wisdom. It was a great protest against nationalism, and therefore it was cosmopolitanism. But no man can be a cosmopolitan without being a geographer. It has more geographical references in proportion to its bulk than any later important work.

A famous example of the inductive method is John Stuart Mill's discussion of peasant proprietors. He does not elaborate from first principles the economic results of the whole produce of land going to the owner worker without a tripartite division into rent, profits and wages, for he calls it one of the most disputed questions in the range of political economy. But instead he examines conditions in Ireland, Switzerland, Norway, the Palatinate, Saxony, Prussia, Holland, Flanders, Channel Islands, France and Lorraine, takes the common factors and then makes generalizations. He declares, first, there is no necessary connexion between the form of landed property and an imperfect state of the arts of production; secondly, that the most effective use of the soil is not endangered; thirdly, that it is supreme in developing industry, intelligence, and frugality; and last, that it raises the standard of life, and does not unduly increase the numbers of the population.

We find no such rich geographic texture in the abstract reasoning of Ricardo, which was "unfavourable to any regional treatment". The German historical school introduced again ideas of relativity in time and space, but as we get down to modern times the text-books of "principles" are rather bare of geographic illustration. Seligman's "Principles" is well based on such facts, but even so objective a writer as Taussig in his "Principles" provokes the criticism of a geographic reviewer that he has very little geography. The latest highly analytical works of Pigou and Keynes are nearly bare of *geographic* facts.

Let us now lay out the field of economic theory on broad lines, and indicate in which quarters there lies most opportunity for geographic illustration or induction. It will be obvious at once that geography has no lot or part in a considerable range of it. Material objects need to have an appeal to human psychology before they are wealth. At least one half of the theory of value is psychological. A good part of invested capital is not geographical. Political and social institutions are of this order and, therefore, in the fields where these matters predominate geographic generalization is at a minimum. Where, however, we come to land, we should expect to find that if the theory, for example, of no rent land, and marginal land of various types, has any validity, we ought to be able to see these things objectively, and it is in relation to land and minerals, that induction from geographic facts should be most productive of theory or illustrative of it.

All questions of location and their effect upon production are capable of geographic illustration. Here is a generalization which is capable of economic analysis and certainly of illustration: "The geographic location of a manufacturing plant assumes an importance now that did not obtain when competition was less keen and almost any site would do. All the geographic factors have to be considered and a mistake in only one of them may offset good judgment in all the rest." Again, the geographer finds various methods of land utilization and describes them. The economist asks the question, why and wherefore—the causes. He finds certain uses bring misfortune; he seeks to impose conditions and so considers values.

When we get to the theory of demand and value, geography is quiescent. It is not, however, out of the question to see some possibilities. Anyone illustrating the principles of inelastic and elastic demand respectively, and taking salt and margarine as examples, might extend the study into the relative stability of employment in geographical areas supplying one as compared with those dependent on the other, to account for their differences. This would be an excellent geographic verification or illustration of the theory. The principle of substitution might well be illustrated by the rise to popularity of particular commodities supplanting others the costs of which had become dearer, relatively, if not absolutely. This change means a change in the economic statistics of geographical areas, which can be examined and stated.

International trade proceeds on the theory of comparative costs (with certain important modifications) and it shows that it is quite possible for *a* to export to *b* commodities in which *b* has the greater natural advantage, provided that *b*'s natural advantages in another commodity are even greater. This ought to be susceptible of verification by reference to geographic facts.

Geography has little concern with money, banks or the technique of trade, and productive methods, but I would not conclude that the economist can make no use of geography at all in these fields. Atkinson says: "But if the metric system gives Germany an advantage over Great Britain in South American markets, it becomes to that extent a factor in the Geographic division of labour—that is, it tends to locate the economic complement of the wheat fields, and cattle ranches of Argentina in Germany rather than England"

Then again, banking systems may affect geographic facts: if the bank reserve system in America draws money from country to cities and gives them a lower interest rate, then it becomes a factor in concentrating industries, and determining the geographic division of labour.

Technical production is not economic geography. But if the Bessemer process causes migration of the steel industry to areas where the ores are free from certain impurities, it is part of economic geography.

A few years ago the American Economic Association had a round table discussion on the various relations between economics and geography[1]. It covered the geographic basis of agricultural production, land economics, economic concept of property in minerals, the study of pioneer belts, and geography in foreign trade prospects.

This probably expresses fairly the field of geography which actually lies within the field of economic theory, but the range of the latter is extensive and may—to reverse the metaphor—throw valuable side-lights at unexpected points of geography. But economics, though now highly specialized, is really one and indivisible. The geographer who aims at strengthening his grasp of causality, especially for expository purposes, by learning economics, would do well to cover the whole field first, in a preliminary way, and then specialize on the particular applications to which our analysis has led us. The economist who would keep his feet on the ground, even if his head is in the clouds, by realistic treatment, will get no such mitigations of his task from the geographer—like John Wesley, he will take the whole world for his parish.

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[1] *Proceedings of the American Economic Association*, March, 1926, p. 112.

Constitution of the Earth*

By J. H. Reynolds

THE behaviour of materials such as granite and basalt can be tested in the laboratory up to a pressure of 30,000 atmospheres, or, as engineers would say, about 200 tons to the square inch. This corresponds to a depth of 120 km. in the earth's crust, but what are the conditions of matter at pressures of 10,000 tons to the square inch or thereabouts, which presumably must obtain near the centre of the earth? Then with regard to temperature, we know that near the surface of the earth in Europe this increases generally with depth by about 30° C. per km. The rate of increase differs considerably from one point of the earth's surface to another. In North America it is three quarters of this amount, and in South Africa only about one half. In regions where volcanic activity has taken place in recent geological times, the rates of increase are abnormally high. In a boring almost a kilometre deep at Budapest a temperature of 69° C. was reached at the bottom. In Tuscany and other places in Italy a similar rate of increase has been found. If we take an average and extrapolate from this, we find that at a depth of something like 50 km. we reach a temperature of 1,400° C.,—enough to fuse all but the most refractory substances.

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* Extract from the presidential address to the Royal Astronomical Society delivered on the presentation of the Gold Medal to Dr Harold Jeffreys on February 12.

But is it safe to extrapolate, and would not the increase in pressure alter the fusing point and also the rigidity ? This undoubtedly takes place, for earthquake foci as deep down as 400–500 km. have been inferred from the various types of seismic waves and their times of travel to different stations. An earthquake focus at such a depth presupposes that the material there is strong enough to fracture, so we must assume that notwithstanding the probability of a temperature certainly equal to, and probably much more than, the free fusing point, the material, whatever it is, has still considerable strength.

Then we have the complication introduced by radioactivity. A certain proportion of the earth's internal heat, at any rate in the outer crust, is due to the presence in igneous rocks of radioactive metals such as uranium and potassium. What proportion of the earth's internal heat is due to this cause, and how much to primeval heat still remaining from the time when the whole earth was a molten-globe ?

The deductions which geophysicists can make as to the internal structure and composition of the earth, below such an insignificant fraction of the earth's radius as a few kilometres, must therefore be in the nature of extrapolations, and the validity of the conclusions reached depends entirely on the assumptions made as to the behaviour of various substances under conditions of heat and pressure which are for the most part far beyond the limit of verification in the laboratory.

Notwithstanding these formidable difficulties, Dr. Harold Jeffreys has boldly grappled with the many problems involved, and has presented us with a conception of the earth's interior which fits in remarkably well with the known data. He first of all postulates a shell which behaves mechanically as a solid, reaching down as far perhaps as 3,000 km. This shell is of a density which increases from the surface downwards, the surface density being about 2·7 and the lowest layer about 5. It is worth noting at this point that Jeffreys' work is quite inconsistent with Wegener's hypothesis of the continents floating on a viscous magma comparatively near the surface, and it is equally opposed to the tetrahedral theory of the formation of the continents. There is a discontinuity between the central core and the shell in the way of transmitting earthquake waves, and as the core is apparently incapable of transmitting distortional waves at all, it is concluded that the central core is still in a molten condition. Its density is only consistent with the heavier metals, and iron is probably its principal constituent.

From a detailed study of the times and rates of travel of the two main types of earthquake waves, the primary and the secondary, with their associated surface waves, it is suggested that the principal constituent of the earth's solid shell is olivine, as this mineral is of about the right density required. But this does not extend to the surface, where there is a layer of granite under the accumulated sedimentary rocks of the continents, and a layer of denser rocks, presumably basic, lies under the oceans. The granitic or continental layer is estimated to be about 10 km. thick, and two other layers of about the same thickness, but discontinuous in their density, may lie between it and the lower shell of olivine or its equivalent.

Stoneley has also made an estimate of two discontinuous surface layers, and he finds a thickness of 12 km. for the granitic layer and 24 km. for the intermediate layer. There seems to be another discontinuity of density at something like 400 km. down.

In substances that contract on solidifying, the fusing point is raised by pressure, so that at great depths materials must be still solid at temperatures much higher than the fusing points at the surface. This rise in the melting point due to pressure at low pressures is about 3° per kilometre, at greater depths probably somewhat less than this. While the earth was molten, the temperature would increase downwards, but the fusing point would increase faster, and as the whole cooled at a uniform rate, so solidification must have taken place from the bottom upwards. If the core is of metals, which have a lower fusion temperature than the basic silicates of which the outer shell probably consists, then the core would remain liquid, while the outer shell, still liquid at the surface, would be solid at great depths. The core, therefore, got trapped under a layer of badly conducting silicates, and its temperature has not dropped greatly since it was originally formed. On this hypothesis the whole process of solidification did not take more than some tens of thousands of years.

It is now established that the earth's surface temperature is practically controlled by solar radiation alone, and it has been so during the greater part of geological time. If we find evidence of variation in surface temperatures in past geological epochs, we must attribute the variation either to changes in the sun's radiation or to altered meteorological conditions. I find it difficult to imagine altered general meteorological conditions without a corresponding cause in solar radiation.

The small amount of heat still leaving the earth by conduction from the interior is partly a relic of the primeval heat from great depths, and partly heat generated more recently by radioactivity. The radioactive metals, uranium, thorium and potassium are found in all surface rocks in minute but measurable amounts. Granite contains a greater proportion of these radioactive metals than the basic rocks. In average granite the rate of generation of heat is found to be $1{\cdot}3 \times 10^{-12}$ calories per cubic centimetre per second, while for basalt it is only $0{\cdot}50 \times 10^{-12}$ calories. Small as these amounts are, it is found that the total heat now being lost from the earth by conduction can be supplied by a layer of granite 20 km. thick over the whole surface. This leaves nothing to be supplied from greater depths, and fixes an upper limit for the thickness of the granite layer. But it has been found from the study of near earthquakes and surface waves that the granitic layer is only 10 ± 3 km. thick There must be, therefore, as large a proportion of radioactive elements in the upper 10 km. as in all the rest of the solid shell beneath it. This leads to the conclusion that radioactivity decreases rapidly with depth, and further that the radioactive metals became concentrated in the surface rocks in the early history of the earth. In any event, volcanoes and subterranean igneous phenomena such as intruded masses of granite and basalt must have some source of heat not a great distance down to explain them, and radioactivity in the earth's crust does this.

Obituary Notices

Dr. F. S. Macaulay, F.R.S.

FRANCIS SOWERBY MACAULAY, who died at Cambridge on February 9, aged seventy-four years, was for many years mathematical master at St. Paul's School and will be remembered by generations of pupils, not a few of whom became distinguished mathematicians; he also produced original mathematical work of high quality, in a field little cultivated in England, the general theory of algebraic polynomials.

Macaulay was the son of the Rev. Samuel Macaulay, and was born at Witney, Oxfordshire, on February 11, 1862. From Kingswood School, Bath, he went up to St. John's College, Cambridge, in 1879, and was bracketed eighth wrangler in Parts I and II of the Mathematical Tripos in June 1882, the first year of the divided tripos. In the January following he was placed in the third division of the new Part III, to which only wranglers were admitted. After two years at his old school, he was in 1885 appointed to a mastership at St. Paul's, where he remained until his retirement in 1911. Before going to Cambridge he had passed the London Matriculation with honours; he took the London B.Sc. in 1891, and the D.Sc. in 1897. He published, in 1895, a text-book on "Geometrical Conics". He was an active member of the Mathematical Association, being for many years an associate editor of the *Mathematical Gazette*. After the Great War he went to live in Cambridge, where, in 1923, he married Norah, widow of Mr. G. A. Matthew.

Macaulay approached his algebraic research from the geometrical side, the theory of algebraic curves. His first paper, of fifty pages, published in the *Proceedings of the London Mathematical Society* (**26**; 1895), is concerned with the number of conditions presented by a finite set of points in a plane, grouped in 'clusters' of any degree of complication, in the determination of algebraic curves of given order. This led on to an algebraic investigation of the intersections of curves at multiple points and to a thorough reinvestigation of the well-known theorem of Noether on the form of the equation of a curve which passes through the intersections of two curves, with the generalizations of Lasker. So his interest was aroused in the general theory of modular systems, that is, of polynomials, in any number of variables, expressible in the form $A_1F_1 + \ldots + A_rF_r$, there the F's are given polynomials and the A's are arbitrary polynomials. A series of papers in the *Proceedings of the London Mathematical Society*, the *Transactions of the American Mathematical Society*, and the *Mathematische Annalen* was followed in 1916 by his Cambridge Tract, "The Algebraic Theory of Modular Systems", in which he gave an account of the whole subject, filling in many gaps in the proofs of his predecessors, and adding considerably to the theory.

Macaulay's work attracted more attention in Germany than in Great Britain, and it was not until 1928 that its first-rate quality was recognized by his election to the Royal Society. In his later years, in Cambridge, he lived a retired life, and was not often seen in College or in society, but he always showed a keen interest in the work of the younger mathematicians on the algebraical and geometrical side, and was a frequent and welcome visitor at seminars in these subjects.

We regret to announce the following deaths:

Dr. Frederick V. Coville, botanist of the U.S. Department of Agriculture, known for his work on the relation of plant growth to soil conditions, on January 9, aged sixty-nine years.

Sir Reginald Craddock, member of Parliament for the Combined English Universities since 1931, on February 10, aged seventy-two years.

Dr. Alfred Daniell, author of the well-known "Text-book of the Principles of Physics", on January 12, aged eighty-three years.

Prof. Max C. W. Weber, For. Mem. R.S, formerly professor of zoology and comparative anatomy in the University of Amsterdam, on February 7, aged eighty-four years.

News and Views

British Industries Fair

THE 1937 British Industries Fair opened in London and Birmingham on February 15 and will remain open until February 26. The organizers tell us, as they have been able to tell us each successive year for many years past, that it is the biggest and most impressive fair that has yet taken place. There is no reason to doubt the claim; the record area occupied by the exhibitors' stands last year has been exceeded by more than 10,000 square feet. No doubt, over and above the increased number of exhibits due to the natural growth of industry and to the recent improvement in trade generally, the fact that this is Coronation year has had a considerable influence upon the record figures. There are more than 1,500 exhibitors detailed in the catalogue, of whom the largest number (78) are from London and the two smallest groups are from Glasgow (12) and from Edinburgh (7). No less than sixty countries are represented by their trade buyers. Holland heads the list, and other countries well represented are Germany, Belgium, France, Denmark, the United States, Sweden and Poland. Italy also is well represented, but Spain, which last year sent a strong contingent of buyers, is this year a notable absentee, for reasons which will be obvious. As before, the hardware and heavy industries section of the fair is held at Castle Bromwich, Birmingham.

OLYMPIA accommodates exhibits of what may perhaps be called the lighter industries, such as chemicals, glassware, leather, scientific instruments, foodstuffs, paper, toys and games, and musical instruments. The textile, furniture and allied industries have their exhibits at the White City. It should be noted that only goods manufactured or produced within the British Empire are permitted to be displayed, and no exhibitor may exhibit articles other than those of his own manufacture. We hope to publish in our next issue an article directing attention to the prominent features of the exhibits that can be regarded as being predominantly scientific. Meanwhile, it is of interest to note that the printers of NATURE, Messrs. Fisher, Knight and Co., Ltd., have installed at Olympia a complete printing works demonstrating block-making, type setting, machining and binding, and volumes of NATURE are being exhibited.

New Equipment for the Royal Air Force

THE publicity recently given in Parliament to the delay in the aircraft building programme scarcely gave due importance to one of its fundamental causes. This expansion in quantity required comes at a time when a radical change is taking place in aircraft constructional methods, made necessary by recent research having caused aerodynamic design to demand a somewhat different exterior form. A continued increase in engine-power available, added to improvements in design reducing resistance and giving greater speed ranges, have enabled the speed of flight to increase so that up to 300 miles per hour can be contemplated for certain types of aircraft which constitute the quite normal equipment of the R.A.F. At such speeds as this, the air friction at the surfaces of the various component parts of the machine becomes a much greater proportion of the total resistance than at the lower speeds used hitherto. It now becomes vital to have both correct aerodynamic shape and smooth surfaces if reasonable efficiency is to be attained. In the past, most aircraft has consisted of girder frameworks taking the loads, covered by linen fabric the function of which was to give an airtight surface to react to the air pressure. It is not possible to avoid this cover sagging between its points of support to a certain extent, thus spoiling the correct aerodynamic form. Also the method of attachment, usually sewing, set up excrescences on the surface the roughness of which was appreciable. Thin metal sheeting, with flush riveting, is the obvious improvement upon this, but its weight is intolerable unless it can be made to take some of the induced loads, and allow the interior structure to be correspondingly lighter.

THE development of this conception has led to the use of 'stressed skin' construction in modern machines, in which both the wings, control surfaces, and the body are formed of strong and hard sheet metal, withstanding the majority of, and in some cases all, the loading. Although the theory of the design of such structures is now becoming fairly well known, the workshop practice of building them in quantities is by no means well advanced. The adoption of these new designs has necessitated the development of new workshop technique and the design and production of new tools and equipment, which has obviously been especially difficult for those firms that are still working on the older type of construction, which is by no means obsolete or even incorrect for certain types of slower-speed machines. It is probably not unfair to say that the speed-up in aircraft production that has taken place in some countries during the last few years began too soon, and has resulted in a large equipment of machines that are already obsolescent.

Dr. Thomas Midgley

THE Perkin Medal of the American Section of the Society of Chemical Industry has this year been awarded to Dr. Thomas Midgley, who has achieved world-wide fame for his discovery of tetra-ethyl lead as an anti-knock agent. This, it should be emphasized, was no chance discovery but the result of systematic trial following a study of the periodic system, the final finding that the lead derivative would solve the problem being predicted beforehand. To-day 'ethyl' is added to seventy per cent of all the petrol used in America, and the increased horse-power thereby generated amounts to a very large figure. In a characteristic address given at the time of receiving the medal, Dr. Midgley told the story of his more recent discovery of a compound of carbon, chlorine and fluorine, $CHCl_2F$, to be used as a refrigerant, which is non-toxic and non-inflammable. Apparently he was told of the need for a new refrigerant over the telephone, and with the aid of two colleagues, the use of a chemical library and some deductions from the periodic table, arrived at the probability that the above fluorine compound might prove non-toxic and suitable. Small quantities were prepared from various samples of available starting material. The first batch was pure and proved non-toxic; in the others the raw material proved to be contaminated and gave toxic products, which, however, could be purified when this fact was realized, and became non-toxic. Three days' work sufficed to solve the problem and to give the refrigerating industry a new material which is expected will prove of outstanding importance in its development.

Gottfried Treviranus (1776–1837)

GOTTFRIED REINHOLD TREVIRANUS, the eminent physiologist, the centenary of whose death occurred on February 16, was born at Bremen on February 4, 1776. He studied medicine at Gottingen, and while an undergraduate wrote an essay on nerve power and its method of action. He qualified in 1796 with a Latin thesis on the reform of physiology, and settled in his native town where he was made professor of mathematics and medicine in 1797. The rest of his life was divided between the practice of medicine and scientific research, though the latter claimed most of his attention. His medical publications were of little significance, being chiefly concerned with the prevention of salivation in the mercurial treatment of syphilis and animal magnetism in Bremen. On the other hand, his biological work was of considerable importance, his principal publications of this kind being entitled "Biology or the Philosophy of Living for Natural Philosophers and Doctors" (6 vols., 1802–22) and "Manifestations and Laws of Organic Life" (2 vols., 1831–33). In addition to physiological research, he devoted special attention to microscopical anatomy of invertebrate animals, especially molluscs and insects. In collaboration with his brother, Ludwig Christian Treviranus, a well-known botanist and medical man of Bonn (1779–1804), he published four volumes of miscellaneous work on anatomical and physiological subjects (1816–20).

Auroral Display and Radio Disturbance

THE probable occurrence of an aurora on January 7, twenty-seven days earlier than the notable display on February 3, as recorded in last week's issue of NATURE (p. 277), is confirmed by Mr. W. N. Craig, of The Manse, Fortrose, Ross-shire. On January 7, between $16\frac{1}{2}^h$ and 19^h U.T., Mr. Craig, who was listening on the 14 Mc. amateur band, found that reception from long-distance stations in South Africa and on the west coast of America, which was good at first, suddenly deteriorated at 18^h 40^m so as to render the signals practically unintelligible by "a very rapid flutter". At 19^h 30^m, Mr. Craig, on looking outside, found that a conspicuous auroral display was in progress. An arch extending from north-east through north to west was beginning to break up into a series of streamers, and at 19^h 45^m, after an apparent increase in auroral activity, a corona formed for a few minutes a little to the north-west of the zenith. The display then decreased rapidly, but was partially renewed as a quiescent arch extending from east-north-east to west-north-west from 22^h until after $23\frac{1}{2}^h$. As mentioned in the previous note, the magnetic traces on January 7 recorded at the Greenwich magnetic station at Abinger show distinctive movements between 19^h and 20^h U.T. The extreme ranges, occurring at about 19^h 32^m, indicate a local increase in the intensity of the earth's magnetic field of about 130 γ accompanied by an easterly swing in declination of about 20′.

Science and Building Exhibition

THE Science and Building Exhibition which is to be held on March 1–25 at the Building Centre, 158 New Bond Street, London, W.1, is being arranged at the invitation of the Building Centre, by the Department of Scientific and Industrial Research. The object of the Exhibition is to illustrate the work being carried out by the various organizations controlled by the Department, or associated with it, of interest to the building industry. The exhibit provided by the Building Research Station will deal with such subjects as concrete, plastering materials, fire resistance, bituminous materials and building units for walls and roofs, an exhibit by the Fuel Research Station illustrates work on domestic heating. The Forest Products Research Laboratory is dealing with wood preservation, dry rot, resistance of timber to abrasion, timber seasoning and insect damage. Interesting exhibits are being shown by the National Physical Laboratory on illumination in buildings, acoustics and engineering investigations such as wind pressure on structures and mechanical tests on structural steels, etc. The exhibit by the Water Pollution Research Board and the Department's Chemical Research Laboratory deals with water softening, the removal of dissolved salts from water and contamination of water by lead. British marbles will be dealt with in an exhibit provided by the Geological Survey of Great Britain. The Industrial Research Council of the British Iron and Steel Federation will show models of steel-frame buildings intended for working-class flats, and the applications of foamed slag as an aggregate for lightweight concrete. An exhibit by the Non-Ferrous Metals Research Association deals with galvanizing and zinc coatings, and recent investigations on the frost-bursting of water pipes. The Cast Iron Research

Association, the Paint Research Association and the Rubber Research Association will also be represented. Lectures have also been arranged to take place at 8 p.m. on March 3, 10, 17 and 24.

Palæobiology and Biostratigraphy

DR. H. G. SCHENCK has published an exhaustive monograph of "Nuculid Bivalves of the genus *Acila*" (Geological Society of America, Special Papers No. 4; 1936). A critical descriptive catalogue of the twenty-five known species and varieties is arranged in the order of their age, from Cretaceous to Recent, and is illustrated by eighteen admirable plates which give a complete iconography of the genus. The systematic part of the work is preceded by the morphology of the shell and by an account of the anatomy, habits and habitats of the living animal. The terms 'paleobiology' and 'biostratigraphy' are used hopefully, but no radically new methods are apparent to correspond with them. Ever since palæontology has been rationally studied, its best workers have used the anatomy, the habits and habitats of living creatures to explain the debris of their precursors. The method requires caution, for some animal genera have changed their mode of life. The marine mollusc *Pholadomya*, for example, is now abyssal; in Jurassic times it lived in shallow water and, so late as the Eocene, it is found in sediments which give no indication of very deep seas. Dr. Schenck was led to this study by the problems of the Oligocene in the United States Pacific coastal areas. His results help to solve these problems, not by any *a priori* palæobiology, but by the accurate delimitation of fossil species and by showing that they are associated with distinct faunas in a sequence of strata. This is not a new method, but it is the only sound one, for all our knowledge of the succession of forms of life is from stratigraphy, which, somewhere or other, must be based upon visible superposition. Terms like 'zone', 'age', 'epoch' are discussed. Palæontologists did not invent these words, which are still current in ordinary speech, so that we can doubt the wisdom of restricting their meaning, for their common, vague sense is sure to lodge in runaway minds and cause confusion.

Investigation into Brood Diseases of Bees

IN May 1934, an investigation into the brood diseases of bees was commenced at Rothamsted Experimental Station, the British Bee-Keepers' Association undertaking to supply half the annual cost of the work (£250 per annum) and the Agricultural Research Council the remainder. As a result, Dr. H. L. A. Tarr was appointed, and has worked continuously on the problem since that time. He has confirmed the fact that American foul brood is caused by a spore-forming organism, *Bacillus larvæ*, and that its incidence is independent of the strength of the bee colony. European foul brood, on the other hand, is a disease which usually affects weak colonies of bees early in the brood-rearing season, and is probably caused by *Bacillus pluton*, a curious organism which has so far resisted all attempts made to cultivate it, in association with other organisms. He has also shown that a third condition known as addled brood is very, prevalent in Great Britain, and has constituted almost one third of the cases of brood disease sent in for examination. The Bee Research Committee at Rothamsted and the British Bee-Keepers' Association are unanimously of the opinion that the investigation should be continued, particularly in connexion with methods of treatment, but the latter have asked that Rothamsted should collect the contributions directly. The Agricultural Research Council has sanctioned an increased grant of £300 for the current year on condition that a sum of not less than £250 is collected from other sources. In the circumstances, Rothamsted Experimental Station is making an appeal for contributions from interested individuals in order that this important investigation may be continued.

Sperm Whale at the Natural History Museum

THE skeleton of the sperm whale stranded at Bridlington on January 25 has now reached the British Museum (Natural History). The animal from which the skeleton was taken was a male 59 feet in length. In the sperm whale, the male is fully grown at about 65 feet, whereas females have not been recorded exceeding 40 feet in length. The sperm whale or cachalot belongs to the division of the Cetacea known as toothed whales or Odontoceti. The Bridlington animal had thirty pairs of teeth in the lower jaw (all unfortunately removed by souvenir hunters) and three small tooth vestiges on one side of the upper jaw. The whole skeleton weighed between four and five tons, of which weight the skull accounted for more than three tons. The sperm whale is not a common animal in British waters, only about six strandings having occurred in the last twenty-five years. It prefers the warmer tropical and subtropical seas. Sperm whales stranded on British shores are almost invariably large old males, and it has been suggested that they are animals which have been driven out from the main herd by younger and more vigorous bulls. The present stranding is therefore rather remarkable. The Museum is informed by coastguards of all Cetacea stranded on the British coasts, and specimens are obtained whenever desirable and practicable. On an average, there are about sixty such strandings in the year. Stranded whales, being "Fishes Royal," are the property of the Crown, and are handed over to the Museum by the authorities concerned.

Botany in China

IN a paper presented at the annual conference of the International Faculty of Sciences, held in London on January 29–30, Prof. H. H. Hu described the progress of botanical sciences in China. Botany in China is a very modern study, having a history of only a quarter of a century, though, of course, the medicinal study of herbs in ancient China is well-known. At present, taxonomy takes pride of place, which is natural in a country so rich in botanical resources. During the past fifteen years, six institutes have been established which are carrying out important exploration work; and this has resulted in a rich harvest, including many rare specimens. Prof. Hu himself is attached to the Fan Memorial Institute of Biology which was established in 1928, and is wholly devoted to the taxonomic study of the flora and fauna of China. The botanical section carries out exploration in Yunnan, during which many new genera have been discovered. Monographic studies of ferns and flowering plant families are also being made, which are published in the bulletins of the Institute. In connexion with systematic botany in China, three botanic gardens have been established. The other branches of botany are still at the pioneer stage. Valuable work is being done on freshwater and marine algæ, mycology and morphology. We would, however, like to see further recruits to the small band of Chinese botanists studying plant physiology, ecology and genetics, in order that the whole subject may become more balanced, since all the subdivisions of the science are so interrelated that satisfactory progress in the whole is not easy without equal progress in each part.

Plastics for Use in Electrical Engineering

IN a recent paper (*J. Inst. Elec. Eng.*, Oct.), A. R. Dunton gives an account of recent advances in the technique of producing plastics. This word is now used for describing 'moulded compounds' which produce intricately shaped articles in a suitably constructed mould under the influence of heat and pressure. The accuracy obtainable by this method has aroused great interest in both mechanical and electrical engineers. There are many fabricated articles still being sold which could be replaced conveniently and economically by suitable mouldings. In Germany, many plastics are employed, and the technical specifications made ensure that they are suitable for the purpose for which they are to be used. The articles supplied are stamped with an identification mark and the maker's number. The national laboratory in Berlin has the right to take samples at any time without warning, and if the test results are not satisfactory, the maker's name is deleted from the approved list published periodically by the laboratory. The British Standard Specification was published by the B.S.I. in 1933; but unfortunately it makes no attempt to define the characteristics of arc-resisting or high-temperature materials. The performance of nearly all plastics is coupled in practice with high temperatures. A method of making rapid tests advocated by Prof. Marten of Berlin is described. It determines without difficulty the softening point of plastics. In a paper in the same issue by A. Caress, an attempt is made to classify typical plastics into those for 'hot service' and those for use at moderate temperatures. The author says that if the electrical industry will specify clearly what it requires, the plastics industry will rapidly develop suitable materials. He states that there is a very large range of new plastic materials to be discovered and examined.

Sterilized Catgut for Surgical Use

IN a Circular (No. 1563. Price 1*d.* net) and accompanying Memorandum (Memo. 199. Med. Price 2*d.* net. London: H.M. Stationery Office) issued to county, and county borough, councils, the Minister of Health directs attention to the responsibility and risk attached to the use of imperfectly sterilized, or unsterile, catgut for surgical purposes. Several groups of cases of tetanus infection have recently occurred following surgical operations in which catgut had been employed, in some of which the infection was definitely traced to the catgut. Under the Therapeutic Substances Act, 1925, and Regulations, 1931, the manufacture for sale and the importation of sterilized surgical ligatures and sutures is prohibited except under licence from the Minister of Health, and the granting of such licence is conditional upon routine testing of samples of the product for sterility, and upon control and inspection of the process of manufacture. When 'sterilized surgical catgut' is employed, the patient may be regarded as adequately safeguarded from tetanus infection, but in many hospitals 'raw' unsterile catgut is bought for use. Such catgut is not controlled under the Therapeutic Substances Act, and is 'sterilized' in the hospital itself by a process which may or may not be satisfactory. The Memorandum describes the method of preparation and of sterilization of catgut. Respecting the sterilization process, heat is sometimes employed, but needs great care, and an aqueous solution of iodine, with or without preliminary treatment with hydrogen peroxide, is efficient and widely used. Most other sterilizing agents are inefficient, or damage the gut.

Yale University Publications in Anthropology

THE second issue of collected papers in anthropology, published by Yale University (London: Oxford University Press. 11*s.* 6*d.* net) under the editorship of Dr. E. Sapir and Dr. Leslie Spier, contains six papers, of which five deal with various aspects of the ethnography of North America. Students of primitive music will welcome an attempt to produce order in a subject to which no little attention has been given in the field, but to which comparative study has still to be applied systematically. This is a regional survey of the music and musical instruments of the indigenous inhabitants of North America by Helen H. Roberts. A contribution by Mr. William Morgan on "Human Wolves among the Navahos" will be found of considerable interest to students of European witchcraft and demonology. Not only do the Navaho beliefs relating to the werwolf bear a strong resemblance to certain of the European beliefs, but also the all-pervasive Navaho belief in witchcraft suggests something of the atmosphere in which the European witchcraft superstition and consequent persecutions became rife. Mr. George P. Murdock studies "Rank and Potlatch among the Haida", providing something of a rational setting for a custom which, as usually described, is beyond the range of normal reasoning, and thereby affording a valuable object lesson for the student of social anthropology. In this connexion, however, Prof. R. C. Thurnwald's account of the profane literature of Buin, Solomon Islands, is even a more valuable pointer towards a method of gauging social values, while affording an index of change under contact with external influences. The songs which he collected, at first in 1908–9 and then in 1934, deal with topics of everyday life, and by their difference in manner and matter show unconsciously but infallibly how times have changed.

Sodium Lamps for Lighting Tennis Courts

FOR the lighting of tennis courts it is essential that there should be complete freedom from glare and that the light should have a high speed of discrimination. In *Philips Technical Review* (Eindhoven) of August last, it is pointed out that both these requirements are exceptionally well fulfilled by a lighting system employing sodium lamps. Although no satisfactory method has yet been found for making quantitative measurements of the disturbing effect produced with different types of light, experience has shown that the presence of a source of light in the field of vision is less disturbing with sodium lamps than with other lamp sources of equivalent total candle power. This is due to the comparatively low luminous intensity of sodium lamps. Several experimenters have also proved that the speed of discriminating objects is quicker with sodium light than with other types of light. The illumination of tennis courts is particularly important in regions with a tropical climate where the heat renders play during the day impossible, and where during the evening, when the atmosphere is cooler, darkness sets in very quickly. Three open-air tennis courts in the Netherlands East Indies were recently equipped with sodium lamps. Good results have been obtained with an arrangement of eight 150 watt sodium lamps arranged in two rows, containing four each, on the sides of the court and situated 20 feet above the ground.

Phenology of 1935

THE Phenological Report for 1935 by I. D. Margary (*Quart. J. Met. Soc.*, 62, No. 265) covers the period December 1934–November 1935 inclusive. That period was of unusual interest on account of two spells of exceptional weather—the very wet December of 1934, and the bitterly cold period of May 1935 when a strong flow of air from polar regions brought severe frosts and snowstorms down even to the coastal regions of the south of England. The early months of 1935 were, on the whole, mild, with the result that in most counties flowers appeared early. The wintry weather in May therefore caused damage to plants and trees on a scale that luckily can probably be seen only once or twice in an average lifetime. Insects reacted eccentrically to this topsy-turvy weather that preceded the setting in of true summer weather, and showed very variable dates for their first appearance. Migrant birds behaved likewise; the species that normally arrive early were in the south mostly much in advance of their average first appearance; those that usually arrive late, for example, the garden warbler and the spotted flycatcher, were nearly all abnormally late. The spotted flycatcher was, however, exceptionally early in reaching the northern parts of Scotland and Ireland.

Soviet Arctic Exploration

IN continuance of its plans of Arctic exploration, the Soviet Government, according to the Soviet Union Year Book Press Service, is planning to dispatch ninety-five Arctic expeditions this year. Besides new geological prospecting work, topographical surveys in high latitudes will be combined with hydrographical work in the Kara and Laptev Seas. The northern rivers will also be studied with the view of improving transport. Research is also in hand on the problem of the northward extension of agriculture. Last year's work led to the discovery of coal deposits in the Chukchee peninsula, and these are now being worked.

New Coastline of Antarctica

THE Norwegian expedition to the Antarctic under Mr. L. Christensen which aims at mapping from the air the partially known coast-line of Antarctica between long. 100° W. and 10° E. is reported by *The Times* to have discovered one of the missing stretches of the coast. Mr. Wideroe, flying from the *Thorshavn*, found land between Queen Maud Land to the east and Princess Ragnhild Land to the west in about lat. 69° 30′ S. and long. 38° E. Even more interesting than this completion of the coast-line south of the Indian Ocean was the discovery by another flight of a mountain range extending westward for at least two hundred miles from lat. 71° 30′ S. and long 26° E., with peaks rising to 6,000 ft. and 10,000 ft. This range would appear to lie in Princess Ragnhild Land and to extend into the new land. Farther east, it may be remembered that in 1930 Sir Douglas Mawson found mountain ranges in the interior of Enderby Land. In all probability, these ranges will prove to be fault ranges along the edge of the plateau of the eastern Antarctic.

Presentation to Dr. E. J. Butler, F.R.S.

FOR many years, mycologists throughout the world have reaped the benefits of the great work carried out by Dr. E. J. Butler, the first director of the Imperial Mycological Institute, Kew. Following upon his resignation, workers in all parts of Australia contributed to a presentation fund organized by Dr. W. L. Waterhouse of the University of Sydney. Acting on their behalf, the High Commissioner for the Commonwealth in London, Mr. S. M. Bruce, kindly consented to make the presentation, which took place at the Institute on February 8 in the presence of the members of the staff, most of whom had been with Dr. Butler throughout his term of office. One of the gifts was an inscribed table clock made of Australian woods.

Biological Equipment

MESSRS. GRIFFIN AND TATLOCK, LTD., Kemble Street, Kingsway, London, W.C.2, have issued a catalogue, No. 30 *K*, of biological and general apparatus and laboratory equipment for bacteriology, pathology, public health, chemistry and cognate sciences. In addition to laboratory fittings, and the ordinary chemical and physical glass-ware and apparatus and reagents, microscopes by various makers, microtomes, incubators, and blood and milk testing instruments are included. An extensive series of anatomical diagrams and models, osteological preparations, and mounted microscopic objects are also listed. Practically all laboratory requirements appear in this catalogue, which is well produced and illustrated, and strongly bound.

Sir Warren Fisher, Permanent Secretary of H.M. Treasury since 1919; Prof. R. H. Fowler, Plummer professor of applied mathematics in the University of Cambridge since 1932; Dr. W. B. Yeats, author of poetic and dramatic works, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

THE Council of the Institute of Metals has elected Dr. Harold Moore and Mr. W. Murray Morrison to the short list of fellows of the Institute, limited in number to twelve, who have "rendered eminent service to the Institute". Dr. Moore is a past-president of the Institute and director of the British Non-Ferrous Metals Research Association. Mr. W. Murray Morrison is an original member of the Institute, having assisted in its formation in 1908. He is vice-chairman and managing director of the British Aluminium Company, Ltd.

AT the annual general meeting of the Royal Astronomical Society, held on February 12, the following officers were elected: *President*, Dr. H. Spencer Jones; *Vice-Presidents*, Sir Frank Dyson, Prof. E. A. Milne, Prof. H. C. Plummer, and Prof. W. M. Smart; *Treasurer*, J. H. Reynolds; *Secretaries*, W. M. H. Greaves, and Prof. H. H. Plaskett; *Foreign Secretary*, Sir Arthur Eddington.

PROF. E. J. SALISBURY will deliver the Masters Memorial Lectures of the Royal Horticultural Society in the lecture room of the Society's New Hall in Greycoat Street, Westminster, on March 9 and March 23 at 3.30 p.m. The subject of the lectures will be "The Plant and its Water Supply".

MR. L. B. TANSLEY has been appointed assistant director of the Testing House and Laboratory of the Manchester Chamber of Commerce, Royal Exchange, Manchester. At present, Mr. Tansley is assistant to the Director of the British Cotton Industry Research Association.

THE second Conference on Industrial Physics arranged by the Institute of Physics will be held in Birmingham on March 18–20. The subject of the Conference will be "Optical Devices in Research and Industry". The president of the Institute, Prof. A. Fowler, will deliver his presidential address, entitled "Spectroscopy in Industry", on March 18. Further information can be obtained from the Secretary, Institute of Physics, 1 Lowther Gardens, Exhibition Road, South Kensington, S.W.7.

IN order to encourage original medical research, the Grocers' Company offers three scholarships, each of £300 a year, with an allowance to meet the cost of apparatus, tenable for one year but renewable for a second or third year. The next election will take place in May. Applications must be made before the end of April to the Clerk, Grocers' Hall, E.C.2, from whom further information can be obtained.

To commemorate the services of the late Sir Grafton Elliot Smith to University College, London, and to the advancement of anatomical and anthropological teaching and research, it is proposed that a bust of him should be modelled in bronze by Mr. A. H. Gerrard of the Slade School, and placed in the Thane Library of the College. Contributions towards the cost of the bust, made payable to "The Elliot Smith Memorial Fund", should be sent to Prof. J. P. Hill, University College, Gower Street, London, W.C.1.

THE Silver Jubilee Commemoration (1934) award of five guineas is granted annually by the Illuminating Engineering Society, which is open to members of the Society less than twenty-six years of age. The award may be made (1) for a suitable paper dealing with illuminating engineering, (2) the design or construction of a novel instrument or appliance for use in researches on illumination, or (3) the carrying out of any investigation beneficial to illuminating engineering. Further information can be obtained from the Secretary, Illuminating Engineering Society, 32 Victoria Street, London, S.W.1.

PROF. GEORGES BOULIGAND, professor of differential and integral calculus in the University of Poitiers, has been elected *correspondant* of the Section of Mechanics of the Paris Academy of Sciences in succession to the late Dr. Joseph Auclair.

PROF. HANS MOLISCH, vice-president of the Vienna Academy of Sciences, Dr. Julius Wagner-Jauregg, emeritus professor of psychiatry at Vienna, Dr. Hans Horst Meyer, emeritus professor of pharmacology at Vienna, Dr. Otto Loisi, professor of pharmacology at Graz, and Dr. Victor Hess, professor of experimental physics at Innsbrück, have been awarded the Austrian insignia for science and art.

A PHARMACOLOGICAL department is being organized in the Gorky Institute of Experimental Medicine at Moscow under the direction of Prof. Nikolayev to study the reactions of various medicines on the sick and healthy. Special attention will be paid to the effectiveness of traditional home remedies of various nationalities and of Eastern medicines in particular.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 332.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Cosmological Constants

THE fundamental constants of physics, such as c the velocity of light, h Planck's constant, e the charge and m mass of the electron, and so on, provide for us a set of absolute units for measurement of distance, time, mass, etc. There are, however, more of these constants than are necessary for this purpose, with the result that certain dimensionless numbers can be constructed from them. The significance of these numbers has excited much interest in recent times, and Eddington has set up a theory for calculating each of them purely deductively. Eddington's arguments are not always rigorous, and, while they give one the feeling that they are probably substantially correct in the case of the smaller numbers (the reciprocal fine-structure constant hc/e^2 and the ratio of the mass of the proton to that of the electron), the larger numbers, namely the ratio of the electric to the gravitational force between electron and proton, which is about 10^{39}, and the ratio of the mass of the universe to the mass of the proton, which is about 10^{78}, are so enormous as to make one think that some entirely different type of explanation is needed for them.

According to current cosmological theories, the universe had a beginning about 2×10^9 years ago, when all the spiral nebulæ were shot out from a small region of space, or perhaps from a point. If we express this time, 2×10^9 years, in units provided by the atomic constants, say the unit e^2/mc^3, we obtain a number about 10^{39}. This suggests that the above-mentioned large numbers are to be regarded, not as constants, but as simple functions of our present epoch, expressed in atomic units. We may take it as a general principle that all large numbers of the order 10^{39}, 10^{78} . . . turning up in general physical theory are, apart from simple numerical coefficients, just equal to t, t^2 . . . , where t is the present epoch expressed in atomic units. The simple numerical coefficients occurring here should be determinable theoretically when we have a comprehensive theory of cosmology and atomicity. In this way we avoid the need of a theory to determine numbers of the order 10^{39}.

Let us examine some of the elementary consequences of our general principle. In the first place, we see that the number of protons and neutrons in the universe must be increasing proportionally to t^2. Present-day physics, both theoretically and experimentally, provides no evidence in favour of such an increase, but is much too imperfect to be able to assert that such an increase cannot occur, as it is so small; so there is no need to condemn our theory on this account. Whether the increase is a general property of matter or occurs only in the interior of stars is a subject for future speculation.

A second consequence of our principle is that, if we adopt a scheme of units determined by atomic constants, the gravitational 'constant' must decrease with time, proportionally to t^{-1}. Let us define the gravitational power of a piece of matter to be its mass multiplied by the gravitational constant. We then have that the gravitational power of the universe, and presumably of each spiral nebula, is increasing proportionally to t. This is to some extent equivalent to Milne's cosmology[1], in which the mass remains constant and the gravitational constant increases proportionally to t. Following Milne, we may introduce a new time variable, $\tau = \log t$, and arrange for the laws of mechanics to take their usual form referred to this new time.

To understand the present theory from the point of view of general relativity, we must suppose the element of distance defined by $ds^2 = g_{\mu\nu} dx_\mu dx_\nu$ in the Riemannian geometry to be, not the same as the element of distance in terms of atomic units, but to differ from this by a certain factor. (The former corresponds to Milne's $d\tau$ and the latter to Milne's dt.) This factor must be a scalar function of position, and its gradient must determine the direction of average motion of the matter at any point.

P. A. M. DIRAC.

St. John's College,
Cambridge.
Feb. 5.

[1] Milne, *Proc Roy. Soc.*, A, 158, 324 (1937).

Gamma Rays excited by Capture of Neutrons

LEA's observations and Fermi's pioneer work has shown that many elements may capture a neutron, and emit gamma rays in the process. This phenomenon has been further investigated especially by Rasetti[1], and more recently by Kikuchi[2] and Fleischmann[3], who used polonium-beryllium, deuteron-deuterium and radon-beryllium sources respectively.

We have used radon-beryllium sources, with an experimental arrangement designed to reduce the high background effects of the Geiger counter due to the gamma rays emitted by this type of neutron source, and also to concentrate slow neutrons on the counter. As indicated in the diagram (Fig. 1), a cylindrical block of lead 18 cm. in diameter and 44 cm. in length is sunk into a thick-walled paraffin wax tube closed at the bottom. The radon-beryllium neutron source is placed on the axis of the lead block at a distance of 29 cm. from the top. The neutrons emitted are slowed down by the paraffin wax, diffuse through the lead core, and slow neutrons emerge at the top of the lead block. The efficiency of this arrangement is based on the fact that the mean free path for scattering of slow neutrons is much larger in lead than in paraffin. Gamma ray effects were measured by a thin-walled magnesium counter covered by a thick-walled lead tube and placed in the neutron stream; beta rays and secondary electrons were measured with the same counter uncovered.

The capture radiation from a thick sheet of cadmium (0·4 gm./cm.^{2}) placed below the counter produced 1,700 impulses per minute above the background; the background amounted to 440 impulses per minute with a radon-beryllium source of about 500 mc. The capture radiation of cadmium (and other strongly absorbing elements) is thus a sensitive, and in many respects a very convenient, indicator for slow neutron intensities in our arrangement.

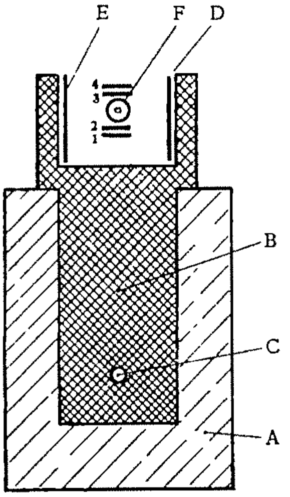

Fig. 1.

A, PARAFFIN WAX TUBE; *B*, LEAD CORE; *C*, RADON-BERYLLIUM SOURCE; *D* AND *E*, BORON SCREENS; *F*, GEIGER-MÜLLER COUNTER, 1, 2, 3, 4, POSITIONS OF THE SAMPLES.

We have used it as an indicator to determine the absorption of slow neutrons in a number of elements. A sample of the element was placed below the counter, a sheet of cadmium inserted between this sample and the counter, and the gamma ray effect measured. This, compared with the gamma ray effects obtained in the absence of the cadmium, and in the absence of the sample, gives the absorption of the sample. The results are shown in Table 1. Our values are not corrected for a slight divergence of the neutron stream, which may account for the fact that most of them are slightly above those of Dunning and Pegram[4], who used the disintegration of lithium as an indicator.

TABLE 1.

Element	Compound	gm./cm.^{2}	Per cent transmitted	Cross-section ($\times 10^{-24}$ cm.^{2})
Cl	CCl_4	1·30	34	52
Co	Co_2O_3	2·87	44	39
Rh	Rh	0·68	51	170
Ag	Ag	1·07	56	97
Cd	Cd	0·0285	50	4,500
Ir	Ir	0·61	46	410
Au	Au	3·14	37	103
Hg	HgO	0·70	50	355

Further, we have compared the gamma ray effect per captured neutron as measured by the counter for a number of strong absorbers of slow neutrons, and the results are given in Table 2. The value for cadmium is arbitrarily fixed at 100.

TABLE 2

Cl	Co	Rh	Ag	Cd	In	Sm	Gd	Ir	Au	Hg
95	86	82	75	100	94	94	94	74	80	105

The same samples of elements were used to measure both the absorption cross-section and the gamma ray effect, and the values given in column four of Table 1 were then used to compute the relative gamma ray effect per captured neutron. The value for indium includes gamma rays from the induced activity of the 54-minute period. Otherwise the figures include only gamma rays from induced activities of periods shorter than half-hour; longer periods were not appreciably excited in our experiments.

The eleven elements investigated give almost equal effects although their atomic weights range from 35 to 200.

A similar comparison of the gamma rays emitted by elements which are weak absorbers of slow neutrons would, in our opinion, require better data on the elastic scattering of such elements than is at present available. So far, with no element heavier than chlorine have we found evidence to show that the gamma ray effect is appreciably different from 'normal'.

About equal effects might be expected if each element emitted one gamma ray quantum per captured neutron, but other observations do not support this simple interpretation of our result, since they seem to indicate that a larger number of quanta are emitted from the investigated elements.

We obtained some indication of this number by comparing the number of fast electrons ejected backwards from lead by the gamma rays from cadmium which were excited by a slow neutron beam, with the number of beta rays from a very thin silver foil made radioactive by the same neutron beam. Half-value thicknesses in lead were determined for the electrons from lead and for the gamma rays from cadmium. The values obtained indicate that more than seven quanta are emitted from cadmium per captured neutron, but this result requires confirmation by an independent method which is now being attempted.

The fact that chlorine shows a 'normal' gamma ray value indicates that its intense neutron absorption is due to radiative capture that leads to a chlorine isotope of long half-life period which has not yet been detected. Samples of yttrium prepared free from gadolinium by Dr. J. K. Marsh, Old Chemistry Laboratory, Oxford, showed only very weak capture radiation and, in agreement with a measurement of Hevesy[5], a small absorbing cross-section. Thus the widespread view[6], based on earlier measurements, that yttrium has a large capture cross-section for slow neutrons and therefore must transform into an undetected radioactive isotope, does not seem to be justified. Barium also shows a much smaller capture cross-section ($< 10 \times 10^{-24}$ cm.^{2}) than given by earlier measurements[4]. In agreement with Kikuchi[2], we find that boron shows a gamma ray effect of about a twentieth of that of cadmium.

J. H. E. GRIFFITHS.
LEO SZILARD

Clarendon Laboratory,
University Museum,
Oxford.
Jan. 20.

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[1] Rasetti, *Z. Phys.*, **97**, 64 (1935)

[2] Kikuchi, Husimi and Aoki, *Proc. Phys.-Math. Soc. Japan*, **18**, 188 (1936)

[3] Fleischmann, *Z. Phys.*, **100**, 307 (1936)

[4] Dunning, Pegram, Fink and Mitchell, *Phys. Rev.*, **48**, 265 (1935).

[5] Hevesy and Levi, NATURE, **137**, 185 (1936)

[6] Cf. Feather, "Nuclear Physics", p. 183 (1936).

Resonance Levels of Neutrons in Silver Nuclei

THE resonance absorption of neutrons by silver nuclei has been studied with a photo-neutron source by Kurtschatow and Schepkin[1] and by us[2]. Continuing this work, we have now estimated the total width of the resonance levels effective for neutron capture which have their energy values lying in the continuous spectrum of the neutrons scattered in a thin paraffin layer. Using the formula of Breit and Wigner[3] for the capture cross-section as a function of energy, and making some simplifying assumptions, we can evaluate the average spacing between adjacent levels in the energy region concerned, by giving a plausible value to the width of a single level.

In our experiment, the neutron source consists of 50 mgm. of radium surrounded with 12 gm. of beryllium powder. It gives $1 \cdot 0 \times 10^4$ neutrons per second, as deduced from the work of Chadwick and Goldhaber[4]. In order to produce a continuous spectrum of neutrons, the source is surrounded with a spherical paraffin shell of 0·5 cm. thickness. Two silver detectors of 0·4 mm. thickness are used. Each is screened with cadmium, and subtends a solid angle 0·71 at the source during exposure. According to a formula of Wigner[5], the neutron-proton scattering cross-section is 11×10^{-24} cm.^{2} for neutrons of 2×10^5 volts. The total number of scattered neutrons received by the detectors is then 450 per second. By means of a Geiger-Muller counter, the number of β-rays emerging from the surfaces of the silver detectors in the saturation state is found to be 1·4 per second for the activity of half-period 22 sec. We had measured also the apparent absorption coefficient of the resonance neutrons in a thin silver absorber of 0·020 gm./cm.^{2} and get the value $12 \cdot 5 \times 10^{-22}$ cm.^{2} per silver nucleus. For the absorption coefficient of the β-rays emitted from silver, we find 10×10^{-22} cm.^{2} per silver atom.

Let us assume that the photo-neutrons consist of one homogeneous group of energy $E_0 = 2 \times 10^5$ e.v.; let n_1 be the density of the effective resonance levels per volt and 2Γ be their half-value width, assumed to be equal for all levels. Then it can be shown by a calculation which will appear elsewhere that the total half-value width summed over the effective resonance levels from zero to 2×10^5 e.v. can be evaluated from our experimental results. We find $2\Gamma n_1 E_0 = 520$ e.v. If Γ be given the value 0·1-1·0 volt[6], the average spacing between adjacent effective resonance levels is then of the order 80–800 volts. This result is in good accord with a recent theoretical estimate given by Bethe[7], namely, of the order 50–500 volts. It is also in conformity with the frequency of occurrence of the resonance groups in the low energy region.

Details of this work will be published in the *Chinese Journal of Physics*.

C. Y. CHAO.
C. Y. FU.

Physics Department,
Tsing Hua University,
Peiping.
Nov. 30.

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[2] Chao and Fu, *Tsing Hua Science Rep*., A, 3, 451 (1936)

[3] Breit and Wigner, *Phys. Rev.*, 49, 519 (1936)

[4] Chadwick and Goldhaber, *Proc. Roy. Soc.*, A, 151, 479 (1935).

[5] See Bethe and Bacher, *Rev. Mod. Phys.*, 8, 117 (1936)

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[7] Bethe, *Phys. Rev.*, 50, 332 (1936)

A New Phenomenon in the Supraconducting Transition of Tantalum and of Tin

THE transition from the supraconducting to the normal resisting state under certain conditions is found not to be continuous but to include a hitherto unsuspected spontaneous increase in resistance followed by a slower decrease. The spontaneous decrease in resistance usually proceeds for several minutes in a succession of steps, until only a fraction of its crest value remains. This crest value of the transient resistance is sometimes 75 per cent of the normal. After such an effect has occurred, it will not occur again when the same conditions are re-established, unless in the meantime the temperature has been lowered or else a time interval of at least half an hour has elapsed.

These spontaneous changes in resistance can be initiated by a step upward in temperature, in current or in magnetic field, and proceed thereafter as described above while all three external conditions are maintained constant. The combination of temperature, field and current at which this phenomenon appears has been studied and the progress of the resistance change under various conditions noted. The effect is pronounced only when the current is relatively large (about 2 amperes in the tin wire, diameter 0·022 cm.).

A more complete report of this work will appear in the March issue of the *Journal of Research of the National Bureau of Standards*.

F. B. SILSBEE.
R. B. SCOTT.
F. G. BRICKWEDDE.

National Bureau of Standards,
Washington, D.C.
Jan. 8.

Influence of Magnetic Fields on Persistent Currents in Supraconducting Single Crystals of Tin

UP to the present, the determination of the effect of a magnetic field in restoring the resistance in a metal conductor which is in the supraconducting state has depended on the direct measurement of the resistance of the conductor, and consequently it has been difficult to find the exact point at which the first traces of resistance return.

In the McLennan Laboratory at Toronto there have been in use supraconducting galvanometers[1] by means of which it is possible to measure directly, under various conditions, the value of the persistent current in a completely supraconducting circuit. With such an instrument, it is easy to find the magnetic field under which resistance begins to appear, for the smallest resistance causes rapid cessation of the persistent current. These measurements have been carried out for a cylindrical single crystal of tin, in both transverse and longitudinal external fields, at a temperature of 3·22° K. (0·5° below the normal transition point).

According to the theory of von Laue[2], F. London[3], and R. Peierls[4], the penetration of a transverse magnetic field into a cylindrical supraconductor should commence when the external field has reached one half of the critical field strength, H_c, and the body should then pass into the so-called 'intermediate state', and show resistance. In a longitudinal field, the resistance should return abruptly when the external field is equal to H_c.

In Fig. 1 the observed persistent current is plotted against the external magnetic field, in Curve I for transverse fields, and in Curve II for longitudinal fields. With a transverse magnetic field, no persistent current flows in a field greater than 41 gauss, while with a longitudinal field the limiting value is 71 gauss. The ratio of the transverse to the longitudinal field for the first appearance of resistance is therefore 0·58 instead of 1/2. This result agrees with the work of de Haas, Voogt and Jonker[5], who also found this ratio to be 0·58 in the case of direct resistance measurements. Along the descending portion *AB* of Curve I, the persistent current decreases as the external field is increased, in such a way that the relation $\frac{H}{0{\cdot}58} + H_i = H_0$ is obeyed, where $H_i = \frac{2i}{r}$ is the field at the surface of the wire due to the current itself.

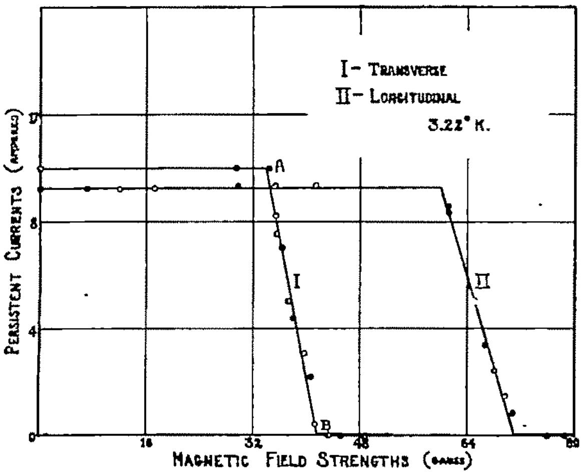

Fig. 1.

Complete results will be published shortly.

E. F. Burton.
K. C. Mann.

McLennan Laboratory,
University of Toronto.
Jan. 7.

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[2] Laue, M. von, *Phys. Z.*, **33**, 793 (1932).

[3] London, F, *Physica*, **3**, No 6 (June 1936).

[4] Peierls, R., *Proc. Roy. Soc.*, A, **155**, 886 (1936).

[5] de Haas, W J., Voogt, J., and Jonker, J. M., *Leiden Comm.*, 229c (1934).

The Sterckfontein Ape

The letter from Dr. E. Schwarz which appeared in Nature of December 5 shows, I think, the necessity for some hesitation before coming to any definite conclusion as to the affinities of *Australopithecus*. Dr. Schwarz considers it "very probable that *Australopitheous* was a pigmy gorilla"; and he has compared it with the dwarf chimpanzee of the Congo (*Pan satyrus panicus*). It is unnecessary at this stage to criticize in detail Dr. Schwarz's views, but the fact that other prominent anatomists have come to quite different opinions shows that we are not yet able finally to place it.

Dr. Adloff, who has made a special study of the dentition of *Australopithecus*, says, "Das Gebiss von *Australopithecus* ist aber rein menschlich und lässt den Schluss zu, dass *Australopithecus* kein Anthropoide, sondern ein Hominide ist". Dr. Gregory, of New York, who is probably the greatest living authority on mammalian teeth, has pointed out that of twenty-six dental characters in *Australopithecus*, not one is nearer to the chimpanzee, two are nearer to the gorilla, one is nearer to the chimpanzee and gorilla, three are common to the chimpanzee, gorilla and primitive man, and twenty are transitional to or nearer to primitive man; and he adds: "if *Australopithecus* is not literally a missing link between the older dryopithecoid group and primitive man, what conceivable combination of ape and human characters would ever be admitted as such?" Romer, of Harvard, the eminent American palæontologist who made a careful study of the Taungs ape in 1929, while not definitely deciding as to the affinities, says it is "clearly not a chimpanzee or a gorilla".

All this seems to show that *Australopithecus* is a form of considerable interest whose affinities are difficult to determine; but I think it likely that the whole question will be quite definitely settled within two years. In the meantime, I may mention that the brain of the Sterckfontein ape was considerably smaller than was at first believed. The contact of the occipital fragment has been found, and the restored brain appears to have been only about 435 c.c. It is thus an ape fairly comparable in size with the chimpanzee, but with teeth which in my opinion resemble those of man much more than they do those of any of the living anthropoids.

R. Broom.

Transvaal Museum,
Pretoria. Jan. 18.

Vitamin P

We reported in our previous notes[1] on the vitamin nature of phenyl-benzo-γ-pyrone dyes, and have described a method for the experimental demonstration of this activity. Using this method, we tested the following substances for their vitamin activity: hesperidine (m.p. 261°), an impure sample of demethylo-hesperidine (mother liquor of 'citrin') and quercitrine, 1 mgm. being given daily.

The experiment consisted of seven groups of 20 guinea pigs each. One of these groups received the basal diet only. The other groups received in addition: hesperidine, demethylo-hesperidine, quercitrine, ascorbic acid (2 mgm.), ascorbic acid plus hesperidine, ascorbic acid plus demethylo-hesperidine.

All three groups receiving ascorbic acid equally showed normal growth. The animals receiving hesperidine, or demethylo-hesperidine only, behaved in the same way as the animals of our previous experiments receiving 'citrin'. The animals receiving the basal diet only or this diet and quercitrine showed severe scurvy and died after a sharp fall in weight on about the twenty-eighth day.

These results admit of the following conclusions: experimental scurvy, as commonly known, is the symptom of a mixed C and P avitaminosis. Pure C avitaminosis can be observed, if in addition to the basal diet vitamin P is administered. The pure P avitaminosis has no clinical symptoms. If, however, vitamins C and P are simultaneously withheld, the lack of P will greatly modify the pathological condition.

There is a great difference in the activity of different phenyl-benzo-γ-pyrones. Since the only essential difference in the formula of quercitrine and hesperidine is found on the C^2 and C^3 atoms, it can be concluded that these atoms are of special importance for the activity. Changing the flavanone hesperidine into the corresponding flavonole entails inactivation.

The therapeutic effects observed after the administration of 'citrin' in man in septic conditions, also accompanied by polyarthritis and endocarditis, suggest that the age-old beneficial effect of fruit juice is partly due to its vitamin P content.

This research is being sponsored by the Josiah Macy Jr. Foundation, New York.

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Institute for Medical Chemistry
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Szeged. Dec. 23.

[1] NATURE, 138, 798 (Nov. 7, 1936)

Plant Collecting on the Pribilof and Aleutian Islands, 1936

THE Aleutian Islands stretch from the tip of the Kenai Peninsula of Alaska for 1,200 miles westwards to Kamchatka. They comprise some fifteen larger islands and hundreds of smaller ones, and owing to their inaccessibility have been very little explored botanically.

The Swedish botanist of Kamchatka, Dr. Erik Hulten, of the University of Lund, made important observations on the Aleutian isles in 1932. I visited them last summer, through the courtesy of the United States Government (to which they belong), and was also allowed to spend some days and make a botanical collection for the British Museum (Natural History) on the prohibited fur-seal islands of the Pribilofs, about 150 miles north of the Aleutians.

Unalaska village, near Dutch Harbour, was my base for botanical work in the Aleutians. I reached it from Seward, in Alaska, in mid-July by a small monthly steamer, the *Starr*. Owing to delay *en route* I was able to spend some time collecting at Seward, and two weeks on the very interesting and fertile island of Kodiak, off the Kenai Peninsula. During the eruption of Katmai in 1913, the north-east portion of Kodiak lay for long under a thick covering of ash which killed all vegetation for a year or two.

At Unalaska I collected during part of July and early August, and made a collection of about 318 specimens. The island is very fertile, vegetation growing up to the summits of many of the mountains of several thousand feet, but owing to the dense vegetation and entire lack of roads it is very difficult in summer to get far afield, as there is no means of transport. Finding the further islands quite inaccessible without the aid of the United States coastguard vessels (which were in 1936 the only ones calling there once or occasionally twice in the season), I applied to the Department of the Interior at Washington, and was granted permission to make the last trip of the season, in August (unfortunately late for botanical work) so far west as Attu, the last of the islands, on the United States Coastguard Cutter *Chelan*, which was doing hydrographic survey work in these uncharted waters. Unfortunately, landings were usually brief, but on Attu (where a precarious landing of a few hours was all that was possible owing to bad weather conditions) I was granted the help of two sailors of the *Chelan* in collecting the plants, and obtained some seventy specimens, including a few Asiatic species not gathered on the other islands. Landings of two days were made at Kiska (where some fifty to sixty species were gathered), an interesting volcanic island, now a prohibited shore to aliens as it is a U.S. naval reserve, and at Amchitka and Atka.

In all, some 2,000 specimens were gathered on the Kenai Peninsula and the Aleutians, including about 160 species from the Pribilof Islands. Many thanks are due to the personnel of the U.S.S. *Chelan* and the coastguard authorities at Unalaska for their kind assistance, and to the agent of the U.S. Government and the Bureau of Fisheries on the Pribilof Isles, for much valuable assistance in transport and collecting.

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An Amphipod, *Eucrangonyx gracilis* S. I. Smith, new to Britain

RECENT exhaustive investigations into the fauna of filtration plants, which are being conducted by the Water Examination Department of the Metropolitan Water Board, under the direction of Colonel C. H. H. Harold, have resulted in the discovery at the Lea Bridge Waterworks of *Eucrangonyx gracilis* S. I. Smith.[1] This species has been recorded only from Canada and the United States. It was collected in October and November 1936 by Mr. A. C. Gardiner, from whom I obtained the following notes on its distribution in the filters and its appearance in life. Specimens were submitted for identification to Prof. A. Schellenberg, of Berlin, to whom my thanks are due.

The majority of specimens were found in culverts below the filter beds at the Lea Bridge Works : these culverts are in complete darkness, and specimens from them were whitish in colour, though with well-developed black eyes. A few were found among weeds on the grating of the intake to these filters, together with *Asellus aquaticus* (which was also found in the subterranean culverts) and *Gammarus pulex*. These specimens were of a quite dark slaty-blue colour. It was not ascertained whether this species was present in the River Lea, from which these filter beds are supplied with water. It is even possible that it is widely distributed in England. In Canada and the United States it has been recorded from a large number of loci, chiefly in surface waters. A list of these can be found in Shoemaker[1].

Eucrangonyx can be distinguished from *Gammarus* by the absence of spines on the dorsal surface of the urosome : from *Niphargus* by the presence of well-developed black eyes and from *Crangonyx* by the presence of a small inner ramus to uropod III. *E. gracilis* can usually be distinguished in life from *Gammarus pulex* by its smaller size. Stebbing[2] gives a detailed description of this species. The only published figure of the whole animal is that of Kunkel[3], which is crude and in some respects incorrect. Various features are figured by Weckel[4], Huntsman[5] and Shoemaker[1]. Weckel's figures are inferior to those of Huntsman and Shoemaker.

G. I. CRAWFORD.
Department of Zoology,
British Museum (Natural History).
Jan. 15.

[1] Shoemaker, C. R., *Amer. Mus Novitates*, 598, 15, fig 9, *a* and *b* (1933).

[2] Stebbing, T. R. R , "Amphipoda Gammaridea" in "Das Tierreich", 21, 390 (1906)

[3] Kunkel, B. W., *Bull. Conn. State Geol. and Nat. Hist. Survey*, 26, 94, Fig. 20 (1918).

[4] Weckel, A. L., *Proc. U.S Nat. Mus* , 32, No. 1507, 32, Fig. 3 (1907).

[5] Huntsman, A. G., "Contrib. Canad. Biol. 1911–14", part 2, 152. Fig 4c (1915).

Origin of Cross-Cousin Marriage in Assam

CROSS-COUSIN marriage is widely prevalent among the primitive peoples of Assam. Of the two types, the marriage with the daughter of the mother's brother is more frequent. Different theories have been put forward by ethnologists as to the origin of this custom, but none of them seems to be tenable in Assam area.

Though most of the tribes of Assam are now patrilineal, yet an earlier stratum of matriliny should not be overlooked. Even among some of the tribes, matrilineal traits are still dominant. These matrilineal people probably came in contact with later patrilineal immigrants of superior culture, and marriages between them were frequent. During this period, the immigrant people, in order to give their sister's family better economic status, introduced the marriage of their sister's son to their own daughters. The contact in some cases led to the formation of dual groups, and there both types of cross-cousin marriage were permitted. But after a time, when the domination of the patrilineal people was complete, the avoidance of the father's sister's daughter came from the idea that father and father's sister inherited the same blood, so her daughter, who also inherited a part of the blood through her mother, was not marriageable. This idea is still common among the Chothe Kukis, Mantak Koms and other tribes of Assam. In some cases, the patrilineal dominance is so strong that, in the absence of the mother's brother, the bride-price accrues to his son, that is, the mother's brother's son will get the payment for his father's sister's daughter, as is found among the Chothes.

This rule, on the face of it, seems to be absurd, but if we go into details we can easily understand the underlying principle. In the early matrilineal stage referred to, the marriage between the children of brothers and sisters was not looked upon with favour by the earliest group as it would break the 'household exogamy'. But the later group would not observe this rule, as it would be against their interest, and they might have no reason for observing 'household exogamy'. The husband in such a group, finding property to descend matrilineally, would try to provide for his portionless sister's family by marrying his sister's son to his daughter. The wife who owns the property and observes the rules of the earlier people would not object as 'household exogamy' on her side of the family would not be violated. In this way marriage with the daughter of the mother's brother would come into vogue. But she would be opposed to her children marrying her own brother's children. Hence the other cross-cousin marriage (father's sister's daughter) would not be permissible. In some cases also, marriage with the daughter of the mother's brother would not be allowable. But if the three groups (two older and the one later) were linked up in a tri-clan system, this problem would disappear.

If later on, through the dominance of the patrilineal people of this group or other groups, the whole social and economic structure passes on to father-right, only the tradition of such preferential mating, with occasional actual marriages, would persist. This seems to be the present position in Assam.

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Dec. 31.

Annual Variation of the Critical Frequencies of the E- and F_2-Layers

THE successive accumulation of data on the critical frequencies, that is, the limiting penetrating frequencies, of the E- and F-layers determined from noon observations show the following main features[1]: the critical frequencies of the E-layer show a regular annual variation depending on the height of the sun, whereas the critical frequencies of the F_2-layer show an inverse annual variation, with high values during winter and lower values in summer. Appleton[2] has explained this as a temperature effect, the density of the air at 200–400 km. in winter being higher on account of the lower temperature. According to the simple theory of photo-ionization, the maximum electron density, that is, the critical frequency, will depend on the pressure.

From a geophysical point of view, it is difficult to understand why an annual temperature variation should be restricted to the F_2-layer alone. Studies of the variation of the auroral heights in the border region between the dark and sunlit atmosphere have shown[3] that there is a marked diurnal variation of temperature at a height of 100 km., that is, in the region of the E-layer. It is therefore probable that the annual variation of temperature in the F_2-layer also must include the E-layer.

A hypothesis explaining the dependence of the critical frequencies of the F_2-layer on, and the independence of the critical frequencies of the E-layer of, the annual temperature (and therefore, pressure) variations will be put forward in the following, based on noon observations of the critical frequencies recorded at Tromsø ($\varphi = 69 \cdot 7°$ N., $\lambda = 18 \cdot 9°$ E.) during the last two years.

The observations from Tromsø show the same inverse annual variation of the critical frequencies of the F_2-layer with high values in winter and low values in summer previously observed. During the dark period in winter, when the sun's height at noon is negative, the sun's rays when producing the dense F_2-ionization in the zenith have to enter the layer from below after first having passed once through the layer. During the same period one does not obtain E-echoes on undisturbed days. This means that the part of the solar spectrum producing the F_2-ionization is only slightly absorbed when passing through the F_2-layer, whereas the rays producing the E-ionization are completely absorbed when entering the E-layer. From this it follows that a variation in the pressure of the air in the F_2-layer will strongly influence the ion-production of the rays, as the spectral energy producing the ionization is in excess. For the E-layer, where the ionizing rays are completely absorbed when entering the layer, a variation of pressure (and therefore temperature) will be of minor importance, as the maximum ionization there will be determined by the limited energy of the ionizing rays.

Chapman[4] has developed a theory according to which there is a stratification in the ionosphere; at heights above 200 km. the oxygen molecules are dissociated and occur as atomic oxygen. There will therefore be different parts of the solar spectrum which produce the ionization in different levels, according to the different ionization potentials of the constituents. The ionization potentials of N_2, O_2 and O correspond to the bands from 766 A., 730 A. and 910 A., and according to Chapman[5] the energy available in the solar spectrum from 910 A.

for ionizing the oxygen atoms is more than a hundred times greater than the energy available for ionizing O_2 and N_2. This fits in with the point of view developed above that the energy of the part of the solar spectrum producing the F_2-ionization is in excess when passing through the layer.

LEIV HARANG.

Auroral Observatory,
Tromsø.
Jan. 1.

[1] Appleton and Naismith, *Proc Roy Soc.*, A, **150**, 635 (1935). Schafer and Goodall, *Proc. Inst. Rad Eng.*, **23**, 670 (1934). Kirby, Berkner and Stuart, *Bur Stand. J. Res.*, **12**, 15 (1934) Harang, *Gerl. Beitr Geophysik*, **48**, 438 (1936).

[2] NATURE, **136**, 52 (1035).

[3] Harang, *Terr. Mag*, **41**, 143 (1936).

[4] *Proc Roy. Soc.*, A, **131**. 353 (1931).

[5] loc. cit.

Excitation of Raman Spectra with the aid of 'Optical Catalysers'

PROSAD and Bhattacharya have reported[1] the 'optical catalysis' of the Raman effect. That this phenomenon should exist is in accordance with the theory of the Raman effect along classical lines which we have presented elsewhere[2]. Moreover, it is possible from that theory to predict the circumstances in which the catalysis should be most pronounced.

According to this theory, the emission of the Raman lines is facilitated by the close proximity of a system resonant at the frequency of the difference line or anti-resonant at that of the sum line. It is hindered by the reverse of these conditions. If the observed effect is due to such a resonance in the 'catalyser', we should expect the following experimental results: (1) The effectiveness of a particular 'catalyser' should vary with the frequency of the incident light, being a maximum for some one frequency. (2) Two substances having different infra-red frequencies should be 'catalysed' by the same added substance, provided the incident frequencies are so adjusted as to make the difference, or sum, frequencies the same for both. (3) It should be possible to find substances the addition of which reduces the Raman effect. In particular, if the effect of a 'catalyser' is found to show a maximum for a particular incident frequency, a shift of the incident frequency, such that the new sum frequency coincides with the old difference, should reduce the effect below normal.

The above considerations apply particularly to experiments at low temperatures, and the effects described might easily be masked at higher temperatures.

R. V. L. HARTLEY.

Bell Telephone Laboratories,
New York.
Jan. 11.

[1] NATURE, **138**, 510 (Sept. 19, 1936).

[2] *Bell System Tech. J*, 424 (July 1936).

Fluorescence of the Bivalent Rare Earths

IN a letter in NATURE of January 19, 1935[1], I stated that the blue fluorescence shown by fluorites is due to bivalent europium produced through reduction of traces of trivalent europium by radium rays. In the same way a yellow-green band shown by some fluorites at low temperatures can be ascribed to bivalent ytterbium. Later[2], it was shown that a red fluorescence band that had puzzled us a good deal is due to bivalent samarium.

From the investigations of G. Jantsch and W. Klemm[3], it appears that these three rare earths, europium, ytterbium and samarium, are the only ones that can be obtained definitely as bivalent ions; whilst for thulium there are at least distinct indications of the formation of traces of bivalent compounds, for the other rare earths there are scarcely any. Taking the hypothetical connexion between the formation of bivalent ions and the appearance of radio-photo-fluorescence bands as a guiding hypothesis, one might hope to get such a fluorescence also with suitable substances containing traces of thulium.

Through the courtesy of Dr. P. Hoernes, I got from the Degea (Auergesellschaft) in Berlin a sample said to contain 93 per cent Tu_2O_3, 3 per cent Yb_2O_3 and 4 per cent Cp_2O_3, for which my best thanks are due. A small amount of this substance was added to calcium sulphate (concentration 10^{-3}). After exposure to radium rays, the preparation was tested with filtered ultra-violet light. At room temperature, nothing was observed, but on lowering the temperature a red fluorescence appeared that became very brilliant at the temperature of liquid air. Calcium sulphate preparations with 10^{-3} erbium or 10^{-3} ytterbium, the neighbouring elements, showed under the same conditions a much weaker fluorescence, evidently due to inevitable traces of thulium. The maximum of the thulium band has nearly the same wavelength as that of samarium in calcium sulphate, about 620 mμ, but it is—at the same temperature—distinctly narrower and reacts quite differently towards changes of temperature, increasing in brightness with decreasing temperature, whilst the samarium band gradually disappears on nearing liquid air temperature. At the latter, the thulium band shows a structure which needs further investigation.

I have to thank Miss E. Rona for preparing the synthetic material, and Miss B. Karlik for photographing the spectra. A detailed report will be presented to the Vienna Academy of Sciences.

K. PRZIBRAM.

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Wien.
Jan. 20.

[1] See also *Wien Ber*, IIa, **144**, 141 (1935); *Z. Phys.*, **102**, 331 (1936).

[2] *Wien. Anzeiger*, Dec. 3, 1936.

[3] Jantsch, G, and Klemm, W., *Z. anorgan. Chem.*, **216**, 80 (1933).

Claims of Geology in School Courses of General Science

PROF. TRUEMAN's letter in NATURE of February 6, as to the parlous state of geology in relation to teaching in schools, leads one to inquire further into the causes of this state of things.

Considering first the cultural aspect of the question, it is abundantly clear that the purely cultural value of geology is insufficiently realized by teachers in secondary schools. This is all the more puzzling in view of the rapid hold which it exercises on the imagination when properly taught, and the extreme value of its field side to adolescents.

My experience during the last twenty years has led to the conclusion that geologists lost a valuable chance of introducing their subject into schools when they allowed geographers to seize a branch (physical geology) in the great expansion which took place in geographical studies just after the Great War.

Turning to the utilitarian side of the problem, it is found that apart from mining and oil geology, geologists as a body are little interested in applications of their science, in this respect forming a marked contrast to chemists and physicists. At the present time, the posts open to graduates in geology fall roughly into four main classes: (1) appointments with mining and oil companies; (2) geological survey posts; (3) museum posts; (4) university appointments; and it is clear that the numbers and prospects of such posts are not such as to attract an increasing number of graduates in the near future One of the chief factors militating against a change in this position is the present overweening importance attached in most quarters to the purely stratigraphical side of the science, to the exclusion of a linking up with other sciences such as chemistry, physics and engineering.

I think it is correct to state that there is not a single trained full-time geologist on the staffs of Government departments, such as the Road Research and Building Research Laboratories, and I find it difficult to believe that there is not an outlet or opportunity for a suitably trained geologist in work of that kind. I have found that the possible applications of the science in civil engineering and building problems are many, but that men who are suited to the study of these problems are not being produced by our schools of geology to-day.

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Application of the Polarographic Effect of Proteins in Cancer Diagnosis

THE investigations of E. Waldschmidt-Leitz[1] have shown that blood serum, similarly to blood itself[2], activates deactivated papain. Prof. E. Waldschmidt-Leitz[1] has also shown that normal blood serum induces in these ferments or in methylglyoxalase a greater activity than serum from carcinomatic blood. This activity is ascribed to the sulphydryl groups of the proteins of serum.

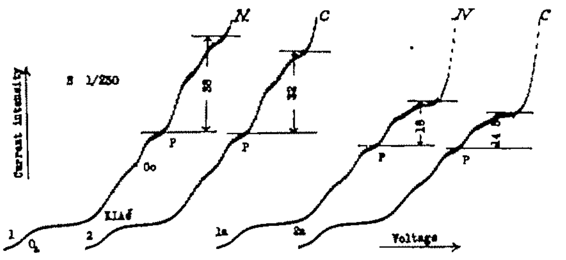

Fig 1.

CURVE 1, NORMAL SERUM, 'WAVE' *P* 38 MM. HIGH. CURVE 2, CARCINOMATIC SERUM, 'WAVE' *P* 32 MM. HIGH. BOTH SERA WERE TREATED WITH ALKALINE IODOACETATE FOR 70 MIN. CURVES 1*a* AND 2*a* WERE OBTAINED WITH THE SAME SERA AFTER 250 MIN. TREATMENT.

Some years ago, I found a sensitive polarographic protein effect, conspicuously exhibited by serum, which I explained as due to the catalytic activity of the sulphydryl groups of proteins[3]. It seemed thus important to investigate the differences between carcinomatic and normal sera polarographically, by electrolysis with the dropping mercury cathode. In this way a method has been worked out, in which the sulphydryl groups of serum proteins are acted upon by iodoacetate in alkaline solution, and after a certain time the denatured serum is subjected to the polarographic investigation. In these experiments, 0·3 c c. of serum, 0·15 c.c. of N potassium hydroxide and 0·3 c c of 0·2 N potassium mono-iodoacetate are mixed and kept at room temperature; after a certain time (about one hour) 0·1 c.c. is taken out and added to 5 c.c. of a solution consisting of 8×10^{-4} M cobalt chloride, 10^{-1} N ammonium chloride, 10^{-1} N ammonia. The polarographic curve of this solution is then recorded. The 'protein effect', consisting in the appearance of a characteristic 'wave' on the current voltage curve, is always found larger with normal serum than if in the same procedure carcinomatic serum is used (Fig. 1. Curves 1 and 2).

Another way which also leads to polarographic differences between carcinomatic and normal serum is to mix 0·3 c.c. of serum, 0·3 c.c. of water and 0·15 c.c. of N potassium hydroxide. After 5, 10 or 20 min., 0·1 c.c. of this mixture is added to 20 c.c. of the above cobalt solution, to be investigated polarographically. 67 different samples of various individuals were thus examined without knowledge of the clinical (histological) investigations, which were carried out by Prof. H. Knaus. 32 of these gave an abnormally low polarographic protein effect, and thus were reported as carcinomatic, in perfect agreement with the results of the medical examination and with the biochemical examination of Prof. Waldschmidt-Leitz.

Whilst the details of this investigation will be found elsewhere[4], it is mentioned here that the polarograms were obtained with Prof. J. Heyrovský's authentic polarograph, made by Messrs. Dr. V. and J. Nojedlý, Prague. A simple 'micropolarograph' suitable for medical routine work of this sort of research is under construction.

R. BRDIČKA.

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Jan. 17.

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[1] Waldschmidt-Leitz, E., Conrath, O., and Gloeditsch, J., *Naturwiss* [Jan. 22]. Waldschmidt-Leitz, E., *Z. Angew. Chem.* (in the press).

[2] Purr, A., and Russel, M., *Z. physiol. Chem*, **228**, 198 (1934).

[3] Brdička, R., *Collection*, **5**, 112, 238 (1933).

[4] Brdička, R., *Rozpr. Čes. Akad.*, II tř (in the press). *Bull. intern. de l'Académie des Sciences de Bohême* (in the press).

Time Lag in the Vacuum Photo-Cell

IN a recent letter[1] Dr. R. A. Houstoun treats equally as vacuum photo-cells the *KMV*6 and the *KV*6, both of which are made in these laboratories. The *KMV*6 is highly evacuated, but the *KV*6 always contains an appreciable quantity of hydrogen evolved from the sensitized potassium; it should not be regarded as a true vacuum cell.

No experiments made in these laboratories throw any light on the question whether the difference between the two cells discovered by Dr. Houstoun is actually due to this difference in gas content. My object is merely to point out that this possibility should not be excluded from consideration.

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[1] NATURE, **139**, 29 (Jan. 2, 1937).

Genetics in Madrid

DURING a recent visit to Madrid for another purpose, I was able to visit some of my colleagues there, and was delighted to find that research work in genetics was continuing. Prof. I. de Zulueta, in the intervals of hiding the more precious contents of the biological museum in cellars, was continuing his work on the polymorphic beetle *Phytodecta variabilis*. Prof. Galan, of Salamanca, was very appropriately breeding the 'explosive cucumber', *Ecballium elaterium*. This plant is hermaphrodite in one half of Spain, diœcious in the other. Crosses between a diœcious plant and hermaphrodites from different areas seemed to reveal the existence of 'strong' and 'weak' local races, differing, like those of *Lymantria*, in respect of sex-determining factors.

Our discussion of these topics was interrupted by an air raid considerably more severe than any of those on London in 1914–18. However, no bombs fell very near us, and at the time I left, the Museo de Ciencias had not yet shared the fate of the University City, the Prado and the Museum of Anthropology. I think that the persistence of de Zulueta and Galan under conditions which are, to say the least, uncongenial for research, deserves to be recorded, and augurs well for the future of biology in Spain.

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Neutrino Theory of Light

PROF. V. FOCK[1] has stated recently in these columns that he has found that the photon operator defined in the Jordan neutrino theory of light is commutable with its conjugate, and has thus claimed an inconsistency in the theory. It may be remarked that Fock's arguments in this connexion are not quite clear. Indeed, if we follow the notation in his note, we get:

$$\sqrt{|\nu\nu'|}\,(b_\nu b_{\nu'} - b_{\nu'} b_\nu) = \int_{-\infty}^{\infty} (\gamma_\alpha{}^\dagger \gamma_{\alpha+\nu+\nu'} - \gamma_\alpha{}^\dagger{}_{+\nu'} \gamma_{\alpha+\nu})\, d\alpha \quad . \quad . \quad . \quad (1)$$

It must not be thought that (1) is zero just because it can be split up into two integrals and the second integral can be transformed to the first by changing α to $\alpha + \nu'$ in it. The splitting of the integral appears to be not justified; when $\nu + \nu'$ is zero, each of the split integrals is divergent, for each of them represents the number of particles both in the positive states and the negative states. This is in fact the argument which implies $\infty - \infty$.

A careful application of the convergence criteria regarding the finiteness of the number of particles in the positive states and the number of holes in the negative states, presented in a report by Prof. Max Born and myself[2], will lead to the result that (1) has the value ν if b_ν and $b_{\nu'}$ are conjugate, and has the value zero if it is otherwise. Jordan[3] has also deduced this result by writing the photon operator in a form that does not involve negative indices.

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[1] NATURE, 138, 1011 (1936).

[2] *Proc. Ind. Acad. Sci.*, 3, 318 (1936).

[3] *Z. Phys.*, 99, 109 (1936).

Breeding Tests and Variations

IN NATURE of January 30, p. 197, Prof. T. F. Dreyer draws certain sweeping conclusions as to genetics and its limitations, from an experiment in which he produced visible abnormality and constitutional defect in 11 locusts by means of environmental treatment during development. He did not breed even an $F1$ generation.

Prof. Dreyer naïvely remarks that the abnormalities "remind one strongly of similarly localized (and similarly produced ?) abnormalities in *Drosophila*, and we may legitimately assume the abnormality will be hereditary".

Such a statement, in the present state of biology, can only rest on unfamiliarity with the facts. For it is a commonplace of genetics that only breeding tests can distinguish between hereditary and non-hereditary variation; and numerous workers, notably Goldschmidt, have directed attention to the frequent phenomenon of the complete identity of visible effect, in *Drosophila* and other organisms, of mutations due to genetic change and modifications due to environmental change and not inherited.

Prof. Dreyer's conclusions are thus founded on an elementary but basic methodological error.

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Activity of Corticosteron in the Glucose Test in Rats

EIGHT days after extirpation of both adrenals, adult rats die in about 5 hours if fed with 2·5 gm. glucose (5 c.c. of 50 per cent solution)[1]. This test can be used to titrate adrenal cortical hormone both quickly and accurately.

By this method, the great activity of corticosteron, the active crystalline fraction of cortical extracts, can be clearly shown[2]. If 0·2 mgm. or more of corticosteron be injected subcutaneously one hour before the glucose is given, the adrenalectomized rats remain alive. With doses of 0·1–0·15 mgm., about 50 per cent of the rats lived, and with 0·05 mgm. or less all the rats died in 3–6 hours (with severe diarrhœa, as in the case of the uninjected rats). The active dose of corticosteron in this test is 0·2 mgm. (per rat of 150 gm.).

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University, F. VERZÁR.
Basel. L. LASZT.

[1] Verzár, F., and Laszt, L., NATURE, 138, 844 (Nov. 14, 1936).

[2] Fremery, Laqueur, Rechstein, *et al*, NATURE, 139, 26 (Jan 2, 1937).

Scientific Worthies and Events commemorated on Postage Stamps

SOME time ago[1], reference was made in these pages to the fact that Ecuador had celebrated the centenary of Darwin's visit on September 16, 1835, by a special issue of postage stamps. These are not the first stamps of scientific interest. In 1923 France issued stamps bearing the head of Louis Pasteur, in 1927 Berthollet and later Pilâtre de Rozier. Louis Blériot and his pioneer flight across the Channel were commemorated in 1934. A recent issue also shows Pasteur at work.

Other countries, too, have issued stamps commemorative of scientific events or famous men of science. In Germany, last year, there appeared stamps showing portraits of Otto Von Guericke, Daimler and Benz; Italy has Volta, and a stamp which shows a portrait of Galvani, commemorating the Radio-Biology Congress in 1934; the United States a stamp issued in 1929 showing Edison's electric lamp. Special stamps were issued in Germany for the mails carried on the Graf Zeppelin's flight to Spain-Brazil-America in 1930, and again in 1936 on the flight to North America.

Mendeléeff appears on a stamp of the U.S.S.R., which also celebrated the bicentenary of the Academy of Sciences by a special issue in 1925. Hungary has two stamps for the tercentenary of the University of Sciences, whilst Yugoslavia remembers Nikola Tesla. So recently as last December, a set of Austrian stamps was issued showing six inventors—Weisbach, Schrauben, Von Ghega, Werndl, Lieben and Kaplan.

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[1] NATURE, 138, 15 (July 4, 1936).

Points from Foregoing Letters

By expressing the age of the universe as derived from cosmological theories (2×10^9 years) in units provided by the atomic constants (e^2/mc^3), Prof. P. A. M. Dirac obtains a number comparable with the ratio of the electric to the gravitational force between the electron and the proton (10^{39}). He suggests that this ratio, and also that between the mass of the universe and the mass of the proton (10^{78}) are functions of the age of the universe. This leads him to the supposition that the amount of matter in the universe is constantly increasing while the gravitational 'constant' decreases. He introduces a new time variable ($\tau = \log t$) similar to Milne's distinction between 'dynamic' time as measured by pendulums, etc., and 'kinematic' time measured by radioactive and atomic phenomena.

A method is described by J. H. E. Griffiths and Dr. Leo Szilard for observing the capture radiation emitted by slow neutron absorbers. Using the capture radiation of cadmium as an indicator of the neutron intensity, the absorbing cross-section for slow neutrons is determined for a number of elements. The effect on the Geiger counter of the capture radiation from the eleven strongest slow neutron absorbers is observed. Though the atomic weight of these elements varies from 35 to 200, the effect per captured neutron is about the same for all of them. The number of quanta emitted per captured neutron is estimated for cadmium.

From the number and absorption coefficient of the 'resonance' neutrons and of the electrons which they liberate in a silver detector, C. Y. Chao and C. Y. Fu have estimated at 80–800 volts the average spacing between adjacent resonant levels effective for neutron capture.

A spontaneous increase in the resistance of supraconducting tin and tantalum, followed by a slower decrease, has been observed by Dr. F. B. Silsbee, R. B. Scott and Dr. F. G. Brickwedde, when the current is relatively high (about 2 amperes in a tin wire, diameter 0·0222 cm.).

By measuring the value of the persistent current in a single crystal of tin, by means of a supraconducting galvanometer, Prof. E. F. Burton and K. C. Mann show that the magnetic field necessary to initiate the restoration of resistance when the field is transverse is 0·58 of the value for longitudinal fields.

Commenting on the uncertainty concerning the affinities of the Sterckfontein ape, Dr. R. Broom mentions that the contact of the occipital fragment has now been found. The restored brain appears to be fairly comparable in size with that of the chimpanzee, but the teeth "resemble those of man".

A. Bentsáth, St. Rusznyák and Prof. A. Szent-Györgyi report that hesperidin and also the mother liquor of 'citrin' show properties which have been ascribed to vitamin P; quercitin, though nearly related in constitution to hesperidin, has no vitamin P activity. (The absence of vitamin P does not in itself affect the animals, but modifies the pathological condition produced by the lack of vitamin C.)

G. I. Crawford records the presence of *Eucrangonyx gracilis* S. I. Smith from the Lea Bridge Works of the Metropolitan Water Board. This amphipod has been previously found only in Canada and the United States.

The reasons why certain types of cross-cousin marriage are favoured and other types are not allowed in Assam is ascribed by Prof. J. K. Bose to economic factors arising during the intermingling of patrilineal and matrilineal clans.

L. Harang explains the regular annual variation of the critical frequencies of the E-layer and the inverse annual variation of the F_2-layer as due to different absorption of the solar radiation producing ionization in the layer. In the F_2-layer the ionizing agency is only slightly absorbed when passing through the layer; a variation of pressure will therefore strongly influence the production of ions. In the E-layer the ionizing rays are completely absorbed and the maximum electron production is fixed by the limited spectral energy and is independent of pressure variations.

Assuming that a connexion exists between the bivalent ions of the rare earths and the radio-photofluorescence bands, Prof. K. Przibram has tested calcium sulphate containing 10^{-3} thulium after exposure to radium rays with ultra-violet light, and has obtained actually a brilliant red fluorescence at low temperatures.

A criticism of the excessive attention paid to the stratigraphical side in the teaching of geology, at the expense of the chemical, physical and engineering aspects, a knowledge of which would be valuable in building and road research, is made by Dr. B. H. Knight.

The behaviour of serum of a number of cancer patients has been compared by Dr. R. Brdička with the behaviour of 'normal' serum, in its effect upon the current-voltage curve of a dropping mercury cathode, after suitable treatment devised to bring about the 'protein effect'.

Research Items

Buddhism in China

A CLUE to the essential quality, often miscalled materialism, in Chinese culture is afforded in a lecture by Prof. Hu Shih, of Peiping, on "Chinese Culture before and after Indianization", which was delivered on September 11, 1936, at the Harvard Tercentenary Conference on Arts and Sciences (*Science and Culture*, Calcutta, 2, 6). As was then pointed out, the Indianization of China affords material for the study of cultural borrowing on a grand scale such as is without comparable parallel anywhere, except perhaps in the Christianization of Europe. The contrasting elements in the culture of China and India stressed by Prof. Hu Shih were the factual outlook of early Chinese religion, a religion of a hard-working and plain-thinking people, and the imaginative and speculative elements in Buddhism, in which Chinese thought, as it became more sophisticated, found a much-needed and long-sought outlet. The rapid spread of Buddhism in the Yangtze valley suggests, it was maintained, that Buddhism had made considerable advances among the people at large, and especially the lowly, long before it was adopted officially in A.D. 68; while the readiness and completeness with which it was assimilated is shown by the fact that the great persecutions of Buddhism, of which the first took place in A.D. 446 and the last in A.D. 955, were none of them of lasting effect. At the same time, in adopting Buddhist concepts of divinity, the Chinese mentality did not fail to mould them to its own categories and needs. The god Avolokita, for example, changed his sex and became the goddess of mercy, while Maitreya becomes the familiar figure of a jovial monk. Nevertheless, the spread of Buddhism in China is not the least remarkable event in the history of that religion, for, as Prof. Hu Shih pointed out, there was an essential opposition in the two modes of thought, as is shown, for example, in the institution of monasticism, which made such great inroads on the population and wealth of China, though entirely opposed to Chinese economic ideas, while asceticism and disregard of family ties contradicted the whole of China's conception of the family and the obligations of, and to, posterity.

Dominance of Genes in Man

IN a paper on the problem of dominance in man (*J. Genetics*, 33, No. 3), Dr. S. G. Levit has made a careful study of a number of pathological genes in man, and concludes that a large majority are 'conditionally dominant', showing weak penetrance and hence frequently skipping a generation. Thirty-eight genes are classed in this category against 14 recessives and 3 indeterminates. It is recognized that some of the recessives, such as epilepsy and schizophrenia, are not always expressed even in the homozygous condition. The 'indeterminates' are sex-linked genes, which are limited to the male sex so that it is impossible to distinguish them as dominant or recessive. Hæmophilia and night-blindness, usually classed as male sex-linked, are placed here, while colour-blindness, another sex-linked condition, is regarded as intermediate, since female heterozygotes have recently been shown to exhibit a partial expression of the condition. It is pointed out that genes which are conditionally dominant in the heterozygote tend to express themselves at a late age, while genes which are recessive (in the homozygote) tend to appear earlier. The evolution of dominance is discussed, and it is concluded that, as natural selection has played a decreasing role in civilized man, the mutant genes of more recent origin have retained some of their original dominance while the less numerous recessive genes are older in origin. This encounters the difficulty that many genes may be expected to have occurred repeatedly at different periods.

Yolk of the Egg of Salmon

THE egg of the salmon, *Salmo salar*, contains a large quantity of yolk, and F. R. Hayes and D. M. Ross (*Proc. Roy. Soc.*, B, Dec. 1936) have studied the manner in which this is utilized during development. During this process fat is used up (burnt) and stored in the embryo, and the total of these two amounts is defined as the fat absorbed by the embryo from the yolk. The rate at which these processes take place is estimated by taking samples of a hundred eggs at a time at various intervals from a few hours after fertilization until the absorption of the yolk sac, and the results are given in graphical form. These curves are compared with the well-known curves for the chick, and when the necessary corrections for the difference in time are made, the resulting curves show considerable similarity. Thus it appears probable that the sequence of energy sources, that is, carbohydrate-protein-fat, is the same in these two widely differing forms.

Metopa Grœnlandica in a Lamellibranch

K. STEPHENSEN and G. Thorson describe an interesting case of commensalism (*Meddelelser om Grønland*, 118. No. 4. 1936). *Metopa grœnlandica* has been recorded from inside ascidians both in north and west Greenland and in the Mount Desert region, Maine, U.S.A., whilst other species of the genus were found in *Actiloba* and in association with the medusoid *Phialidium* from Millport, Scotland; but apparently this is the first time it has been seen in a bivalve (*Pandora glacialis*). This bivalve is a high arctic circumpolar species, the southern limits of which are east Canada and the Murman coast, but it does not occur in west Greenland and Iceland. Its mantle lobes are united almost entirely, and are only free at the anterior end to allow the foot to pass out. Thus the habitat must be a natural one for the *Metopa*, although peculiar and with little available space as the shell has one valve quite flat and the other only slightly convex. The *Metopa* adheres to the gills of the mollusc by sticking its antennæ between the lamellæ, or it lies free, back downwards, head pointing towards the caudal end of the host. Quite young specimens of the amphipods and also adults were found, which probably indicates that breeding takes place within the mantle cavity of the shell. Out of twenty-three *Pandora*, eight contained *Metopa*.

Effects of Cyclone on Coral Reef

In the Reports of the Great Barrier Reef Committee, vol. IV, Part II, 1936, Mr. F. W. Moorhouse records the effects of a cyclone in 1934 on Low Isles, North Queensland. This was the island on which the Great Barrier Reef Expedition had its headquarters in 1928–29. At that time, the island and reef were surveyed in great detail and Mr. Moorhouse, who was himself a member of the expedition, has been able to give valuable information on the destructive effects of the cyclone and the changes that it wrought in the formation of the reef. The effects of lowering of the waters of the moats on the perforate coral *Porites* are dealt with in some detail. The polyps of the newly exposed zones of the coral appear to become stimulated and an increase in lime deposition follows. This deposition takes the form of sharp pointed spines. As a result of the constant expansion and retraction of the polyps over these spines, the tissue becomes penetrated and the spines are exposed to the exterior. The bared spines become settling points for filamentous algæ. As the algal growth increases, sediment is held by it, which can no longer be removed by the polyps. As a result they become smothered. The whole process takes several months.

Cytology of *Agave*

The century plants of the genus *Agave* include *A. sisalana* and various other species native to Mexico and Central America but now widely grown in the eastern tropics as a source of fibre. In connexion with breeding experiments at the Amani Agricultural Research Station in Tanganyika, Mr. L. R. Doughty has examined the chromosomes of various species (*J. Gen.*, 33, No. 3). He finds that *A. amaniensis*, a new species of unknown origin found growing in the plantations, is diploid, having $2n=60$ chromosomes, 10 long and 50 short. In addition to two other diploid species, *A. cantala* is found to be triploid, *A. Zapupe* tetraploid, *A. fourcroydes* and *A. sisalana* approximately pentaploid ($2n = c.\ 140$). That these species are autopolyploids is shown by the behaviour of the chromosomes, which frequently form trivalents, quadrivalents and pentavalents in meiosis. The species are of limited natural distribution and nearly related. Breeding experiments indicate that they are heterozygous. The diploid species will cross with one another and with polyploid species. The diploid species fail to set fruits at Amani, and even with artificial pollination the setting of seed is low. *A. sisalana* becomes partially fertile under certain conditions which appear to be connected with the formation of the abscission layer at the base of the ovary.

Phytopathology in India

A section of "Biochemical and Allied Research in India, 1935" (pp. 100–112) summarizes the investigations into Indian plant diseases during 1935 and previous years. A reprint of the section has been received from the author, Dr. B. B. Mundkur, and shows a gratifying amount of research work in progress. Cereal diseases are mainly represented by the smuts and *Helminthosporium* troubles. A new disease of gram (*Cicer arietinum*), caused by a species of *Mystosporium*, was reported by Mitra during the year, and a new virus disease of til (*Sesamum indicum*) made its appearance (Pal and Nath). The immunity of Indo-American strains of cotton to the Indian strain of the fungus *Fusarium vasinfectum* has been compared with the susceptibility of Indian cottons. Diseases of the sugar-cane, of fruit trees, and other crops, are further considered. Dr. Mundkur has also two recent articles in the *Indian Journal of Science*, on the "Systematic Position of the Smut causing Malformation of *Vitis quadrangularis*" (6, Pt. 3; June 1936) and "A Rhizoctonia on Sweet Potatoes in Bombay" (6, Pt. 4; Aug. 1936).

The Geological Time Scale

Following up his important work on the determination of the age of the Keweenawan basalts (510–560 million years) by the helium method, W. D. Urry has now applied the latter to small groups of basic igneous rocks representative of many of the geological horizons above the Keweenawan (*Bull. Geol. Soc Amer.*, 47, 1217). The results include the following:

		Millions of years
Pliocene	Basalt, Steens Mt., Oregon	13 ± 1
Miocene	Basalt, Douglas Creek, Washington	17 ± 1·5
Oligocene	Basalt, Lower Silesia, Germany	36 ± 2
Early Cretaceous	Little Hatchet Mts., N. Mexico	85 ± 3
	Dykes cutting the Nevadan Granodiorite	90 ± 4 110 ± 7
Late Jurassic	Nevadan Granodiorite	110 ± 5
Triassic	Palisade Sill, New Jersey	165 ± 8
	West Rock Sill, New Haven, Conn	170 ± 12
	First Flow, Watchung Mt., N Jersey	180 ± 11
Permian	Basalt, Brighton, Mass	230 ± 15
Devonian	Newbury volcanic rock, Mass.	300 ± 10
Ordovician	Diabase in Martinsburg Shales, Pa.	355 ± 15 375 ± 15
Cambrian	Basalt, Unicoi formation, Tenn.	440 ± 30 465 ± 30

Brief descriptions are given of the analysed specimens, and it is shown that the ages found are consistent with those obtained from strongly radioactive minerals by the lead method.

Nature of Atmospherics

E. V. Appleton and F. W. Chapman (*Proc. Roy. Soc.*, A, 158, 1) have published the latest stage of their investigation of atmospherics, which appears to mark a distinct advance in the study of atmospherics and of thunderstorms. An aperiodic elevated aerial was used as in the classical experiments of C. T. R. Wilson, but the potential changes were recorded by a cathode ray tube with a screen which gave a persistent image. This was photographed automatically, the camera shutter being itself tripped by the transient discharge. As is to be expected, the field change produced by a lightning flash nearby is mainly due to the electrostatic effect of the change in charge distribution, while the field at a great distance is that due to electromagnetic radiation. This results in a progressive change in the wave form of the atmospheric at increasing distance from the source. The picture obtained from a near discharge shows a change of field taking place usually in a series of steps, as may be expected from moving-plate photographs of lightning flashes. The first part of the discharge is often comparatively slow, corresponding to the 'leader stroke' of the flash photographs. During the period of maximum current, there are often superposed pulsations with quasi-periods down to 10 micro-seconds. The atmospherics observed at great distances commonly show several quasi-periodic half-cycles, and sometimes a tail with much slower cycles. These changes in shape as the disturbance is propagated are possibly caused by dispersion in the ionosphere.

Automatic Regulation of the Temperature of a Room

PERHAPS the most difficult problem in connexion with the automatic control of the temperature of a room is to find the most suitable spot at which to fix the thermostat. In an article in the *Electrical Contractor and Retailer* of January, it is stated that the British Thermostat Co., Ltd., has been able to show that for the vertical walls of the room there is a cushion of air extending about 1¼ in. from the wall surface in which, owing to the existence of convection currents and other causes, the temperature varies considerably. Further, owing to heat exchange between the outside and inside of a wall, its temperature is continually changing. To avoid these sources of error, the British Thermostat Co. has recently introduced a new design of room thermostat. The main features of the design are, first, that the sensitive element is spaced sufficiently far from the wall to avoid the abnormally heated air cushion; and secondly that the contact area between the back-plate and the wall is small and the conductive heat path between the back-plate and the main body of the instrument 'housing' is at the top of the instrument, so that conducted heat, already reduced to a minimum, has little effect on the sensitive element. The thermostat is contained in a vertical bakelite tube open at the top and bottom to permit free circulation of air, and thus assists rapid operation. The instrument has an adjustable setting scale, the standard range being from 45° to 75° F., and operates on a differential of 3° F. If required, a locking device can be fitted to the setting scale so as to prevent unauthorized interference.

Iron-Nickel Alloys of High Permeability

IN a paper read by W. F. Randall before the Institution of Electrical Engineers on January 8, a most interesting summary is given of the metallurgy and magnetic properties of the remarkable group of iron-nickel alloys of high permeability. Difficulties experienced with the first 'permalloy' containing 78·5 per cent of nickel have led to its substitution by iron-nickel alloys containing other metals, and in this paper the copper alloy known as 'Mumetal' is specifically considered. Details of the manufacture of the strip and of its practical heat treatment are given, together with a fairly detailed treatment of the factors which determine its magnetic characteristics. The paper ends with a short account of the testing methods employed and of the practical applications of this material for loading cables, for the cores of instrument transformers, transformers and chokes for radio apparatus, magnetic screening, magnetic relays and the armatures for moving-iron instruments.

Solubilities in Deuterium Water

PUBLISHED measurements of solubilities of salts in deuterium water have been limited to a few determinations near room temperature. R. W. Shearman and A. W. C. Menzies (*J. Amer. Chem. Soc.*, 59, 185; 1937) have now measured the solubility of potassium chloride in 98·2 per cent deuterium water from 0° to 180°, the total weight of deuterium water used being 1·39 gm. By comparing the solubilities with those in ordinary water, a short linear extrapolation gave the solubility in pure deuterium water. The solubility was lower than in ordinary water, but increased faster with temperature. From about 60° to 180° the solubility difference is approximately a linear function of temperature; the more rapid increase with temperature below 60° may be connected with changes of the average configurations in liquid water. The authors emphasize that, contrary to a prevalent belief, deuterium water is not always a poorer solvent for salts than ordinary water (cf. NATURE, 138, 121; 1936).

Inorganic Chromatographic Analysis

THE adsorption method of analysis known as chromatography, which has been used with such marked success in the investigation of the carotenoid field of organic chemistry, and in the examination of many other complicated organic molecules, has now been applied by Schwab and Jockers (*Naturwiss.*, 25, 44; 1937) to the problem of the separation of inorganic cations. The method depends upon the fact that the different cations are adsorbed to different extents by aluminium oxide. The solution containing the cations to be separated is poured over a column of alumina. As it runs through, the cations are adsorbed at different positions in the column. The column is then washed and 'developed' by passing through it a reagent, usually ammonium sulphide, which forms coloured compounds with the adsorbed cations. Coloured rings are thus produced in different parts of the column, by means of which the different cations present in the mixture can be detected. From neutral aqueous solutions of nitrates of the metals the cations are adsorbed by alumina in the following series: antimony, bismuth, chromium, ferric, uranyl, lead, mercuric, cupric, silver, zinc, cobalt, cadmium, nickel and manganese. In some parts of the series, however, the adsorption rings are very close, and separation is difficult. Hydrogen ions are themselves adsorbed rather more strongly than most cations. The adsorption series is different when solutions of the cations in ammonia or alkaline tartrate solutions are used. A practical use of the method lies in the detection of traces of elements lying high up in the adsorption series in those adsorbed further down. Thus, a trace of iron in copper or cobalt solutions, or a trace of copper in cadmium or cobalt solutions, is readily detected.

The Stellar Problem of Three Bodies

PROF. E. W. BROWN has recently published two papers on this subject (*Mon. Not. Roy. Astro. Soc.*, 97, 1; November 1936). He limits the solution to those terms which may be capable of being detected by observation at present and in the immediate future. In the first paper, "Application of Satellite Theory", where he shows how a literal satellite theory could be adapted to the stellar problem, the results are useful only when the eccentricities and inclinations are small. This restriction is removed in the second paper, "The Equations of Motion With a Simplified Solution", where nearly all eccentricities and inclinations can be included. In both cases, however, there is one important limitation; no periodic term which has the square or products of the ratio of the periods and that of the mean distances as a factor of its coefficient can be detected by observation. After dealing with the satellite problem a simple rule for deducing the stellar problem is given, and it is shown that this rule holds good for the second, and hence for all higher approximations.

Optical Lenses moulded from Plastic Material

An interesting exhibition of optical lenses moulded from plastic materials was held on February 9 at the Waldorf Hotel, London, under the auspices of the Combined Optical Industries, Ltd. Those responsible for the production of the material and for the process of moulding it are Mr. A. Kingston, the inventor, and Mr. Peter Koch de Gooreynd, chairman of the company, who has been associated with the development of the process.

It is claimed that this invention, which is British in origin and development, offers an opportunity for the increase of an industry in which Great Britain has hitherto taken a comparatively small share. The optical medium is produced from various plastic and transparent materials of a resinous character. It is originally prepared in sheets, which are guillotined into strips and then into small squares. These are subjected to a special treatment in which compression and the maintenance of temperatures of varying degrees play an essential part. The refracting surfaces are produced by moulding, and lenses polished and ready for mounting are delivered from specially designed machines. The long and difficult process of grinding at present necessary in the manufacture of optical systems is thus avoided, and it is evident that the cost of the production of the essential parts of optical instruments can be very greatly reduced.

The lenses shown at the exhibition were made of a particular form of the plastic material known by the trade name of 'Perspex'. It is a substance of high transparency, very light, being about half the density of glass, and practically unbreakable. It is possible to throw one of the lenses with great force on to a marble table without damaging the surfaces so far as can be seen by eye. It appears that the material can recover from a considerable degree of strain without apparent permanent set.

The refractive index of the material has been determined by the method of apparent depth and was found to be approximately the same as that of crown glass. It is extremely transparent in the ultra-violet region extending to 2700 A. but is more absorbent in the infra-red.

These properties of the material suffice to show that it has the right to be regarded as a valuable optical medium, which may well exercise a revolutionary influence in the optical industry. Cameras, spectacles, range-finders and similar apparatus can be produced more quickly and cheaply and in a more robust form in this material than in glass. A striking exhibit was a photograph enlarged about twenty times showing excellent detail. Small opera glasses exhibited very little colour effect, although it is true that the magnification was not more than three diameters.

Certain questions naturally arise as to the possibility of the development for the manufacture of accurate scientific apparatus, where it is essential to eliminate the effects of aberrations. It appears that a number of different kinds of plastic materials is available, and, if they can be produced with the right dispersive powers and refractive indices, there is obviously a great future for the material in the field of research.

It appears that surfaces can be silvered. Can they be produced optically flat, and is the medium so optically perfect that it can form a Lummer plate ? We do not know if information on such points is available yet, but enough was shown at the exhibition to supply convincing proof that, in the wide and extending field where optical instruments come into contact with modern life, this medium will play an important role.

The British Electrical and Allied Industries Research Association

The sixteenth annual report, covering the period from October 1935 to September 1936, of the British Electrical and Allied Industries Research Association, now usually called E.R.A., has been published. It shows that its research work is rapidly increasing in magnitude and importance. When the formation of research associations in Great Britain was first considered some twenty years ago, their value to industry was considered highly problematical by many. This distrust is now completely dispelled. It can be proved that their work has resulted in the saving of millions of pounds every year to the consumers. In the electrical industry alone it has resulted in a great increase in the continuity of the supply and the length of life of the cables and the efficiency of the lamps.

Knowledge cannot be gained without expense. The funds contributed by the manufacturers and the equal contributions from the Government are converted into 'knowledge stock' which the chairman of the council of E.R.A. calls a priceless national asset which repays the investor by ever increasing dividends of prosperity and progress. There are 450 voluntary workers, some of them well-known experts, serving on the various committees of E.R.A. The electrical industry is one of the best organized in the country and now fully recognizes the commercial value of research. Within its present field there are many problems still to be solved by E.R.A. When solutions are obtained, some of them will doubtless lead to the active development of profitable branches of the industry.

A very happy state of affairs is disclosed in the report by the way this Association co-operates with the leading engineering institutions, with numerous international committees, with the Electricity Commission, with the G.P.O., the B.B.C. and the Radio Manufacturers' Association. Its financial position is very sound. It has built up its laboratory at a cost of £26,000 out of its own reserve fund. Out of a total income of £68,000 last year, the Department of Scientific and Industrial Research contributed £19,000.

Of individual researches, we may mention the research on the electric strength of thin dielectrics and varnish films. The electric strength of mica has been found to be constant up to 300° C. This value agrees with certain calculations based on recent theories. The oscillographic studies of the current and voltages which occur during a breakdown have led to valuable practical results. A research is proceeding on the deleterious effects of ionization products and coronæ (brush discharges). Two papers were presented on behalf of E.R.A. to the British Association, by Dr. S. Whitehead and Prof. W. M. Thornton respectively. The latter is also revising the tables for spark-gap calibration.

Important tests were carried out with the co-operation of the Central Electricity Board, on the Portsmouth–Reading line, on the interference produced by high harmonics in neighbouring circuits, and a report will also be issued. A number of reports on interference were presented to the Commission Mixte Internationale, and some of the conclusions put forward were incorporated in the final recommendations. The issue of a report by the Institution of Electrical Engineers on electrical interference with broadcasting brought the large-scale co-operative researches co-ordinated by E.R.A. to a close. They have been superseded by a series of investigations which aim at (1) obtaining accurate data and limits for standard specifications and (2) compiling reports upon specific matters of interest to manufacturers of electrical plant. In railway engineering research, it has been found that cadmium–copper wire shows considerably less wear than pure copper as a trolley wire material; the small quantity of cadmium present only reduces the conductivity of the wire by a small amount. Its freedom from stretching makes this alloy of copper very suitable for use as a trolley wire.

The report is published by E.R.A., 15 Savoy Street, W.C.2.

International Fisheries Research[*]

THE twenty-ninth reunion of the Conseil Permanent International pour l'Exploration de la Mer was held in Copenhagen in May 1936 under the presidency of Mr. Henry B. Maurice. The present position being unchanged, all the States now participating will continue for another five years as from July 22 of last year. Latvia is now desirous of becoming a full member.

Among the many subjects involved was the position of the various countries as regards size limits and mesh regulations (Point 7 of the agenda), the president having circulated a memorandum previously prepared by himself summarizing, so far as was possible, the present position with regard to mesh regulations and size limits.

Three special scientific meetings were held during the Council meeting of 1936, the first to discuss the physiological problems of interest to the marine biologist in his studies of the most important species of fish, the second to compare stocks of fish in the several areas in respect of age composition, the third on the measurement of submarine light and its relationship to biological phenomena. The programmes and reports of the different area committees are included in Part 1 of the *Rapports et Procès-verbaux*.

Part 2 includes the Administration Report, which was passed without amendment. A large part of this has to do with the herring. A special meeting of herring experts was held at Lowestoft on October 16–17, 1935. Besides the report with recommendations, there are papers on the herring from the Skagerak, Kattegat and Baltic, Fladen Ground, Western European waters, the Southern Bight, the southern part of the Transition Area, Faroes, Iceland and Greenland, and from Scotland, also others on race questions, populations and larvæ. M. le Gall's paper on the present state of knowledge concerning the origin and distribution of herring populations in western European waters was specially discussed.

The following recommendations were made. Any group of herring spawning in a given area at a given season from year to year should be defined as the natural 'Biological Group', and morphological characters should be used as a practical aid in the identification of these biological groups outside the area and season of spawning. Work on biological groups and other local and seasonal population should be continued. Vertebral counts of selected material should be continued, additional characters such as the number of keel scales being also studied when necessary. A co-operative study should be undertaken on the practicability of utilizing a count of separate portions of the vertebral series in such a way as to draw distinctions between morphologically distinguishable groups with a minimum of labour and material. Spawning times should be defined by stating the actual month, and in the northern area group, characters of the autumn and spring spawning populations on the north-west coast of Iceland should be investigated and compared. All countries working in one way or another in the waters of the Faroes, Iceland and Greenland should arrange for material of herring to be collected for age determinations and distribution of larval stages; fishing experiments should be carried out in the open sea between Norway, Faroe Isles and eastern Iceland to collect material in order to get information as to the exchange of population between different parts of this region; and the collecting work concerning age composition, population-characters, exact determination of maturity and distribution of larvæ should be carried out in all important areas systematically and continuously for a period of years. Samples of spawning herring from the Viking Bank should be collected and investigated as opportunity occurs; samples from western Greenland and from Labrador should be collected with the view of comparing the population characters, age composition, spawning time and growth. It is of importance for the international work that contact be maintained with the herring investigations in Russian northern waters by the U.S.S.R. Further, it was recommended that in the North Sea and Channel Area the following problems be investigated: the three subgroups of 'autumn' spawning herring of the North Sea, the degree of mixing, if any, in the winter spawning herrings of the southern North Sea and Straits of Dover, the herring of the Smalls, the mixing on the Fladen Grounds and the herring population in general in the Irish Sea; that further investigations be carried out in the Skagerak, Kattegat and Baltic as regards the 'autumn' spawning population of the Kattegat, co-operation being necessary between Denmark and Sweden, and that population investigations be carried out on the eastern coast of the Baltic, on a co-operative basis between the countries concerned.

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[*] Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. C. 1$^{\text{ère}}$ partie: Procès-verbaux (Mai 1936). Pp. 62. 3.00 kr. 2$^{\text{ème}}$ partie: Rapport administratif (1935–36). 3$^{\text{ème}}$ partie: Appendices. Pp 111+25. 4.00 kr. (Copenhague: Andr. Fred. Høst et fils.)

A second special meeting of experts from the Baltic countries met at Copenhagen on December 4-5, 1935, to examine more closely the question of further measures to protect the stocks of fishes in the Baltic. The meeting dealt mainly with the flounder and salmon, and recommended further protective measures.

The third part of the Report (Appendices) contains several papers, including one by F. S. Russell on "The Importance of Certain Plankton Animals as Indicators of Water Movements in the Western End of the English Channel" and "Handliste zur Sicherung der Bestimmung nordischen Plankton" by H. H. Gran, E. Hentschel and F. S. Russell. The latter paper is an attempt to list the more important plankton organisms, both micro- and macro-plankton, plant and animal, in order that it may be seen at a glance which to record in any preliminary plankton investigations. Only those species which can be identified easily are included, and if two or more important species of a genus are easily confused the genus only is given.

The Natural History of Barra, Outer Hebrides*

EDINBURGH has been enterprising and has adopted the island of Barra in the Outer Hebrides as a centre of its natural history activities. The Biological Society of its University produced eight zoologists, seven botanists and four geographers and geologists who invaded the island, camping there for the first fortnight of July.

The island is a useful size for this purpose, about 8½ miles long by 5½ miles broad. This gives only about twenty-five square miles of land, as it has a much indented coast, with many sandy bays between rocky headlands. Its central parts are about 700 ft. high with hills to the south of 1,260 ft. and 1,092 ft. The geology was already known, the surface being peat moor with rocky knolls and ridges of gneiss with intervening boggy hollows. The character of the coastal scenery is said to suggest recent subsidence, some of the inlets appearing to have been originally freshwater lochs. Heavy south-west winds dominate one side, carrying the shell-sand over the peaty soil and producing excellent grazing grounds (machair). Once completely afforested, there are now only three patches of woodland. Lastly, there are nine freshwater lochs, these containing about 0·2 per cent calcium, 0·02 per cent chlorine and pH 5·6–7·4.

Clearly, in this diversified island of Barra there was plenty of room for the botanists. To commence with, one party had to collect and determine all the species of plants dwelling there, while another set to work to see how far the vegetation had been segregated into communities. Coastal areas, moorland, loch, woodland and cultivation were recognized, and lists are given of the higher plants found in each; these are obviously incomplete, being collected in a restricted season, but serve to indicate the associations. The layman would remark that this section consists largely of Latin names, whereas the botanist would see a necessary start. The lochs are particularly interesting, one set with a rich lacustrine and a poor marshland flora and a second set with opposite characters—it is not clear how far these are due to topographical conditions. Of the lower plants there is a particularly rich moss and liverwort flora, 85 and 21 species respectively. To these must be added 27 species of pteridophytes, 42 fungi and 30 lichens—while evidently one botanist was interested in marine algæ, of which 78 species were named, here an evident correlation with the relatively warm, oceanic waters.

Inasmuch as the fauna is a consequent of the flora, it cannot be collected in any completeness without a knowledge of the latter—and in any event there are many forms which are seasonal. All we can say is that an excellent start has been made on the land fauna. At this stage it is a mere list of the species, for as the authors say, "it would be premature to discuss the animal ecology". The lists vary in value; thus Waterston's section on land and freshwater Mollusca records 51 species in Barra as compared to 64 species known from the whole Outer Hebrides and contains excellent notes on their distribution. There is an element of completeness here, as indeed there is in respect to the whole freshwater fauna. In contrast, the insect fauna probably does not record a third of Barra's species—and lists of the marine fauna are obviously out of place and of little value.

Now is there to be a sequel of a further expedition by the Edinburgh Biological Society to Barra? The preliminary work has been done and upon this the plan for a serious attack on the ecology can be based. The island must be so mapped as to show the distribution of the plant communities and the proportions of the various species in these determined. Then the animals associated with each plant community must be collected and such species as are of general distribution or are chance visitors eliminated. This will entail a study of the physiological connexions of the animals with their environments and of their numbers of individuals. The island is small enough and its parts so clearly defined that valuable ecological results seem certain. Lists of the species of animals and plants in any locality cannot form a natural history; for this science is one of life, not of death. Edinburgh has a great University and it may perhaps be invited to bring its work to full fruition, even if it means student-expeditions at different seasons extending over several years.

Proc R. Phys Soc., Edin., **22**, 241-96 (1936).

East African Rift Valleys*

J. W. GREGORY'S classical work on the rift valley in Kenya focused attention on the rift valleys of Central Africa, and the historical retrospect given by Bailey Willis at the beginning of the recent Carnegie Institution volume on the subject provides a summary of the views of the pioneers, though there are some notable omissions both in this and in the bibliography.

The work consists of two principal parts: the first giving the 'general picture' with a hypothesis of rift valley formation, and the second detailed characters of the several areas, which include the coastal region of Tanganyika and the Tanganyika plateau, Lake Victoria and the central plateau, and also the rift valleys, Lake Albert with the Ruwenzori range at its southern end, Lake Tanganyika, the Rukwa trough, Lake Nyasa, the Ruaha trough, the classical rift valley (called Gregory Rift Valley throughout the work), and Lake Rudolf. A chapter on the volcanoes is given, and shorter chapters on earthquake conditions and on gravity tests. So little space is devoted to seismology that it might be wondered why this volume is one of the series in the studies of that science until it is realized that the work forms a very suggestive basis for a seismological study, and it is probable that the seismologist will be best qualified, when more data are available, to decide whether the general hypothesis will stand. It is likely that the physicist will object to some of the theories put forward, where conceptions such as anti-gravity or levity, downdraft and suction, are given the status of scientifically defined forces acting in the crust of the earth and capable of forming the structures under consideration.

A brief outline of the main thesis is here attempted. An area of uplift where the high plateaux of Central Africa are developed is situated over an asthenosphere consisting of "relatively incompetent but solid elastic rock". By gradual heating, probably by radioactive processes, this asthenosphere becomes a molten body, or asthenolith, which is covered by the competent shell about twenty-five miles (40 km.) thick. The melting of the magma causes an expansion in volume and hence a forcing up of the central area, while various forces at the margins, which are rather convincingly described, cause the edges to sink down. The author points out that the great plateaux "exhibit a tendency to a circular form" and shows (p. 72) that "this is strikingly the fact in the case of that plateau which is most completely surrounded by rift valleys of East Africa, the Tanganyika plateau and its northern extension beyond Lake Victoria".

We are to suppose that the large central plateau is the raised cover of the asthenolith of molten magma twenty-five miles below, and that the rift valleys and troughs, and the upraised masses of Ruwenzori and Elgon(?) are round the edges, and that any escapes of magma to give volcanic eruptions also lie round the margins. This roughly fits the facts, and it must be noted that the central cover is thick enough to have prevented any eruptive or intrusive activity since Karroo times.

The details of structures which form the second part of the volume constitute a mass of information very usefully assembled together. Bailey Willis is to be congratulated on having reached the top of the rim of the great Ngorongoro hollow and found that it is not a giant crater as stated by Jaeger. He warns the reader who visits Lake Tanganyika not to be disappointed, as he was, on first seeing that mighty trough which is almost filled with water (p. 185). There is very little evidence for a central core of greenstone to the Ruwenzori range, as postulated by the author, and the basic intrusive rocks known on the mountains are far older than the uplift of the mass. There is some confusion between Mgahinga, a volcano almost as large as Muhavura and Sabinyo, and Gihinga, a small cone to the north-east.

This important and stimulating work is beautifully printed, with few misprints, while the plates (many of which appear to be from infra-red photographs and most of which are by the author) much enhance the value of the volume. It will be read by all geographers and geologists, as well as by seismologists, who are interested in rift valleys in Central Africa, and will be referred to by those who are now working in, or studying, that most impressive part of the globe.

WILLIAM C. SIMMONS.

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* Studies in Comparative Seismology: East African Plateaus and Rift Valleys. By Bailey Willis. (Publication No. 470.) Pp. x+358+78 plates (Washington: Carnegie Institution, 1936.)

Breeze and Clinker Aggregates

THE Department of Scientific and Industrial Research has issued a revised edition of a bulletin published some years ago on "The Properties of Breeze and Clinker Aggregates and Methods of Testing their Soundness" (Building Research Bulletin No. 5. London: H.M. Stationery Office. 6*d*. net). Since the original publication, investigations carried out at the Building Research Station have established the cause of the occasional failures of these materials and have enabled tests to be devised which are suitable for application under ordinary working conditions.

'Clinker', or well-burnt furnace residue, and 'breeze' —the name applied to the smaller and less definite residues—usually contain a proportion of unburnt fuel, which has been proved to be the cause, when these materials are used as aggregates, of cracking which develops and becomes visible in the set concrete at various periods after pouring, by reason of the swelling movements which these unconsumed coals undergo in the mass. Certain types of coal are more likely to give trouble of this kind than others and, it is stated, the extent of the action can be predicted from the physical properties of the coal from which these aggregates were originally derived. For laboratory purposes, samples of coal are distinguished by their power of removing the colour from an aqueous solution of methylene blue and by their relative moisture absorption properties, and it is suggested that the presence in the aggregate of as little as 4 per cent of a coal of the most dangerous class may be sufficient to cause failure.

Investigations made on the setting and maturing movements in breeze and clinker concretes, and on the influence of sulphur and of water content, are described, while it is also explained why these aggregates may not be used in reinforced concrete construction owing to the rapid corrosion resulting from their permeability. Of the two tests recommended, the 'pat test' is said to be reliable in the majority of cases. A standard pat is made by mixing a sample of the material under test with fine white plaster of Paris, and a normal Portland cement; if in a period of 1–4 days this exhibits certain defined symptoms of movement, the material is to be judged unsound and must be rejected.

Fossil Algæ in Boghead Deposits

BOGHEAD coal is a comparatively rare and valuable material yielding gas and paraffin on distillation. It is characterized structurally by the presence of minute 'yellow bodies', the nature of which has been a subject of discussion. An algal nature was suggested for these in 1889 by Edgeworth David, but their peculiar properties in resisting decay and compression prevented any general acceptance of this view. Since that time, reports of C. E. Bertrand and Renault, Zalessky, and Thiessen have supported the algal view, and finally P. Bertrand in 1930 came to the conclusion that the *Pila* of C. E. Bertrand and Renault was *Botryococcus* and their *Reinschia* a member of the Volvocales.

The subject has now been placed on a much surer basis by a detailed study of living *Botryococcus Braunii* and material from the muds of glacial lakes and more recent peat deposits by Dr. K. B. Blackburn, and a re-examination of the 'yellow bodies' of boghead deposits by Dr. B. N. Temperley (*Trans. Roy. Soc. Edin.*, 58, 1935–36). Dr. Blackburn has followed the alga through its many variations in form; she shows that the inner membranes of the cells are cellulose, but external to this each cell has, towards the periphery of the colony, a cellulose and pectin cap, which contributes to the general mucilage surrounding the colony, whilst towards the centre of the colony, a thick fatty thimble forms around each cell, and these constitute the general matrix of the colony. The cuticular nature of these thimbles would explain their resistance to decay. The cells are rich in oil and also contain appreciable quantities of starch.

Dr. Temperley finds that the 'yellow bodies' described as *Pila* show extremely close agreement with *Botryococcus Braunii*, the various polymorphic forms of which are recognizable in the deposits. The form *Reinschia*, formerly ascribed to the Volvocales, differs from *Pila* in the hollow form of the colonies, but the details of structure correspond so closely with those of *Botryococcus* that Dr. Temperley concludes that "there is no doubt that the various forms of *Reinschia* and *Pila* are fossil colonies of the same type of alga".

Science News a Century Ago

Medicine in Chili

"THE science of medicine has hitherto made but small advances in Chili. . . . Twenty years ago medicine was practised by men of colour and the most ignorant quacks, the hospitals were entirely under the control of the monks, and the few well informed physicians, those, namely, who had received an European education found in Lima a more lucrative field for their exertions than was offered to them anywhere in Chili. This state of things, however, no longer obtains, for the number of physicians is now even greater than necessity requires, and there is a college at Santiago at which medicine is taught, although on a somewhat compendious plan. Still there is a scarcity of educated practitioners in the country, where the healing art is chiefly exercised by matrons and old Indian women. The country people are tolerably familiar with the virtues of the rather numerous indigenous plants, but to many of them properties are attributed which the individuals in question do not really possess, and many other remedies supposed to be of great efficacy are solely indebted for the estimation in which they are held to a credulous superstition. When any particular part of the body is the seat of disease, the remedy is sought for in the corresponding part of some animal, variously prepared; thus for ophthalmic disorders the carbonized eyes of birds of prey are administered, the claws of the condor are given for gouty pains of the hands, and the flesh of the smooth-skinned lizard for scurfy affections of the skin." (*London Medical and Physical Journal*, February 18, 1837.)

The Colony of Western Australia

AT a meeting of the Statistical Society held on February 20, 1837, Lord Glenelg, then Colonial Secretary under Lord Melbourne, communicated "A Report of the Committee of Correspondence of the Colony of Western Australia". Known first as Swan River Settlement, Western Australia was formed into a province in 1829, and the towns of Perth, Freemantle and Guildford were founded the same year. The development of the colony, however, had been slow. The report consisted of nine sections written by different individuals and dealt with agriculture, live stock, shipping, commerce, population, crime, religion and other matters. The total population of the Swan River Settlements west and east of the Darling Mountains was but 1,550. Sheep farming was the principal industry, there being in the York district east of the Darling Hills about 5,000 sheep in excellent condition. The original flocks were imported from "Van Diemen's Land". The animals were a large-framed and very coarse-wooled breed, but being crossed with Merino rams, the quality of the wool was constantly improving. The merino flock consisted of about 900 pure descendants of the choice Spanish flock presented in 1791 to George III by the King of Spain. This breed had much improved since imported into the colony. The amount of wool shipped for England and the Cape of Good Hope in 1836 was 12,500 lb.

The East India Company's S.S. *Berenice*

ACCORDING to *The Times*, on February 22, 1837, the East India directors gave a dinner at the West

India Dock Tavern, Blackwall, to Captain Grant and the officers of the S.S. *Berenice*, which was being prepared to leave for India. This vessel was the first steamship for the East India Company contracted for by the famous engineer and shipbuilder Robert Napier (1791–1876), and her success had much to do with Napier being entrusted with the contracts for the earliest ships of the Cunard Company. The *Berenice* was 170 ft. long by 28·8 ft. broad and of 646 tons with engines of 250 nominal horse power. She was a wooden paddle vessel; her boilers working at a very low pressure were of copper and her engines were of the ordinary side-lever type. Leaving Falmouth on March 16, 1837, she reached Bombay on June 13, having called at Santa Cruz, Mayo, Fernando Po, Table Bay and Port Louis. Her average speed was about 8 knots.

Therapeutic Use of Odours

AT a meeting of the Medico-Botanical Society on February 22, 1837, reported in the *Lancet* of March 4, Dr. George G. Sigmond read a paper on odours. Though not now used therapeutically, the older physicians employed them, and, according to Dr. Sigmond, they might once again be found of service in medicine. Travellers, he remarked, who sleep in houses made of cinchona wood, escape intermittent fever, probably from the odour of sulphate of quinine. A similar odour has also relieved tic douloureux. In a work published by a pupil of Linnæus after the death of that eminent botanist, who, however, superintended the construction of the volume, plants were divided into seven classes according to their smells as the *aromatica*, the *fragrantia*, etc., each odour having an action peculiar to itself, and some suggestions were made for imparting odours to scentless flowers through the roots, etc.

Davenport's Invention of an Electric Motor

ON February 25, 1837, Thomas Davenport (1802–51) secured a patent for an electric motor, the first of its kind taken out in the United States. Davenport was a blacksmith of Brandon, Vermont, who about 1833, with his friend Orange Smalley, began experimenting with magneto machines, unaware of what Henry had already accomplished. By December 1834 they had made a machine having twelve permanent magnets and two electromagnets connected through a form of commutator consisting of wires dipping into mercury cups to an electric battery. By May 1835 he had substituted for the mercury cups insulated segments on the lower part of the wheel shaft, which were rubbed by contact springs made of flattened wire. His new machine he showed to Henry at Princeton, and there saw Henry's own electromagnetic engine.

On Henry's advice, Davenport showed his machine to Alexander Bache and to a group of men at the Franklin Institute, but being short of money, sold it to the Rensselaer Polytechnic Institute for 30 dollars. Encouraged by Prof. Eaton, he made a new machine adapted for traction purposes, and this was exhibited at Troy on October 14, 1835. He was joined by Ransom Cook, and new models were built and exhibited, and Davenport lodged a model and applied for a patent, but at the Patent Office fire of December 15, 1836, both model and papers were destroyed. Soon after this, however, he secured his patent of February 28, 1837, and his model is now preserved in the National Museum at Washington. The inventor, however, reaped no reward for his ingenuity and died on July 6, 1851, on a small farm in Salisbury, Vermont.

Faraday on Marshall Hall

THE *Lancet* of February 25 contains the following note on a lecture delivered at the Royal Institution by Prof. Faraday on "Dr. Marshall Hall's Discoveries in the Nervous System": "The principal feature in these discoveries appears to be the fact that in the medulla oblongata and the spinal marrow resides a function which is distinct from sensation and volition, and termed by Dr. Hall the *reflex excito-motory function*, from its generally proceeding along the nerves from the point of excitement to the spinal marrow, and being reflected from thence to some muscular organ. For this reason the seat of this class of action is called by him the excito-motory system. Müller, of Berlin, Mr. Faraday stated, has in a remarkable manner confirmed the truth of Dr. Hall's discoveries by a recent and separate investigation, although the former still confounds the nature of the function with sensation. . . . Mr. Faraday concluded by observing that Dr. Hall's views are original, all preceding physiologists having confounded the phenomena alluded to with sensation. The subject appears to have interested Mr. Faraday, as not improbably preparing the way for some future discovery relating to electricity as connected with the nervous system; for, as he said, the division of the nervous system into distinct portions was somewhat simplifying any investigation with regard to electricity, considered as a nervous agent."

University Events

CAMBRIDGE.—G. E. Briggs, of St. John's College, has been appointed reader in plant physiology.

The Raymond Horton-Smith Prize awarded to that candidate for the degree of doctor of medicine who presents the best thesis for the degree during the year has been divided between Dr. F. Goldby, of Queens' College, and Dr. J. Gray.

Mr. Thomas Dalling has been elected to the professorship of animal pathology, in succession to Prof. J. B. Buxton, Queens' College, who resigned last term on being appointed principal of the Royal Veterinary College.

Dr. R. G. W. Norrish, formerly fellow of Emmanuel College, H. O. Jones lecturer in physical chemistry, has been elected to the professorship of physical chemistry vacant by the death of Prof. T. M. Lowry.

* * *

OXFORD.—The Herbert Spencer Lecture for 1937 will be given by Dr. Joseph Needham on May 27 at 5 p.m. in the Examination Schools. The subject is: "Integrative Levels, a Revaluation of the Idea of Progress".

Prof. The Svedberg, of Uppsala, will give two public lectures in English in the Museum, Oxford, at 5 p.m. on February 26 and 11.15 a.m. on February 27. The subject is: "Sedimentation, Diffusion and Electrophoresis Technique for the Study of High-Molecular Compounds".

Societies and Academies

London

Royal Society, February 11.

N. G. Heatley and P. E. Lindahl: Studies on the nature of the amphibian organization centre. (5) The distribution and nature of glycogen in the amphibian embryo. N. G. Heatley, C. H. Waddington and J. Needham: (6) Inductions by the evocator-glycogen complex in intact embryos and in ectoderm removed from the individuation-field. Total glycogen, lyo-glycogen and desmo-glycogen have been estimated by quantitative micro-chemical methods in the amphibian embryo around the gastrulation period. Prior to gastrulation, the glycogen concentration is highest at the animal, lowest at the vegetal, pole. During gastrulation, the total glycogen decreases in amount all over the embryo, but especially markedly (30 per cent) in the material which invaginates through the dorsal lip of the blastopore. Desmo-glycogen also decreases in all regions. It is thought unlikely that desmo-glycogen can be identical with that fraction of glycogen to which the evocator may be attached in the cells. The finding that both lyo-glycogen and desmo-glycogen preparations produce successful neural inductions in the chick embryo makes this still more unlikely. The distinction between evocation and individuation has been studied by implanting desmo-glycogen preparations (containing the adsorbed evocator) into isolated pieces of competent ectoderm. Massive neural inductions are produced, but these have not the character either of recognizable parts of the nervous system or of sections of a normal neural tube. On the other hand, the cells are not oriented entirely at random. This is believed to demonstrate the effect of the homogeneous stimulus of the primary evocator. Following on the induction of neural tissue in these explants, the repulsion of overlying ectoderm and the formation of melanophores were observed. These two effects are interpreted as dependent differentiations brought about by the presence of neural tissue as such.

A. Haddow and A. M. Robinson: The influence of various polycyclic hydrocarbons on the growth-rate of transplantable tumours. A. Haddow, C. M. Scott and J. D. Scott: The influence of certain carcinogenic and other hydrocarbons on body-growth of the rat. While intra-peritoneal administration of a number of carcinogenic hydrocarbons produced considerable inhibition in the rate of growth of the Jensen and Walker tumours, a series of related non-carcinogenic compounds gave no such inhibition. One synthetic œstrogen was moderately inhibitory and another quite inactive. Inhibitory activity was also shown to a variable extent by chrysene and by 1:2-benzanthracene and certain of its derivatives (3-, 4- and 7-methyl-), the carcinogenicity of which is either very feeble or nil. In comparative experiments on body-growth, X-radiation, lead, and colchicine were found to produce a temporary interference which was followed by recovery to the normal growth-rate, with or without compensation. Although the carcinogenic hydrocarbons must be regarded as toxic substances, their growth-inhibiting action is apparently independent of toxicity in any non-specific sense. The inhibition produced by the carcinogenic compounds was extremely prolonged, even after a single injection. There is thus a correlation in compounds of this type between carcinogenicity and growth-inhibitory power. The mode of action of these substances seems to be indirect; they operate by producing a prolonged retardation of the growth of normal cells, which eventually react by a process of discontinuous variation to give a new cell race with a greatly increased fission rate.

Paris

Academy of Sciences, January 18 (*C.R.*, 204, 161–200).

Léon Lecornu: Obituary notice of Joseph Auclair.

Gabriel Bertrand and Georges Brooks: The composition of the wood of the trunks and branches of the principal French trees. Determinations of xylose, mannose and cellulose.

Serge Finikoff: (T) Configurations admitting an infinity of Calapso transformations.

Douchan Avsec: The wave forms of vortices in longitudinal bands.

Jean Hély: A synthetic theory of gravitation and of electromagnetism.

Maurice Cotte: The convergence and achromatism of centred systems of electronic optics.

Pierre Jacquet: The application of electrolytic polishing to the study of metallic deposits. The crystalline nature of the supporting metal is destroyed by the usual mechanical polishing methods; but the electrolytic method recently suggested by the author gives smooth, brilliant surfaces without altering the structure of the underlying metal. Some experimental results with copper are described.

Salomon Rosenblum, Marcel Guillot and Mlle. Marguerite Perey: The α magnetic spectra in the actinium family.

Paul Bayard. The infra-red absorption spectrum and molecular structure of pyruvic acid. From the data given, it appears that pure pyruvic acid exists almost entirely in the ketonic form, but the presence of a band attributable to the (OH) vibration proves the existence of a certain proportion of the enolic form.

Paul Laffitte and André Parisot: The influence of the velocity of detonation of an explosive on the velocity of the shock wave. The results of experiments proving that the velocity of the explosive wave and that of the shock wave increase at first with the density of the charge. This disagrees with the results of Gawthrop, and possible causes for the difference are discussed.

Fernand Gallais: The constitution of solutions of potassium iodobismuthates. These solutions possess an exceptionally high magnetic rotatory power, and utilizing this property it was found that the chief complex ion in solutions of potassium iodobismuthate was either $(BiI_6)^{3-}$ or $(BiI_7)^{4-}$, and it was not possible to decide between the two formulæ. Compounds of both types have already been isolated.

Emile Thellier: The magnetization of baked clay: application to the study of the intensity of the earth's magnetic field in the past. A method is described for deducing the intensity of the earth's magnetic field at the time the brick was baked.

Jean Feldmann and Robert Lami: The marine vegetation of Guadeloupe.

Julien de Saint-Laurent: The formation of resiniferous canals in the ligneous tissue of the seedlings in *Pinus halepensis* and *Pinus Pinaster*.

Jean Michel Guilcher: The comparative respiratory intensity of the andrœcium and gynæcium in flowers.

Roger Duffau: The influence of *B* avitaminosis on the composition of the muscle of the pigeon.

Mme. Véra Dantchakoff: The experimental production of free-martins in the guinea pig, and the nature of the factor conditioning their sexual histogenesis.

Yves Raoul: The estimation of tyrosine in raw material from plants.

Copenhagen

Royal Danish Academy of Sciences and Letters, October 16.

Harald Bohr: Contributions to the theory of almost periodic functions (7, 8).

Th. Mortensen: Studies on the development of echinoderms: from the Biological Station, Ghardaqa (Red Sea).

November 13.

Thorvald Madsen: The negative phase of the immunity curve.

November 27

A. Langseth: Constitution of the benzole molecule.

December 11.

Elis Strömgren and H. Q. Rasmusen: The origin of Comet 1863 VI.

Elis Stromgren: Description of Ole Römer's micrometer after Horrebow's "Basis Astronomiae".

C. M. Steenberg: A morphological and biological investigation of the larva and pupa of *Delopsis aterrima* Zett.

George Hevesy, O. Chiewitz and G. Hevesy: Studies on the metabolism of phosphorus in animals. Radioactive phosphorus (phosphate) prepared from sulphur is added to the diet of animals and the path of the phosphorus in the body followed up by radioactive measurements.

Moscow

Academy of Sciences (*C.R.*, 4, No. 4; 1936).

M. Keldyš: A class of extreme polynomes.

M. Subbotin: A new anomaly which comprises, as particular cases, the eccentric, true and tangential anomalies.

M. A. Rosenberg and K. E. Avaliani: Dissolution of the 'vacuum films' of metals in acids (2). Dissolution of iron and nickel in sulphuric acid.

I. I. Čerajajev and A. D. Gelman: Isomerism of ethylene compounds of platinum.

B. N. Forsch: The problem of a field of thermal waters.

M. V. Klenova: Sediments of the Kara Sea.

O. S. Vjalov and V. I. Solun: Palæogenic Turritellidæ of Ferghana.

J. A. Birstein: Growth and propagation of *Cardium edule* in Uertvy Kultuk and Kaidak in the Caspian Sea, in connexion with salinity.

A. N. Družinin: Contribution to the knowledge of the anatomy of the yak (*Poephagus grunniens* L.).

G. U. Lindberg and D. I. Ochrjamkin: The flatfishes of the Japan Sea, *Liopsetta obscura* Lichtenstein and *Limanda schrenki* Schmidt.

(*C.R.*, 4, No. 5; 1936.)

G. V. Pfeiffer: The expression of functions by functions.

M. Lavrentiev: The continuity of univalent functions.

L. Kantorovič: A class of functional equations.

G. Fichtenholz: Linear functions continued in generalized direction.

V. Fock: The impossibility of a neutrino theory of light (1). Contradictions between the neutrino theory of light and the principle of superposition (see Nature, Dec. 12, 1936, p. 1011).

F. N. Kirilov: The sand-eel of Novaya Zemlya (*Ammodytes marinus* Raitt).

D. M. Fedotov: The late post-embryonic development of *Operophthera Crumata* L.

Rome

Royal National Academy of the Lincei (*Atti*, 23, 643–713; 1936).

L. Pucclanti: Inductances and fields of force.

S. Cherubino: Reduction of matrices to canonical form (2).

B. Segre: Oblique ovals, and the extension of the theorem of Cavalieri-Lagrange to functions of two variables.

M. Manarini: Vectorial homographies with kinematic applications in S_n spaces (3). General formula for the velocity and composition of the instantaneous motions of rotation.

E. Volterra: Plane elastic arches (3).

C. Agostinelli: The helicoidal vortex.

B. Finzi: Plastic rotations.

C. Jodi: Procedures for experimental researches on elastic floors.

R. Bruscaglioni: Investigation of the resolving power of sensitive photographic materials by means of a new type of interferometer.

P. Guareschi: Viscosity of liquids (2).

A. C. Blanc: Submarine deposit of *Cyprina islandica* L. in the gulf of Terranova Pausania (Sardinia).

A. Galamini and E. Serianni: Survival of *Bufo vulgaris* after bilateral pneumectomy.

V. Zagami: Further observations on the behaviour of creatin bodies and of urinary sulphur, phosphorus and chlorine during fasting and subsequent feeding.

V. Figura: Alimentary and nutritive value of the acorn and the possibility of utilizing it in human nutrition.

C. Rizzo: Movements of teleosts in relation to experimental lesions of the peripheral apparatus of movement and of sensation (4). Labyrinthine lesions.

Sydney

Royal Society of New South Wales, October 7.

M. D. Garretty: Some notes on the physiography of the Lake George region, with special reference to the origin of Lake George.

G. J. Burrows and A. Lench: (1) The action of lead tetrachloride on primary and secondary halogenated arsines and on tertiary arsines. (2) Note on diphenyl dihydroxy arsonium chloride, $Ph_2As(OH)_2Cl$.

O. U. Vonwiller: Interference by reflection from a concave spherical mirror. Interference bands may be observed when light is reflected at large angles of incidence from a spherical concave mirror, the result of the superposition of beams which have undergone different numbers of reflections. Two, three or more beams may contribute. An examination is made of the conditions for the occurrence of the bands and of the ranges over which those due to particular pairs of beams are observed. The band interval for a given system is $a\lambda/\theta^2$, θ being the deviation of the light and a depending on the numbers of reflections of the two beams concerned. The factors controlling intensity are investigated. A convenient and reasonably accurate method for the determination of wave-length is based on the effect.

J. C. Earl and N. G. Hills: The action of nitrous acid on amines. A comparison has been made of the behaviour of aniline and methyl aniline, respectively, with nitrous acid. The possibilities of interference by secondary reactions in the case of aniline has to be kept in view. Allowing for this the experimental results recorded indicate that the reactions are essentially similar. Dilatometric and conductimetric methods were used in making the comparison.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, February 22

Victoria Institute, at 4.30.—Alan Stuart: "Science and the Interpretation of Scripture".

Bedford College for Women, at 5.15.—Dr. Friedrich Zeuner: "Some Aspects of Evolution revealed by the Study of Fossils".*

University of Leeds, at 5.15.—Prof. F. A. Lindemann, F.R.S.: "Low Temperature Research".*

Royal Geographical Society, at 8.30.—Eric Shipton: "More Explorations round Nanda Devi".

Tuesday, February 23

Warburg Institute, at 5.30.—Prof. J. Huizinga: "The Play Element in Culture".*

Wednesday, February 24

Society for the Study of Alchemy and Early Chemistry, at 8—(at University College, Gower Street, W.C.1).—Discussion on "Alchemical and Chemical Symbols".

Royal Society of Arts, at 8.15.—Prof. W. L. Bragg, F.R.S.: "Alloys".

Friday, February 26

Institution of Chemical Engineers, at 11 a.m.—Fifteenth Annual Corporate Meeting to be held at the Hotel Victoria, Northumberland Avenue, London, W.C.2.

Geophysical Discussion, at 4.30—(at the Royal Astronomical Society).—Discussion on "Radio Observations in High Latitudes" to be opened by Prof. E. V. Appleton, F.R.S.

University of Oxford, at 5—(in the Museum).—Prof. The Svedberg: "Sedimentation, Diffusion and Electrophoresis Technique for the Study of High-Molecular Compounds" (succeeding lecture on February 27 at 11.15 a.m.).*

British Psychological Society, at 8.30—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Prof. T. H. Pear: "Psychological Problems of Television".

Royal Institution, at 9.—Lord Horder: "Old Diseases and New".

Association of Technical Institutions, February 26–27.—Annual General Meeting to be held in the Carpenters' Hall, Throgmorton Avenue, London, E.C.2.

February 26, at 10.45.—The Right Hon. Lord Kennet: Presidential Address.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant in Mathematics and Engineering Science and Assistant in Electrical Engineering in the Willesden Technical College—The Secretary, Willesden Local Higher Education Committee, Education Offices, Dyne Road, Kilburn, N.W.6 (February 26).

Scientific Officer (Ballistic Problems) in the Air Ministry—The Secretary, Air Ministry S.2.D., Adastral House, Kingsway, W.C.2. Quote No. B348) (February 26).

Lecturer in Chemistry in the Wigan and District Mining Technical College—The Principal (February 27).

Inspector of Mines, Burma—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (February 27).

Senior Agricultural Advisory Officer for West Norfolk—The Director of Agricultural Education, Agricultural Station Offices, Sprowston, Norwich (February 27).

Pharmacist in Runwell Hospital, near Wickford, Essex—The Clerk to the Visiting Committee (February 27)

Government Chemist, Cyprus—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, London, S.W.1 (March 6).

Assistant Lecturer in Mathematics and Assistant Lecturer in Zoology in University College, Exeter—The Registrar (March 6).

X-Ray and Radium Physicist in the National Research Council of Canada—The Secretary, National Research Council, Ottawa (March 15).

Professor of Physiology in the Lady Hardinge Medical College, New Delhi, India—The Principal (April 15).

Lecturer in Domestic Science in the Gloucestershire Training College of Domestic Science, Barrack Square, Gloucester—The Secretary.

Official Publications Received

Great Britain and Ireland

Air Ministry Aeronautical Research Committee: Reports and Memoranda. No. 1687 (1792): Performance and Longitudinal Stability of a Single-Engined High Wing Monoplane; Experiments on a Quarter Scale Model with Airscrew Running. By L. W. Bryant, D. H. Williams and A. F. Brown. Pp. 31+41 plates. 3*s.* 6*d* net. No. 1691 (2238): Comparison of Drag of Trousered and Retractable Undercarriages. By Dr. R. Jones, A. H. Bell and A. F. Brown. Pp. 6. 1*s.* net No. 1701 (2004): The Effect of Central Cutaway in Split Flaps on the Trim of a Low Wing Monoplane. By D. W. Bottle, C Callen and K. W. Kirkby. Pp. 17. 3*s.* net. No 1704 (2212): Structure of Turbulence in a Natural Wind, with a Description of a Sensitive Pressure Gauge. By A. Graham. Pp 16. 2*s.* 6*d.* net. No. 1707 (1939). Trailing Edge Flaps in relation to Take-off and Landing of Landplanes By S B. Gates Pp. 31. 4*s* 6*d.* net No. 1711 (2072): A Successive Approximation Process for Solving Simultaneous Linear Equations. By J. Morris. Pp. 12. 2*s* net. No. 1712 (2107). Full Scale and Model Porpoising Tests of the Singapore IIc. By W. G. A Perring and J. L. Hutchinson. Pp. 26. 3*s.* 6*d.* net. No. 1713 (2087): Full Scale Tests of Slots and Flaps on a Heinkel He 64, with Special Reference to Landing. By J. E. Serby and H. B. Squire. Pp. 15. 2*s.* 6*d* net. No. 1718 (2186): The Use of Dynamically Similar Models for Determining the Porpoising Characteristics of Seaplanes By L. P. Coombes, W. G. A Perring and L. Johnston. Pp. 14. 2*s.* 6*d.* net. No. 1719 (2146): Full Scale Tests of the Hendy Heck (with an Appendix giving Pilot's Notes). By A. E. Woodward Nutt and P. A. Hufton. Pp. 18+2 plates. 3*s.* net. No. 1722 (2038): The Effect of a Reduction of Aileron Torsional Stiffness on the Flutter of a Model Wing. By V. M. Falkner, W. P. Jones and C Scruton. Pp. 8. 1*s* 3*d.* net. (London: H.M. Stationery Office.) [281

Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. C S I.R.: Ten Years of Progress, 1926–1936. Pp. 67. (Melbourne: Government Printer) [251

Mikrochemie: Internationale Zeitschrift fur deren Gesamtgebiet. Festschrift zum 80 Geburtstag von Prof. Dr. Hans Molisch. Pp. viii+454+1 plate. (Wien und Leipzig: Emil Haim und Co.) 28 gold marks. [261

U.S. Department of the Interior: Office of Education. Leaflet No. 37: Physique of School Children By Dr. James Frederick Rogers Pp. 17. 5 cents. Bulletin, 1936, No. 9: Testing Practices of High School Teachers. By J. Murray Lee and David Segel. Pp. v+42. 10 cents (Washington, D.C.: Government Printing Office.) [271

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No. 3513 SATURDAY, FEBRUARY 27, 1937 Vol. 139

Conservation of Buildings and Landscape

THE discussion which took place in the House of Commons on February 10 on the motion of Mr. A. C. Bossom, member for Maidstone, on the destruction of beauty in town and country and of buildings of historical or architectural interest now proceeding in Britain, evoked a striking unanimity in expression of opinion from all sides. The motion had not only called upon the House to deplore the present situation and to agree as to its urgency; but it had also pressed upon the Government the need for active steps to ascertain "whether its existing powers are adequate, or whether they require substantial reinforcement". No voice was raised to repudiate responsibility, or to deny that this destruction was in the least degree anything but a serious matter of public concern; while in the final result the motion was adopted by the Government, and an inquiry promised.

In the course of the debate, it became evident that there was a general consensus of opinion that control of development, in so far as it affects the beauty of rural Britain, the preservation of structures of historic interest in a broad sense, and the protection of buildings and landscape from grossly incongruous structural associations, is in present conditions a national duty and not merely a matter of a local sense of responsibility. This also was the view, it may be mentioned incidentally, strongly urged by Sir Halford Mackinder and Sir Percy Hurd before the Council for the Preservation of Rural England on the following day.

While the House of Commons paid well-deserved tribute to the success of the Office of Works in carrying out its duties in the protection of ancient and historic monuments with the exiguous resources at its disposal, it was pointed out in debate that in the most extensive field of its operations, that of the inhabited house, its powers are restricted, and that here even more than elsewhere, its activities are impaired by lack of funds.

The inhabited house has always presented a difficult problem in this connexion. To a certain extent, no doubt, shortcomings in the action now open to public authority will be met by the legislation to be introduced on behalf of the National Trust, to which reference was made in the reply for the Government by Mr. R. S. Hudson, Parliamentary Secretary of the Ministry of Health, accompanied by an assurance of the good will and sympathy of the Ministry of Health, the Office of Works and the Treasury. The scheme, however, for which powers will be sought, as it is understood, will apply in the main to the larger and more important examples of domestic architecture, and will be of little avail for structures of lesser pretensions and the villages typical of rural Britain in its varied cultural phases, for which Mr. Marshall, member for Sheffield, stressed the importance of preservation, as a unitary whole, as examples of "an architecture wedded to the landscape in which it is situated", each of a type and characteristics peculiar to its environment.

The problem of preserving these humbler structures should not be insuperable. Recent experience in reconditioning has shown how far villages, in which buildings have already been or are about to be condemned, may be preserved at a reasonable charge, and that whole villages need not necessarily be radically changed in character or ruthlessly spoiled on a demand for sanitary reform, which is blind to all considerations but one, important as that may be. The ways of the county surveyor and the rural district council, however familiar, never cease to seem wonderful. Even in urban conditions where the call for improvement may be more insistent and financial considerations more difficult to meet, it may yet be possible to preserve historical and cultural associations, other things being equal, by the application of modern methods of reconditioning.

Of the two factors, lack of interest or knowledge and finance, which enter into the problem and appeared to weigh most with members of the House as insistently demanding the intervention of central authority, the latter, finance, demands by far the more drastic treatment. As Mr. Hudson pointed out in his reply, and as was mentioned by other speakers, training and knowledge are, or can be made, readily available for the advice of local authorities. Yet while it is true that there are numerous local societies—field clubs, natural history societies and archæological societies—distributed up and down the country, of which the members are fully competent, as the Parliamentary Secretary suggested, to educate their neighbours, anyone who is acquainted with actual conditions is well aware that the standing of these societies and the influence which they can bring to bear when action is contemplated in any given instance, varies enormously from one locality to another. The expression of instructed opinion available in these bodies needs to be co-ordinated and disseminated in such a manner that its weight will receive due recognition. For such an organized expression of opinion the machinery already exists in the various associations and federations in which these societies combine for the discussion of common interests. In certain directions and on occasion, common action is taken, at times with conspicuous success. More systematic organization with the specific needs of the present situation in view is required.

Further, would it be too much to ask, failing a systematic survey and enumeration of ancient and historic structures worthy of preservation, such as has been carried out by the Surrey County Council, and is, it is stated, to be urged on other authorities, that each town-planning scheme should include a clause safe-guarding such structures? Such a clause would show that an authoritative opinion had been obtained that no building of historic or æsthetic interest and importance had been marked for demolition, or, if any such there were, a reasoned justification for its destruction would be put forward for consideration and decision by central authority.

It is questionable if even this goes far enough. Excellent though the work of the Council for the Preservation of Rural England and similar organizations may be in creating a public sense of responsibility, no unofficial body, can view conditions so comprehensively, or speak with the authority of a central body or department, with powers delegated from the people as a whole.

Finance is obviously the real crux of the problem. Upon whom is the expense of conservation to fall? Even under existing legislation, the powers of a local authority are considerable, though, it may seem unfortunately, permissive only. The town-planning acts make it possible for the authority to intervene—but do not require that it must intervene—when the demolition of a structure of historic interest is contemplated. At once there arises the question of compensation, with all the possibilities of abuse. Nor is it practical to expect that an authority with only a low rateable value upon which to draw, will contemplate action entailing heavy expenditure, whether for purchase or compensation, with an entirely open mind. At the same time, to brand indiscriminately development of land or an urban site as merely personal greed, because such development conflicts with æsthetic ideals or archæological and historical interest, is to invite derision from those whose co-operation it is desirable to enlist.

Each instance must be judged on its own merits; and the arguments which weigh for conservation should help to determine where the financial burden should fall. When national considerations determine the issue—and this must cover the claims of associations bound up with the nation's history at large—or matters of wide general interest in the scientific pursuit of archæological and historical studies, as in the instances of the Roman Wall and the country around Stonehenge and Avebury, the burden of conservation is one which should fall on the nation's purse. A scale of grants might well be devised for the assistance of local funds, when interests more restricted in range, but nevertheless of historic, scientific or æsthetic weight, are involved and public action is demanded. On the broad issue, however, the principle should stand. As Sir Halford Mackinder said on the occasion to which reference has already been made, we and the countryside have grown together; the loss of its beauty would be the loss of half of ourselves; and its protection should be a national charge.

The Fullness of Days

My Fill of Days
By Sir Peter Chalmers Mitchell. Pp. 440. (London: Faber and Faber, Ltd., 1937.) 15*s*. net.

THE modern practice of using single words, or fragmentary sentences, bearing little or no relation to the subject-matter, as the titles, not only of novels—where it is excusable—but even of important biographical works, will undoubtedly cause much embarrassment, and even loss, to the historian and bibliographer of the future; but if ever such a title was justified, it is justified by the absorbingly interesting volume before us. It may be said at once that no man has ever lived, the fullness of whose days has been more striking and complete than those of Sir Peter Chalmers Mitchell, from the time that he made fireworks and other scientific experiments as a schoolboy, until he left the smoking ruins of Málaga, on a British destroyer on February 11, 1937. Chalmers Mitchell is a man devoid of fear—though perhaps, to quote Dr. Johnson, he never snuffed a candle with his fingers—but probably the boldest, one might say the most foolhardy event of his life, was his return to Málaga immediately after the publication of this volume, in which he gives a vivid account of Málaga in 1936 (chap. xx) and makes no concealment of his attachment to the so-called Red (Government) régime, and his activities in protecting and assisting the escape of 'Red' proscripts. What emerges most significantly from this book for 'the eye of wisdom' is a side of the author known only to his most intimate friends He reveals himself here as a poet and as an artist, capable of warm-hearted and disinterested sympathies for the oppressed, and a loving and lovable nature—rarely to be found in those who, like him, are actively disinclined to the suffering of fools gladly—as recommended by St. Paul.

Chalmers Mitchell's descriptions of scenery, for example, of the Biscayan coast, of Montpellier, and of Arles, to quote but three vivid passages, are the unconscious work of both poet and artist, nor are his pen-pictures of the celebrated men who have been his friends and colleagues, to name but a few out of very many, Ramsay, Clemenceau, Ruskin, Freeman, Minchin, Ray Lankester and Burdon Sanderson, less striking and exact—as the present reviewer, having personally known most of the subjects of his pen-portraits, is in a position to appreciate. Equal in quality and charm is his description of Oxford and its influence upon the adolescent mind, a description that will awaken echoes in the mind of every whilom undergraduate.

It is interesting to note the record that the author narrowly escaped being a son of Sir Archibald Geikie, in which case the world might have honoured a great geologist, instead of a zoologist of world-wide reputation. It is a task of extreme difficulty to pick out the salient features of a book, almost every paragraph of which arrests the attention of the reviewer, for the author writes as he talks—or lectures—in a style that is incisive and arresting, interspersed with sly flashes of humour which no Scotsman would resent being described as 'pawky'. The plan of his idealized Zoological Gardens may be said to have originated in the 'Zoo' at Hamburg, long before the days of Hagenbeck, who later became an intimate friend, adviser and colleague. At this period, he heard in Berlin the first indication of Bismarck's *Weltpolitik* (in 1884), and in that connexion we get here a lucid statement and study of the inter-relations of Great Britain and Germany He has saved from oblivion, in these pages, his article published in the *Saturday Review* (Feb. 9, 1896) entitled "A Biological View of Our Foreign Policy", in which the cataclysm of 1914–18 is soundly and clearly adumbrated.

Valuable advice is given to lecturers, founded upon the author's own vast experience, and no one who has delivered a Friday evening discourse at the Royal Institution will fail to appreciate sympathetically his mental reactions when undergoing that terrifying experience. His first enforced plunge into the science of accountancy (p. 100 ff.) sheds a significant light on the mastery of finance which he unexpectedly displayed when he became secretary of the Zoological Society.

The pages devoted to 'Weissmannism' are lucid and instructive; and it is amply apparent to what an extent his friendship with Hagenbeck encouraged him in the reform of the old Zoological Gardens, and in his views upon the treatment of animals in captivity, which led to the crowning episode of his life, the establishment of Whipsnade, the history of which must fascinate any zoologist.

The author is usefully polyglot, and he lays stress upon the influences of French literature, though doubtless many critics would meet him in the gate when he sandwiches Octave Mirbeau between Zola and Anatole France. His almost lifelong industry as a journalist has been amazing. He has been a prolific leader writer in the *Saturday*

Review, in NATURE and, above all, on the staff of *The Times*, all of which led to the important part that he played at the Ministry of Intelligence and Propaganda during the Great War, and especially to his attempted flight from Cairo to the Cape, which, from circumstances over which he had no control, may be described as a brilliant and useful failure. His description of this journey as a scientific spectator reads like an adventure story, and occupies some seventy pages of this remarkable book.

We have already referred to Chalmers Mitchell's vivid picture of Málaga in 1936, a description for which we were prepared by his long account of the conditions existing there, published in *The Times* (October 20, 1936). Where one must, we think, accuse him of hasty judgment is where he connotes brains and ill-health. He says (p. 209): "I cannot recall . . . any person greatly distinguished by the product of his brain, who was a type of good health." We would answer this blazing generalization with the question: "What about Peter Chalmers Mitchell ?"

The Epilogue will be read with close attention and with very varied reactions by a vast number of readers. The author is a convinced, almost a militant, Communist. It cannot fail to arouse the interest and the regretful appreciation of the most hardened Conservative. If only his gospel were in any degree credible the world would be profoundly modified—whether for better or for worse is a controversial matter. One may, we think, fairly say that the Epilogue is the dream of a Communist poet, crystallized—and beautifully crystallized—into a politico-utopian creed suitable for an Ideal Commonwealth.

Electron Theory of Metals

The Theory of the Properties of Metals and Alloys
By Prof. N. F. Mott and Dr. H. Jones. (International Series of Monographs on Physics.) Pp. xiii+326. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 25*s*. net.

THE great interest with which the electron theory of metals has been received by physicists is due chiefly to two reasons. The first is the practical importance of metals and their great variety, enhanced by the possibility of alloying different metals. Thus a large amount of experimental data has been collected, and offers an extensive field for theoretical investigation which, in its turn, will be helpful from the practical point of view as a guide for the classification and discussion of the material.

The second reason lies in the fact that, before quantum mechanics, metals represented one of the greatest puzzles of theoretical physics. At a time when the properties of atoms, the structure of ionic crystals, etc., were at least qualitatively understood, any attempt to explain the behaviour of electrons in metals landed one in hopeless contradictions. Therefore it was natural that when the papers of Fermi, Pauli and Sommerfeld showed that the difficulties could be overcome with the aid of quantum mechanics, the centre of interest in the theory of metals lay in these difficulties and their removal. One saw how Fermi's statistics reconciled the absence of a high specific heat of the conduction electrons with their large contributions to electric and thermal conductivity, and how the wave nature of the electron reconciled the strong forces acting on the electrons with a mean free path greatly exceeding the atomic distance. There was a large number of similar questions, all concerning the properties of metals *as a class*. During that time the other aspect of the theory of metals, the discussion of the differences between *individual* metals and the relations between the properties of any one metal, was neglected.

This group of problems has been attacked only in the last few years in a number of papers, among which those of the Bristol workers are of outstanding importance. In the excellent account they give in a new volume of the "International Series of Monographs on Physics", Prof. N. F. Mott and Dr. H. Jones very rightly emphasize this second point of view, and indeed theirs is the first book on metal theory in which the properties of individual metals are reliably discussed and explained. At the same time they do not neglect the other aspect of the subject, and give a good introduction to the general foundations of the theory of metals.

The work which they discuss, and the many original contributions to the subject they have made in the course of preparing the book, are with few exceptions based on the picture of one electron moving in a field of force. In other words, the correlation between different electrons is neglected or at least greatly simplified. This limitation is customary in the theory of metals, and is imposed by the need of avoiding mathematical complications which nobody has yet been able to overcome and which are not likely to be overcome in the near future. This 'one-electron approximation' results in a slight uncertainty in the predictions of the theory; it is most probably responsible for the failure of the theory to account for supraconductivity. The authors point out clearly where use has been made of this simplification, and which results may possibly be affected by it. One would thus not be surprised if the results agreed with the experimental evidence less well than they actually do; they seem to confirm a general rule—very comforting to the theoretical physicist—that "every approximation gives better results than it might do".

It is, of course, not possible here to give a complete list of the problems dealt with in the book, but they include a thorough discussion of the structure and the thermal, optical, magnetic and electric properties of metals. Surface phenomena, such as the thermionic emission and the photo-electric effect, are wisely omitted. Also electron diffraction is not mentioned—which is perhaps a pity, since it would have been instructive in connexion with the 'zone structure' of the electronic levels inside a metal.

On all these problems, the theoretical situation is reviewed and the empirical constants are related to the fundamental constants of the metal in question, or, as in the case of the cohesion forces and the elastic constants and the specific heat at low temperatures, calculated on purely theoretical grounds. Then the experimental data are reviewed in the light of the theoretical results.

Every mathematical proof is preceded by a short qualitative argument showing its main points, and in this way the important steps remain clear to a reader who does not want to follow the formal argument in detail. This, together with frequent cross-references and a large number of diagrams and tables, makes the book also very handy for reference to special points.

It need scarcely be said that the exposition is as clear and the mathematical treatment as simple and reliable as we have become used to expect of a book that bears Prof. Mott's name. R. P.

Reinforced Concrete

(1) Principles of Plain and Reinforced Concrete Construction

By Dr. E. Probst. Pp. xii+344. (London: Edward Arnold and Co., 1936.) 30*s*. net.

(2) Elementary Structural Problems in Steel and Timber

By Prof. C. R. Young. Second edition. Pp. xiii+315. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935). 20*s*. net.

(3) Architectural Graphic Standards:

for Architects, Engineers, Decorators, Builders and Draftsmen. By Charles George Ramsey and Harold Reeve Sleeper. Second edition. Pp. xii+284. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 30*s*. net.

(1) FOR a number of years, as professor and director of the Concrete Laboratory, Karlsruhe, as a private investigator in his own laboratory and as a practising engineer, Dr. E. Probst has studied the use of concrete, its properties and its possibilities, and the results and conclusions arising out of this work have recently been published. In the English translation, "Principles of Plain and Reinforced Concrete Construction", for which the author accepts responsibility and which may therefore be taken as authoritative, his investigations have been described and explained in an easy style and in full accord with English nomenclature and units, the notation and symbols being those adopted in the Report of the Reinforced Concrete Structures Committee (Department of Scientific and Industrial Research).

Dr. Probst takes the view that, in general, the solutions of the unexplained problems of concrete construction are to be obtained from a study of the material itself, not as an idealized structural material constituted according to preconceived theories and more or less dissociated from the purpose for which it is required, but with the steady aim of bringing design, calculation and execution into harmony with the peculiar and individual properties which the material can be shown to possess. With this purpose, the author first examines the plain concrete, noting the properties of the various cements and aggregates used and discussing their testing, grading and mixing, and the physical and chemical properties of the mortars and concretes which they can be made to form. Relative to the influences of different qualities and proportions of the materials used, of shape, of methods of curing and other causes on the final result, extensive data have been collected and explained, and suggestions given as to those most suitable for particular conditions. Passing lightly over the subject of the qualities and forms of steel in use, the author treats at length the combination of concrete and steel, citing the results of numerous tests and observations and, in addition, examining the effects of ageing, heat, electric currents and chemical action.

In the second part of the volume, the statics of reinforced concrete structures are discussed and elaborated in relation to cases of axial tension and compression and to those of bending, and the calculation of normal and shear stresses in reinforced concrete sections is explained. The internal stresses at various periods after placing and those due to repeated loading are closely examined, and are shown to differ appreciably from the previously assumed modes of distribution, thus suggesting the need for revised methods of calculation such as are here exhibited. By means of a number of examples it is shown how the equations deduced in this investigation can be applied in simple designs.

(2) Prof. Young's book, in its second edition, contains many new problems involving the design of entire structures or portions of structures in addition to all the original material which is not out-dated by present-day methods. It is, in the main, concerned with the design of steelwork in buildings, bridge spans and cranes and also gives a substantial section to timber beams, trestles and roofs. The new material introduced includes welded connexions, a floor panel using reinforced concrete joists, and several other typically modern examples.

(3) "Architectural Graphic Standards" is an encyclopædia, wholly in the form of drawings, of building construction, fittings and furnishings, and gives the usual sizes of practically every item of which an architect is likely to require data. Here also reinforced concrete is largely represented in the new matter introduced.

Zulu Society

The Social System of the Zulus

By Eileen Jensen Krige. Pp. xix +420 +12 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd.; Johannesburg: University of the Witwatersrand, 1936.) 25*s*. net.

FOR several reasons the Zulus were for long, to the British public, the typical and, notwithstanding the eccentricities of Bushmen and Hottentot, the best-known of the indigenous peoples of South Africa. Their highly organized society and their resistance to British arms, especially at Rorke's Drift in 1879, made a deep impression on the popular imagination. The high estimate of Zulu character to which this gave rise found confirmation in the fiction of Rider Haggard. Further knowledge of the number of distinct peoples to be found in South Africa and of their marked differences has not entirely obliterated the impression.

Miss Krige's account of Zulu society, though not a comparative study, gives the English public a fuller and more comprehensive picture of its essential and distinctive features than has as yet been available within the compass of a single volume. For the anthropologist she has provided an invaluable summary of previous records, classified, digested and interpreted in the light of personal investigation among the people as they are to-day. Obscurities, omissions and doubtful points have been cleared up by inquiry from those among the people themselves who are reputed to be best acquainted with tradition.

As with other native peoples of South Africa, the place of origin of the Zulu is unknown, the attribution to West Africa, which has been favoured, resting on an early Portuguese inference of little value. Their traditions suggest that they were in South Africa in the sixteenth century. The crucial period of Zulu history, however, and their dominance among South African tribes, lies in the nineteenth century. In the early years of that century, Shaka acceded to power as king, and moulded his people into a fighting unit, organized into regiments, which maintained its independence until the fall of Cetewayo in the Zulu War of 1879.

Shaka was a man of strong and ruthless character, possessed of a genius for political organization, such indeed as is not without parallel in African history, but in his instance of an exceptional order. The consolidation of the Zulu people and the extension of their power was coupled with the rise of the Matabili and other movements of peoples, which affected tribal distributions so far north as Lake Nyasa. It was not unique. Similar consolidations appear to have taken place elsewhere in Africa at about the same time, or not long after. In the present state of African research, the predisposing conditions are not clear. Similarly, the regimental organization was based on the advantage taken of the age classes common to most Bantu peoples. In these and other details of Zulu organization, Shaka showed his outstanding ability by bending them to serve his purpose of Zulu supremacy and his own personal dominance. Obviously Zulu history is not without its lessons for to-day, when it thus demonstrates the political capacities and social adaptability of the African along lines congenial to his traditions.

This and like reflections must occur to any reader interested in the African, who takes Miss Krige's book in hand. Such broader implications of the theme lie beyond her scope; but she sketches the history of the Zulu people adequately to show its bearing on the development of Zulu society. Much of the old military organization, such as the regiments, survives, although it has lost its military purpose and meaning; and checks and counter-checks devised to consolidate Shaka's power, as for example in overriding the witch-finder, are still operative.

The Nile

The Nile:
the Life-Story of a River; from the Source to Egypt. By Emil Ludwig. Translated by Mary H. Lindsay. Pp. 352 + 34 plates. (London: George Allen and Unwin, Ltd., 1936.) 16*s*. net.

IN this book a famous biographer has attempted to give a description of the course of the Nile from its sources to the sea as if it were the life-history of a person. In it the reader with no first-hand knowledge will find much interesting information about the topography, vegetation, human and animal life, and history of the Nile basin, and may think that he is reading an authoritative work by one who has seriously studied the river and travelled extensively in its basin. If, however, he is sufficiently interested to pursue the subject further and refers to standard works, his confidence in the author will be badly shaken by the many mistakes which he will discover. The book is written in flowery language, and the reader will become very weary of the personality device and its meaningless symbolism before he comes to the end.

The first portion of the book is concerned with the great Lakes Victoria and Albert and the surrounding country in which the White Nile has its sources. Some of the information produced about the region is a little surprising, as for example the natural bridge at Nimule, "such as hardly another river on earth possesses in this form, consisting of rank water plants, so strong that it bears the elephant from one bank to the other, and so powerfully rooted that when floods have destroyed it, it closes up again of itself". Nobody else has ever reported this bridge, and as an elephant weighs five tons or more, the rank water plants must have been considerable trees. Some of the remarks about evaporation are equally strange, for the author says: "As Lake Victoria is not three hundred feet deep, so that more water evaporates than is received, this constant diminution, as we shall see later, presents the Nile engineers with a very grave problem." This is an example of the lack of knowledge of the elements of natural science displayed in the book and of the inaccuracies which are of frequent occurrence. Lake Victoria has not progressively diminished in volume in the forty years over which records extend, though, like other large lakes, it has fluctuated with the variations of the rainfall.

The author continues his description of the White Nile and then describes the Blue Nile and the Atbara, with some account of the history of Abyssinia, and the Main Nile as far as Aswan, the description of Egypt being left for a second volume. Towards the end of the book he has a few paragraphs on hydrology in which he gives some figures about the volumes of water flowing in the various tributaries. As many of these figures are badly wrong, it would have been better to have omitted them.

The remarkable feature about the book is the number of errors it contains. Some, like the picture of hippopotami entitled "rhinoceros" and the statements that the hippopotamus has been seen starving to death on phantom islands of grass, and that the Atbara rises in Lake Tana, will be readily detected; others, like the statistical errors, of which there are so many, will escape the notice of the general reader and be assimilated and perpetuated, for a false statement once started can never be overtaken. The most reliable feature of the book is the maps, which are taken from another work.

It is a misfortune that a book which is written by a well-known author should be so unreliable; but in a serious description of natural phenomena there is no excuse for gross inaccuracies, and the author owes it to his own reputation as well as to his readers to make no mistakes in his presentation of facts. Perhaps the lesson may be drawn that literary ability will not make up for lack of knowledge of the subject, and we recommend this consideration to the author before he produces the second volume of the work.

H. E. HURST.

Differential and Integral Calculus

By Prof. R. Courant. Translated by Prof. J. E. McShane. Vol. 2. Pp. x+682. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 30*s*. net.

THE English edition of Vol. 1 of this work was briefly reviewed in NATURE of March 9, 1935, and the present volume is a translation, also by Prof. McShane, of the original German text which was published in Berlin in 1929. It is devoted to the more advanced parts of the calculus; chiefly to functions of several variables and their physical significance. As in the case of vol 1, this edition differs in several respects from the German. It is indeed a much larger book, for there were only 360 pages in the original. Considerable additions have therefore been made, consisting mainly of an extended chapter on differential equations; new chapters on the calculus of variations and on the complex variable, whilst a supplement on real numbers and the concept of limit has been provided at the end. It may be remarked that it seems somewhat strange that the text of a modern book on advanced calculus should have to be amplified by a treatment of the complex variable.

The course, introduced by a chapter on the fundamentals of analytical geometry and vector analysis, embraces the usual topics generally considered as advanced calculus—derivatives of functions of several variables; multiple, line and surface integrals with the theorems of Gauss, Green and Stokes; differential equations with special reference to mechanical and physical problems, etc. Chapters ii–v are each followed by a useful appendix in which the relevant theory is further elaborated.

The needs of the student are well provided for, as the book not only abounds in copious exercises, but also devotes fifty-five pages at the end to answers and helpful hints. Mention should likewise be made of the very full and valuable summary of important theorems and formulæ. The text is well developed, clearly illustrated and excellently printed.

F. G. W. B.

The Birds of Tropical West Africa:

with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. By D. A. Bannerman. (Published under the authority of the Secretary of State for the Colonies.) Vol. 4. Pp. xl+459+14 plates. (London: Crown Agents for the Colonies, 1936.) 22*s*. 6*d*.

THE publication of Mr. Bannerman's six-volume work on West African birds has been suspended midway for nearly three years, owing to financial exigencies of the times which have affected the Colonial Governments supporting it. Happily, these difficulties have now been surmounted, and with the appearance of this volume there is prospect of the early completion of a valuable record which should place the ornithological study of the region in a strong position. The book, it may be repeated, admirably serves the double purpose of a summary of existing knowledge and an aid to further investigation. In the latter respect, great pains have been taken to assist the observer in identification. As well as the detailed description of each form, there is at the beginning of the volume an illustrated key to the families and genera, and there is also for each family a further key to the genera and species. This useful feature was included in the earlier volumes, but it is especially welcome now that Mr. Bannerman is dealing with the huge and difficult order Passeres, the treatment of which will occupy the whole of the second half of his great work. In addition to text figures, the fourteen coloured plates beautifully depict sixty-five different species.

The Modern Dowser:

a Guide to the use of the Divining Rod and Pendulum. By Le Vicomte Henry de France. Translated by A. H. Bell. Pp. xvii+139. (London: G. Bell and Sons, Ltd., 1936.) 4*s*. 6*d*. net.

THE subject of dowsing is one to which a great deal of attention has been given in France in recent years, and its range of application has been extended in many directions, chiefly in the field of biology and medicine. This little book gives an excellent summary of the main facts, but its chief value lies in the instructions given which enable the reader to experiment for himself. Contrary to the practice of most of the best English dowsers, the author makes great use of the pendulum, and most of the instructions refer to this rather than the rod. As is usual in books on this subject, the physical explanation given could not be accepted by physicists in the form in which it is given, and when the author's account of the claims with regard to distinguishing wines, finding aeroplanes, and diagnosing disease are examined, the scientific imagination is stretched to the limit. However, there is no doubt of the enthusiasm with which the study of this curious, and in some sense genuine, human faculty is being carried on in France, and it is to be hoped that further experiment will throw some light on its physical nature.

Inorganic Preparations:

a Systematic Course of Experiments. By Alexander King. Pp. xi+164. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1936.) 5*s*. 6*d*. net.

THE present book contains detailed descriptions of 187 preparations, and sketches of almost as many additional preparations. The accounts of the experiments are sufficiently detailed to ensure success, and references to the literature are given. The text is arranged under the headings: physical state, elements, binary compounds, acids, bases and salts, complex salts, compounds of some rarer elements, and reactions which form the basis of some industrial processes. Many of the experiments are suitable for pupils in schools and the more difficult ones for university courses. They will form a valuable supplement to the courses in analysis, which fail to teach many important aspects of laboratory manipulation. The book may be warmly recommended, and it deserves to be widely used.

The Percy Sladen Expedition to Lake Titicaca, South America

By Prof. J. Stanley Gardiner, F.R.S.

AT the International Geographical Congress held at Cambridge in 1928, Mr. Hope-Jones and Major Vallenas, representing the Sociedad Geografica de Lima, suggested that a British expedition be arranged for the investigation of Lake Titicaca in all its aspects, and proffered the support of their Society. Owing to financial conditions in Great Britain, the contemplation of such an expedition was not possible then or for some years. Finally, in January 1936, the matter was referred to the Percy Sladen Trustees, who decided to send an expedition to work on the lake during the winter or dry season (April–October) of the present year, the proposed researches meeting with the complete approval of the Royal Society and the Trustees of the British Museum. The expedition is also receiving a generous welcome from the Peruvian and Bolivian Governments.

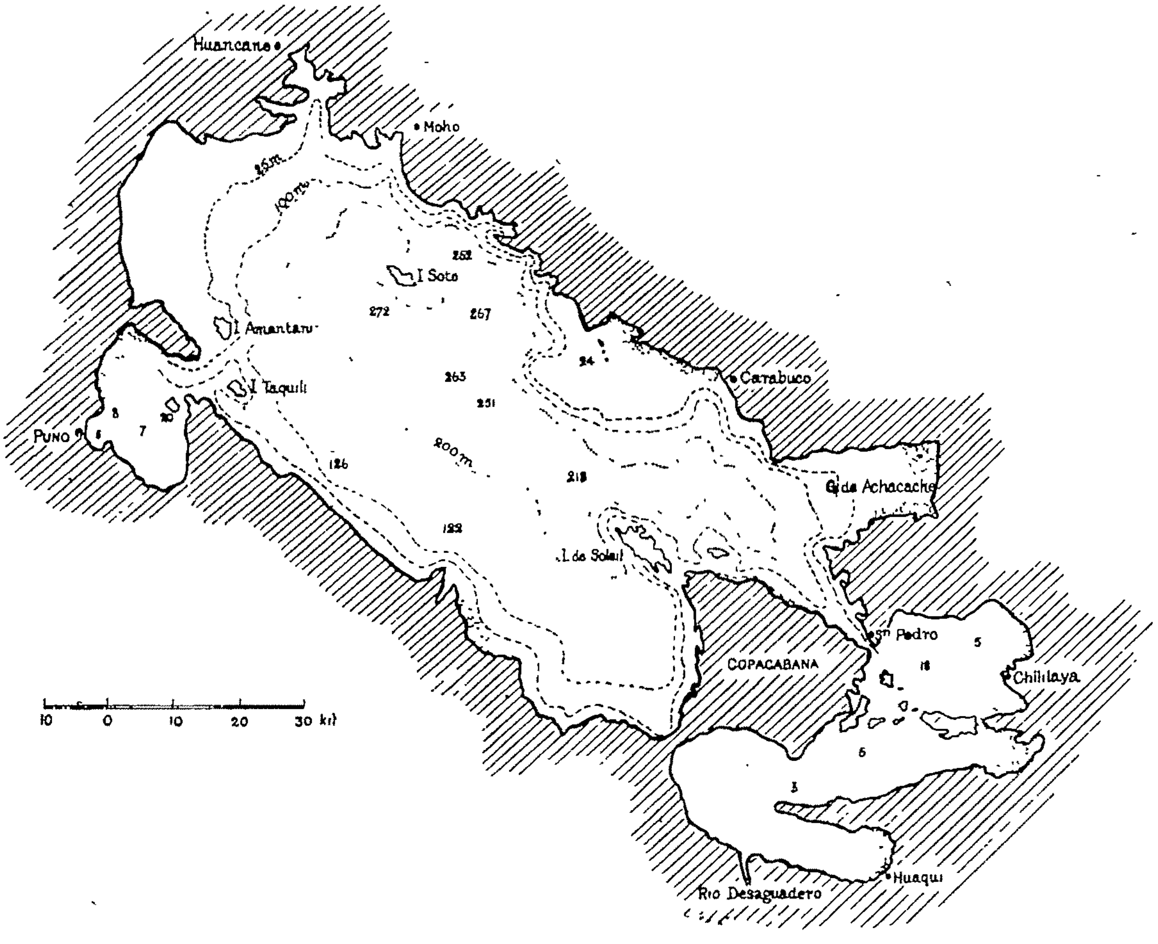

Fig. 1.
Lake Titicaca.

Lake Titicaca is situated in an area in the middle of the Andes, where these mountains branch and afterwards rejoin, and about two thirds of the lake are in Peru and a third in Bolivia. It is situated at 12,500 ft. above sea-level and covers more than 3,000 square miles, its deepest sounding at present being 273 metres. It is fed mainly by streams from the mountains, which attain a height of 22,000 ft. to the east, while the railway pass from Molliendo to the west is at 14,666 ft., the total area of this central plain being more than 100,000 square miles. The lake itself is subject to differences in level of its waters, the causes of which are not clear, since it has an outflow by the Rio Desaguadero to the shallow Lake Poopo, about 300 miles to the south. Around this is a large area of partially overgrown marsh, into which there is extensive seepage from Poopo, the whole plain having no communication on any side with the sea. On Lake Titicaca the nights are cool, often with ground frost, but the days frequently experience a temperature range of 60°–70° F. However, the temperature of the lake remains relatively constant, perhaps due to the strong winds along its length from south to north causing mixation of its waters.

The country around, almost certainly the original home from which potatoes were imported into Europe, is for the most part dry and bare of timber. It is approached by the Southern Railway of Peru, the main line of which extends north to the Cuzco region, the central part of the Inca Empire. Around it are lead and other mines, and the Peruvian Corporation, which has most generously extended its help to the Expedition, besides managing the railway and conducting business enterprises, runs a regular steamer service from Puno in Peru, a town of more than 20,000 inhabitants, to Huaqui in Bolivia. Around the lake are a few small settlements, and the Island of the Sun in the Bolivian area is the centre of an important pilgrimage.

The lake itself is evidently little affected by drainage from settlements, and agriculture in its surrounding lands is little developed. It indeed seems to be fed mainly by glacier streams of relatively constant volume and composition. It was visited by Alexander Agassiz sixty years ago, when a few amphibians, two genera of fish and some higher crustaceans were obtained. Its birds were collected by an expedition from the American Museum, and lately there has been an investigation of its biology with the view of introducing more profitable fish, as has been done into some northern Peruvian lakes. Apart from the fauna and flora, the full range of which will have to be ascertained, the lake presents a unique field for ecological study Its position suggests that it is a relatively primitive lake, and it may well belong to an 'oligotrophic' type, in contrast to the 'eutrophic' lakes of the East Indies and Central Africa. In this connexion, the question of its nitrogen cycle will be a main object of interest, the distribution of nitrates, nitrites, ammonia and organic nitrogen, the seasonal changes in the same at various depths to determine their transformations ; such researches, perhaps owing to a certain simplicity in the lake, should form invaluable data for comparison with the more complicated phenomena of the sea. Simultaneous determinations will have to be made of the quantity, composition and distribution of the plankton, which is as yet unknown. To obtain an understanding here will necessitate *p*H, oxygen, phosphate and other analyses. Further, the fauna and flora of the shallow waters of its long coast-line will have to be surveyed adequately and ecologically.

On the physical side, here is a lake with the sea-level pressure reduced to two thirds with consequent effects on wind-force. The solar radiation is greatly increased, especially at the ultra-violet end of the spectrum, which has particular biological significance. Here are two matters of which relatively little is known, and on which it is hoped that results may be obtained that will elucidate conditions in low-lying lakes. Measurements of light penetration are desirable to determine the limits in depth to which the phytoplankton can flourish. These are special subjects in the general hydrographical study of the lake and of its circulation as revealed by temperature and density observations.

The expedition as now arranged is under the leadership of H. C. Gilson, fellow of Trinity College, Cambridge, who will be accompanied by T. G. Tutin as botanist, H. P. Moon, G. I. Crawford of the British Museum, P. F. Holmes and D. M. Hall. All are graduates of the University of Cambridge, relatively young, because at these altitudes no others can, without long acclimatization, be expected to carry on the constant labour that the expedition will entail, and because to the optimism of such must be assigned the scientific attack in new directions, for which they have now been preparing for many months. They are to be joined by Dr. H. E. Hinton as a volunteer, his study being the water-living insects of the lake and streams.

The expedition leaves England on March 11, Messrs. Gilson and Hinton having proceeded in advance on February 18 to present their credentials to the Peruvian Government and to arrange for camp and commissariat on the lake, on which it is hoped to obtain six months' continuous observation. Besides the necessary scientific equipment, the expedition is taking out a motor-launch especially equipped for its daily observations, its speed of 16 knots at sea-level reduced to about 10 knots at this altitude. While the whole of the members of the expedition in respect to its objects are to a large degree interchangeable, it is anticipated that they will fall into pairs concerned with the chemical, physical and shallow water ecological observations, the plankton, fauna and flora being the concern of all. Clearly, this expedition will not be a 'joy-ride', and it is one to which the good wishes of all the scientific world will be gladly extended.

The Measurement of Time

By Prof. H. Dingle

TIME cannot be measured as any other physical magnitude is measured. Measurement is the determination of the number of 'units' contained in the assigned quantity, and the unit is defined either (as with mass and space) as an arbitrarily chosen, permanently preserved piece of the magnitude in question, or (as with temperature, electric charge, etc.) as that which produces a specified amount of an arbitrarily chosen effect ultimately measurable in terms of mass or space. But it is impossible to preserve a standard second, and time produces no effects—events occur *in* it but not *because of* it. Consequently measurement of time must be a special process.

The only practicable procedure so far conceived is the following. Choose a sequence of events (natural or artificial) between consecutive members of which there is an interval of some other (measurable) physical magnitude as well as an interval of time; then the time intervals can be defined as proportional to the corresponding intervals of that magnitude. This process involves three successive steps:

(1) Choice of the kind of measurable interval between the events.

(2) Choice of the particular sequence of events separated by intervals of this kind.

(3) Choice of the unit of measurement of those intervals.

Physics has chosen under (1) intervals of space; under (2) the successive spatial positions of an ideal body free from external forces—represented approximately by the successive directions of a specified radius of the earth; and under (3) an ideal rigid rod, represented approximately by the standard metre.

Each of these choices is in the last resort arbitrary; there is nothing in Nature to prohibit the selection, for example, under (1) of intervals of mass, under (2) of the successive masses of any particular body, and under (3) of any standard unit of mass. There are differences in convenience, of course: no sane physicist would normally define equal times as those in which a Californian redwood tree acquired equal increments of mass according to a standard piece of uranium. But so far as Nature is concerned, this and the traditional measure adopted by physics are equally valid.

Before the theory of relativity was formulated, it was thought that each of the three steps was prescribed by Nature. Time must be measured in terms of a sequence of spatial intervals; there was one unique uniformity of velocity defining the only valid sequence of spatial positions; and there was one unique standard for measuring the spatial intervals between those positions. Then came the discoveries that two rods, equal in length when relatively at rest, became unequal when in relative motion, and that in the latter circumstances it could not be determined which was moving. It followed that Nature's standard measuring rod in (3) could not be identified. Relativity saved the situation by pointing out that it was mythical, all standards being equally legitimate if used consistently. This discovery of the arbitrary character of step (3) is known as *special relativity*.

Steps (1) and (2) remained unique. This meant, first, that the unit of time must share the voluntary character of the unit of space, for since, under (1), time intervals were proportional to space intervals, any arbitrariness in the latter must appear also in the former; and secondly, that whatever choice was made under (3), the changes in space and time measurements could never convert uniform into accelerated motion, or vice versa, because, to preserve the uniqueness of (2), the units must be related so that the earth rotated uniformly. The supposed absoluteness of step (1) accounts for the common statement that time has become space. Having decided to measure time in terms of space measurement, it naturally follows that time and space measurements are related, but the relation does not belong to Nature. If intervals of mass or temperature had been chosen in (1), time would have 'become' mass or temperature. Again, the supposed uniqueness of step (2) accounts for the restriction of special relativity to uniform velocities: the equations of transformation had been determined experimentally for such velocities and the passage to accelerations was closed.

The next advance was the realization of the essential arbitrariness of step (2). Nature makes no demand that the earth shall rotate uniformly; we can choose *any* sequence of spatial positions, measure the space intervals between them by *any* standard rod, and define equal times accordingly. This discovery was *general relativity*; it destroyed the supposed absolute distinction between uniform and accelerated motion.

The effect on formal physical theory was in each case a simplification: special relativity eliminated time, and general relativity mass (or force), as independent conceptions. A velocity was no longer definable only as so many space units divided by so many time units. A velocity of 4 miles an hour was a movement through 4 miles while the earth rotated through 15°, and could be expressed as "4 miles per 15°". Space (or space-time, as it was called) measurement was thus adequate to describe velocity. A further elaboration of space measurement included force or mass, so the whole of metrical mechanics became expressible in terms of a single concept of space.

The arbitrariness of step (1) is not yet generally realized, but clearly we are just as free to choose a sequence of, say, entropy intervals as one of space intervals to define a time scale, and as a result we might expect an expression of the laws of thermodynamics in terms of a timeless entropy just as the laws of mechanics are expressed in terms of a timeless space. Two opposite extreme attitudes of physicists to this matter require attention.

In the first place, though apparently no one has explicitly noted the arbitrariness of (1), it is inherent in Milne's recent kinematical theory. Milne points out that any sequence of events whatever is valid for enumerating time instants, and this clearly gives us permission to choose events separated by intervals of any kind to provide a measure system for time. But he goes no further: having claimed freedom he takes no advantage of it, so that his claim, though perfectly just, is also perfectly useless. Instead of proceeding to advance physics by measuring some physical interval between the events chosen and defining a time scale in terms thereof, he restricts his consideration to the numbers identifying the instants themselves. The result is naturally that nothing of physical interest emerges; it is impossible even to distinguish between relative rest and relative motion until some choice of clock is made. Milne tries to define a basis of choice by postulating a 'cosmological principle', but this, being obviously beyond experimental confirmation, is metaphysical, and furthermore has not succeeded in making the distinction mentioned. Time is essentially immeasurable by ordinary processes, and you get out of its so-called measurement just what you put in. If you measure time in terms of space, time becomes space; if you measure it in terms of temperature, time becomes temperature; and if you measure it in terms of a cosmological principle, time becomes metaphysics.

At the other extreme is the position taken by the majority of physicists who, ignoring the voluntary character of (1), by implication accept as a natural necessity the measurement of time in terms of space. Probably the most emphatic expression of this acceptance is Eddington's statement ("The Nature of the Physical World", p. 74) that the second law of thermodynamics holds "the supreme position among the laws of nature". His reason is that this law alone reveals "time's arrow". But clearly this distinction is arbitrary. Having elected in (1) to measure time spatially, we can choose, and have chosen, in (2) for defining equal time intervals the particular sequence of spatial events that puts an arrowless time in mechanical laws. Thermal laws, being temporally 'out of step' with mechanical laws, then show time's arrow. But if we choose in (1) to measure time thermally, and in (2) the sequence of thermal events which puts an arrowless time in the laws of heat (for example, we might define as equal times those in which a standard body radiates equal amounts of heat or falls through equal ranges of temperature or changes by equal increments of entropy, etc.—heat, temperature and entropy measurement, of course, being defined by an arbitrary choice under (3)), time's arrow goes over into mechanics, which then assumes the 'supremacy' now assigned to thermodynamics.

We must distinguish two things:

(*a*) The *order* of events in time.

(*b*) The *intervals between* events in time.

The first is independent of measurement and is not arbitrary. The second, which alone give us our mathematical 'laws of Nature', depend on measurement which is arbitrary in the three-fold manner indicated above. For example, the statement that entropy tends to increase belongs to (*a*); the statement that the increase tends towards a finite maximum value depends on (*b*). If we define equal times as those during which a standard body acquires equal increments of entropy, there is no finite maximum value, and the entropy of that body increases uniformly through eternity.

The system of measurement to be chosen depends on the question of interest. If we ask whether terrestrial life will ever cease through failure of solar heat supply, the appropriate system must be indicated by the biologist; if rhythmic vital processes adapt themselves to solar heat supply such cessation will never occur, but if they adapt themselves to our physical system of (approximately) uniform rotation of the earth, it probably will. The former would seem more likely to be the fact. There is, however, the further consideration that life may depend on terrestrial (determined by solar) temperature more than on heat supply (though the present maintenance of the same body temperature in the arctic and tropic zones prohibits dogmatism on this point), and the fact that the sun cools comes under (*a*) and not (*b*). That is true, but there is no evidence that it is a 'fact'.

Apart from arbitrary choice, there seems to be complete equivalence between mechanical and thermal processes. Both show a one-way tendency in (*a*)—moving bodies tend to stop and hot bodies tend to cool. We do not need a special entropy clock to show which of two instants is the later; a grandfather clock will do—the later instant corresponds to the lower position of the weight. In favourable circumstances (for example, the rotation of the earth), 'uniform' motion may be eternal, and in favourable circumstances (for example, the radiation of the sun) 'uniform' radiation may be eternal. There is no evidence that the sun's temperature is falling, apart from the laws of mechanics, which presuppose fall and are therefore inapplicable: on the contrary, there is much difficulty in accounting for the fact that the sun radiates *without* observable fall of temperature. We are no more compelled to say that an isolated body would move uniformly than that it would radiate uniformly: in each case we can observe only bodies that are not isolated, and we find, first, that neither motion nor radiation is uniform, and secondly, that the nearer we approach isolation the nearer we approach a *common* uniformity of both motion and radiation.

Space prevents discussion of the possibility of re-expressing thermodynamics in terms of a thermal time measure, but there seems to be a reasonable prospect that choice of the proper thermal quantity for the purpose, and application of relativity methods of relating time with this quantity, would introduce the quantum of action, h, in a manner analogous to the introduction of the velocity of light, c, into spatial relativity. The relation of one constant to thermal processes at least partly resembles that of the other to mechanical processes. If this possibility were realized, the way would be open for a completely unified field theory. This, of course, is at present a speculation, but the three-fold arbitrariness of time measurement and the deductions drawn therefrom rest on logic and historical fact.

Obituary Notices

Prof. Max C. W. Weber, For. Mem. R.S.

DR. MAX WEBER, for many years professor of zoology in Amsterdam, doyen of late of the whole brotherhood of zoologists, died at Eerbeek on February 7, in his eighty-fifth year. He was born at Bonn on December 6, 1852, of a Dutch mother and a German father, and learned his natural history from Franz Leydig in Bonn and from Eduard von Martens in Berlin. Leydig was an excellent anatomist, who gave Weber his lifelong bent towards mammalian anatomy; von Martens, a famous conchologist, who had travelled and collected in the East, was a man of fine taste and liberal education. In 1879, Weber went to Holland, where he taught anatomy, first in Amsterdam then in Utrecht, and presently went back to Amsterdam as professor of zoology. In 1883 he took out papers of naturalization, and married Mlle. Anna van Bosse, a young botanist of his own age, who proved herself the perfect wife and helpmeet.

Weber had already made a voyage to Barents Sea, in a little schooner 75 ft. long, the *Willem Barents*, named after Willem Barents who had discovered Spitsbergen at the end of the sixteenth century and so opened the way to that rich whale-fishery in which the Dutch had a paramount share for the next hundred years. The *Challenger* had not long come home, and Weber, like many another young naturalist, was all agog to go fishing in unexplored seas with dredge and trawl. For a few years after their marriage the Webers went every summer to Tromso, he mostly to dissect whales, and she to study corallines or calcareous algæ, on which she was even then becoming the chief authority. In 1888 they went to the Dutch East Indies, where they made large and varied collections and where Max Weber took up in earnest the study of geographical distribution. He belonged to an age, and he was of late its most conspicuous survivor, when a man could take all natural history for his province, and could make discoveries in many diverse fields. In the *Ergebnisse* of this Dutch East Indian Expedition, in which many colleagues including his old master von Martens came to help him, Max Weber himself wrote on the freshwater sponges, on that queer trematode worm *Temnocephalus*, which is a parasite (and yet scarcely a parasite) on a river-crab, on the anatomy of certain Siluroid fishes, on local species of reptiles and of mammals, on the scaly coat of the pangolin and its associated hairs—which led him to think that all mammals were once scaly, and that in many the arrangement of the hairs recalled the ancestral pattern of the scales—and lastly, together with his wife, on the green and yellow algæ symbiotic (to use a word lately coined by De Bary) in *Spongilla*.

The Webers' next journey was to South Africa—it was always to some homeland of the Dutch—again to study the freshwater fauna, and in Max Weber's case to study the anatomy of *Chrysochloris* and certain other South African mammals: the results of this expedition were published in the *Zoologische Jahrbücher*. Then, in 1899, Weber, resigning his professorship and becoming professor extraordinarius, embarked (of course with his wife) on their famous Siboga expedition to the Dutch East Indies. The *Siboga* was twice as big as the *Willem Barents*, but was still a very little ship; she was of some 800 tons burthen, and carried a crew of fifteen all told. But the scientific work she did and the collections she brought home were out of all proportion to her size and the modest cost of the expedition. The splendid series of Siboga reports have been coming out under Max Weber's editorship for all these years, and are scarcely finished yet: they carry on the work that Rumphius had begun two hundred years before and that had been in abeyance ever since; and they give the *Siboga* an honourable place among the reports of the great historic voyages of exploration.

The Dutch East Indies are classic ground for the study of geographical distribution, and Max Weber had it from the first in mind to re-study Wallace's line, or whatever better boundary there might turn out to be between the Indian and the Australian regions. He was soon out of conceit with Wallace's line, which runs in the channel, not a deep one, between Bali and Lombok—"diese unglückliche Linie von Wallace", as he called it; rather does the Indian fauna begin to be impoverished in Bali, and to dwindle out in Lombok and Timor. Celebes is the great puzzle, not only as to the boundary-question but also for other questions of its own. It is an old story, but a truly amazing one, that the rich freshwater fish fauna of Sumatra, Borneo and Java, each of them with a hundred and fifty species less or more, practically disappears in Flores and Timor and Celebes: there is nothing left but one or two immigrants from the sea like *Symbranchus*, and one or two widespread fishes, tenacious of life, like *Anabas* and *Ophiocephalus*. Great families, Silurids, Cyprinids, Mastacembalids, simply disappear as we pass from Borneo to Celebes. As to what is often called the mixed fauna of Celebes, Max Weber was, I think, the first to lay stress on the great difference between the north and south halves of the island. Each half has its own population of squirrels; *Babirusa* and *Paradoxurus* and certain monkeys are confined to the north; and of sixty-four species of land-snails, only two are common to the two halves of the island. It was Max Weber who pointed out that, while Celebes occupies a deep-water area and Borneo, Java and Sumatra a shallow-water or continental one, the deep water around Celebes has a temperature of above 3°, instead of the usual 1° of oceanic bottom-temperature; there must therefore be some unknown barrier to separate the deep waters of the archipelago from the main ocean.

Conspicuous among the many Siboga reports are Max Weber's own on the fishes, marine and freshwater, and his wife's on the coralline algæ, or so-called nullipores. Mme. Weber van Bosse found these latter in vast abundance, though of few species; Stanley Gardiner had already shown their important share in the building of coral-reefs, and geologists knew their vast importance as rock-builders, even (or so we are now told) in pre-Cambrian antiquity! As to the fishes, Bleeker, who had studied them for twenty years, had made known many hundreds of species from the rich tropical East Indian fauna; but among a thousand species in all, Max Weber found a hundred and thirty-one that were new to science, and two hundred and forty more that were new to the area in question. In Bleeker's time the deep-sea fishes were all unknown, there and elsewhere, for the *Challenger* and the *Valdivia* had not begun to discover them. Max Weber dedicated his great work on the Siboga fishes to his wife—"die mir im hohen Norden, in Süd-Afrika, im indo-australischen Archipelago, und auch während der Siboga Expedition eine immer freudige und hülfreiche Reisegefährtin war". In his later years, with the help of his pupil and successor Prof. L. de Beaufort, Max Weber undertook the task of setting in order the whole Indo-Australian fish-fauna, of some three thousand species in all. Of this great and laborious work seven volumes have appeared, and the old scholar was busy with the proof-sheets until within a few weeks of the end.

In the midst of all these great undertakings Max Weber had found time to write what is in some ways the greatest of them all, his text-book of the Mammalia. We have seen how comparative anatomy was his first love; he worked for years in Amsterdam in an old and rich museum, and next door to a fine zoological garden, which gave him continual work to do. His book "Die Säugetiere", did for mammalian anatomy what Owen had done when Weber was a boy; it was first published in 1904, and a much enlarged edition appeared in 1927–28, to which Otto Abel contributed the palæontological part and Prof. de Berlet (now of Groningen) certain anatomical chapters. From the days when he first learned his anatomy from Leydig, Max Weber never ceased to work at that inexhaustible and delightful theme; and among all his other abundant work, "Die Saugetiere" stands out a monument to his industry and his learning.

Max Weber was a childless man, but he had all else that should accompany old age. He was rich in honours. He had the order of Orange Nassau, the knightly order of the Lion of the Netherlands, and several foreign decorations. He was a foreign member of many academies, including our own Royal Society.

Weber was a great figure of a man. He had both charm and dignity, and he enjoyed for many years such general admiration and esteem as are only given to the very best of men. Fifteen years ago, when he reached his seventieth birthday, a letter was sent him by a number of English zoologists. They spoke with unaccustomed warmth, saying in conclusion: "Your solid learning has upheld the great scientific traditions of your country, your investigations have influenced and stimulated many of us, your broad interests, your singleness of purpose, the simplicity of your life and your genius for friendship have set an example for us all" (NATURE, **110**, 780, Dec. 9, 1922).

D'ARCY W. THOMPSON.

Dr. R. F. Rand

RICHARD FRANK RAND, a brilliant young surgeon trained at Edinburgh, was one of the Rhodesian pioneers and served as medical officer with the pioneer column sent by Cecil Rhodes to Mashonaland in 1890. As medical officer to the Chartered Company's police, and later chief hospital surgeon at Fort Salisbury, he devoted himself specially to the treatment of malaria, the scourge of the early settlers and then not recognized as a mosquito-borne disease.

The active period of Dr. Rand's long life was spent in practice in South Africa, chiefly at Salisbury and other places in Southern Rhodesia, and his great experience of tropical diseases was an important asset to the British forces in the Boer War and later in the Great War. His last years were spent in England, and he died very suddenly at his home at Brightlingsea, Essex, in his eighty-first year on January 3.

Rand was a keen naturalist, his great hobby was live botany; he not only collected but also keenly studied his plants in the field in intervals snatched from his always exacting medical duties. His collections of specimens sent to the British Museum Herbarium were accompanied by notes of his observations on their relation to environment, life-history and especially on details of floral structure and dispersal. He was one of the earliest collectors in Southern Rhodesia, and his gifts to the Museum in the late 'nineties and the early years of the present century provided many novelties. Accounts of these and his valuable field-notes and observations were published in the *Journal of Botany*. A. B. RENDLE.

Prof. David Ellis

PROF. DAVID ELLIS, professor of bacteriology in the Royal Technical College, Glasgow, died suddenly at his home in Bearsden on January 16, aged sixty-two years. He was educated at the University College of Wales, Aberystwyth, and after graduating in the University of London in 1896, taught for some time as a science master in secondary schools. Later he proceeded to the University of Marburg where he gained his Ph.D. degree in 1902, for researches in bacteriology. On returning to Great Britain he again took up science teaching, this time in Dollar Academy, and from there he went, as lecturer in bacteriology and botany, to the Glasgow and West of Scotland Technical College, the lineal descendant of the old Anderson College, now the Royal Technical College, Glasgow. Later he was appointed professor of bacteriology in the College and superintendent of its Schools of Pharmacy and of Bakery.

For his researches in mycology, Ellis obtained the D.Sc. of London in 1905. From 1907 until 1919 he was lecturer in nature study to the Glasgow Provincial Committee for the training of teachers, and during that period he was, for many years, chief examiner in botany to the Central Welsh Board. He was an early and successful worker in the field of adult education, his popular lectures in botany attracting many hundreds of people of the type which has the desire for learning but little opportunity of acquiring a scientific training. His work covered a wide field; and in the performance of the duties associated with the Schools of Pharmacy and of Bakery he showed a marked gift for the expression of scientific subjects in simple language.

Prof. Ellis was widely known for his work on the iron bacteria and the sulphur bacteria, on each of which subjects he had published a monograph. In addition to his more recondite publications he contributed articles to the press on scientific topics and was the author of "Outlines of Bacteriology", "Guide to the Common Wild Flowers in the West of Scotland" and "Medicinal Herbs and Poisonous Plants".

Prof. Ellis's services were in demand as an expert on problems relating to the disposal of sewage, and frequently he figured as a consultant in law cases, when water pollution had led to litigation in which the interests of communities were involved. Such was his authority on this and kindred topics that he was consulted by Government departments including the Department of Health. His leisure time was divided between golf and the care of his garden, and it was while happily employed in his garden that he died. He is survived by two sons. J. P. T.

Dr. W. V. Shaw, O.B.E.

DR. WILLIAM VERNON SHAW, a member of the medical staff of the Ministry of Health, died on January 21, aged sixty-three years.

Dr. Shaw had a brilliant career at Oxford, where he gained first-class honours in the final honour school of Natural Science, and at St. Mary's Hospital. He had a distinguished career in the public medical service first as medical officer of health for the Malton and Norton rural district, and later at the Ministry of Health. He was an expert epidemiologist and did valuable work for the Ministry in the investigation of outbreaks of infectious disease in many parts of the country. His diagnostic skill particularly of smallpox was widely recognized.

WE regret to announce the following deaths:

Prof. William Campbell, Howe professor of metallurgy in Columbia University, and an authority on physical metallurgy, on December 16, aged sixty years.

Dr. W. H. Collins, consultant to the Branch of Mines and Geology of the Canadian Department of Mines and Resources, and acting director of the National Museum, formerly director of the Canadian Geological Survey, on January 14, aged fifty-eight years.

Prof. Louis Mangin, director of the Marine Laboratory of the National Museum of Natural History, St. Servan, formerly professor of cryptogamic botany in the National Museum of Natural History, Paris, aged eighty-five years.

Prof. Bindo De Vecchi, since 1930 Rector Magnificus, and since 1925 professor of pathological anatomy of the University of Florence, on December 28, aged fifty-nine years.

Prof. R. L. Weighton, emeritus professor of engineering in Armstrong College, Newcastle-upon-Tyne, on February 19, aged eighty-five years.

News and Views

Sir James Frazer, O.M., F.R.S.

AT a dinner and reception given by Mme. M. Levinskaya at 2 Leinster Gardens, W.1., on February 17 in honour of Sir James Frazer and to celebrate his attaining the age of eighty-three years on January 1 last, Prof. B. Malinowski spoke in appreciation of his contribution to the study of man. After referring to the pre-eminent position long held by Sir James among anthropologists, he said that while such pioneers in the study of the early forms of religion as Mannhardt, Tylor and others looked to animism and the belief in spirits, Sir James was the first to indicate the place and junction of magic in primitive belief and to demonstrate the significance of magical practice and ritual in man's early conceptions of the universe. Further, that what Andrew Lang some twenty-five or thirty years ago flippantly termed "the Covent Garden school of anthropology", had become the fundamental principle in a great body of anthropological investigation into such beliefs as that of the spirit of fertility, the mother goddess and the like; while what was intended to be no more than a short essay of twelve pages dealing with the Priest of Nemi had grown into the twelve volumes of "The Golden Bough". Of all Frazer's great qualities, the most marked, as well as the most immediately striking, was his transparent and single-minded devotion to the cause of truth. He had never been so wedded to his own theories as to seek to impose them upon others in such a manner as to obstruct the attainment of the truth. He had never hesitated to abandon a theory which conflicted with further examination of the facts or fresh evidence, as was shown by the development of his views on totemism. In conclusion, Prof. Malinowski pointed out that, in principle, the studies upon which Sir James had been engaged were not confined to primitive man alone; they were equally applicable to our modern civilization—an application especially needed in the conditions of the world to-day.

Native Policy in Northern Rhodesia

SOME important observations on policy, present and future, in the administration of native affairs in Northern Rhodesia were made by the Governor of that Dependency, Sir Hubert Young, when addressing the members of the East African group of the Over-Seas League at Over-Seas House on February 19. It was evident from his remarks that, while the cosmopolitan population of the mining area naturally is concerned primarily with the interests of copper, the most important industry in the country, the outlook on the native question is somewhat different in other districts. In a country in which there are one and three quarter million natives to eleven thousand Europeans, it is recognized, Sir Hubert said, that the native has a right to have work most suited to him. Presumably it would be legitimate to interpret this as meaning, in less diplomatic terms, that the development of the native along lines in harmony with his own culture is to be the aim of administration, rather than the exploitation of labour solely to meet the needs of a European industry, important though this may be. An announcement, welcome in this connexion, was that an anthropological institute is to be established. This will ensure—or at least, so it may be hoped—that native custom and cultural trends will be studied thoroughly in order to meet the needs of administration. It will certainly afford an indispensable aid in the attempt which is now being made to re-establish the native organization and the native authorities. Sir Hubert Young expressed himself as "rather a heretic" in the matter of indirect rule. In view of the difficulties of re-establishing a system which now for some years has been in process of disintegration, it will perhaps be wise not to expect too much. At the same time, in regarding it as a training only, Sir Hubert wisely emphasized a fact often overlooked, that indirect rule cannot be an end in itself.

Archæological Investigations in Western Asia

SIR LEONARD WOOLLEY, accompanied by members of his archæological expedition, left England on February 23 for Syria, where excavations will be resumed on sites in the Antioch region early in March. The personnel of the expedition includes Lady Woolley, Mr. E. A. Lane of the Victoria and Albert Museum, who was with Sir Leonard at Ur, and Mr. Murray Threipland, who was a member of the expedition last year. Work will be resumed on both the coast and the inland sites. Results from the latter will be awaited with special interest, in view of the significance of the evidence obtained last year from a preliminary examination of the site of Tell Atchana on the River Orontes, which, as Sir Arthur Evans has pointed out, when viewed in conjunction with the evidence from the other Syrian site of Ras Shamra and that from Palestine, for the first time carries the relation between this region of western Asia and Minoan Crete back so far as 1700 B.C. Further indications are not wanting that the diversion by circumstance of the preoccupations of archæologists from the Mesopotamian area to peripheral regions, which to many at first sight seemed deplorable, will have speedy and far-reaching beneficial effects. Especially worthy of note in this connexion are the recent discoveries of the Neilson Expedition of the University of Liverpool on Cilician sites at Serkeli (*The Times*, Feb. 13) and of Miss Winifred Lamb, whose report on recent developments in the prehistory of Anatolia was presented before the Society of Antiquaries on February 19.

MISS LAMB, before dealing with her own excavations on the newly discovered site at Kusura, which began in 1935, pointed out that recent archæological investigations in Anatolia had deduced from the surface examination of prehistoric mounds and the excavation of two or three large sites, that during the Bronze Age two main cultures were to be distinguished, of which one, a western, had affinities with Troy, and the second, a central and eastern culture, was marked by the principal Hittite remains. Kusura lies on the southernmost of three routes from east to west of which one extends to Troy, the second to the coast near Smyrna, while the third, with which she was concerned, traverses the upland plains south of Afyonkarahissar. The town itself, it would appear, was occupied for the first time about the end of the fourth millennium B.C. A cemetery yielded pottery markedly local in character, unlike anything found elsewhere in Asia Minor. This strongly marked local character in the culture Miss Lamb found to persist even at the end of the Bronze Age, when there were signs of Hittite influence as well as of connexions with Troy. Further evidence relating to the 'indigenous' culture and its contacts with east and west will obviously be of considerable interest, especially in view of the results obtained by the Neilson Expedition at Serkeh, where also, judging from the preliminary report, there appears to be a strongly marked local culture. This is clearly of considerable antiquity, as it underlies levels which correspond with the earliest culture of El Obeid and Arpachiyeh in Mesopotamia. The stratum in question is said to be nine feet thick and to lie at a level of twenty-five feet below the Hittite levels. Its distinguishing feature is a peculiar painted pottery and plain pottery, while obsidian and flint were in use.

Promotion of International Equity

A PRELIMINARY outline of the proposals of the New Commonwealth Society for the creation of an equity tribunal for the settlement of non-justifiable disputes between nations is contained in a pamphlet, "An International Equity Tribunal", which has just been issued by the Society. It is urged that three institutions are required: (1) a body endowed with the legislative function and with the power to effect peaceful changes in the public law; (2) a court to interpret that law; and (3) a police force to uphold the decisions of the Court and to maintain law and order. The League of Nations is considered the foundation upon which the structure of an enduring peace is to be built, and these institutions should form part of its permanent machinery. By an equity tribunal is meant an impartial or neutral body which is called upon to investigate a political or industrial dispute, and the findings or awards of which are based upon natural justice. Consequently an international equity tribunal would be capable of effecting peaceful change in the public law, including the revision of treaties, and would be empowered to arbitrate upon all political disputes which cannot be settled by negotiation and conciliation. The members of the equity tribunal would require to sever their connexion with the Governments and politics of their respective countries and devote their time exclusively to the service of the tribunal and of the League. An embryonic example of the working of an equity tribunal may be seen in the Lytton Commission, and a further stage towards the development of the tribunal system would be the creation of permanent committees by the Council or the Assembly in place of such *ad hoc* bodies.

IT is suggested that the formation of an equity tribunal with a permanent and independent status, with members elected in the same way as the judges of the Permanent Court, is likely to provide the most effective machinery for the adjudication of political disputes and the revision of treaties. Its addition to the machinery of the League would disarm the assertion of certain non-members that the League is simply a vehicle for protecting and sponsoring special interests. The tribunal would be related to the Permanent Court, possibly as an independent division, with a personnel not consisting mainly of lawyers, and enforcement of its awards in the last resort would be secured by the existence of an international police force. The pamphlet is obtainable from the New Commonwealth Society, which has established itself as one of the most active organizations working in the field of international peace. Particulars of its work and conditions of membership can be obtained from the Secretary, Thorney House, Smith Square, Westminster, S.W.1.

Organization in Petroleum Research

RESEARCH is necessary in practically every phase of the petroleum industry to-day and, in view of its importance, should be prosecuted in the most efficient and economic manner possible. In a paper read before the Institution of Petroleum Technologists on December 8, J. H. Vermuelen discussed the organization of research. The main point to which he directed attention was that although decentralization is inevitable in every petroleum company owing to its very nature, yet its technical and administrative activities should be controlled and guided by a central laboratory. The laboratory should be so designed and equipped that routine and ordinary research can be carried out at the same time as applied and pure research and, while there should be no interference between the two types of research, yet there should be ample facilities for exchange of ideas. The routine function of the central laboratory should be to collect technical and commercial data from all branches of the company, systematize it and render it available in a convenient form for reference.

AT the same meeting of the Institution, W. C. Asbury and D. A. Shepard threw further light on the organization of research by a description of methods adopted by the Standard Oil Co. (N.J.). Since its inception, sixty-five years ago, the company has been engaged continuously in research, and has had to meet the diversified interests and needs of several hundred subsidiary companies. Its technical organization has grown on lines which combine centralization and decentralization. Problems peculiar to one operating unit are studied in laboratories controlled by that unit, but in addition all operating units are served by a commonly controlled central staff organization which incorporates research and development laboratories and co-ordinates the technical, scientific and patent activities of all units. Further, it has long been the practice of the company to support research programmes in special fields in university laboratories and to give recognition to the contributions to petroleum technology made by scientific workers and technologists. This is perhaps the most striking manifestation of the necessity felt by petroleum companies for some form of decentralization and external collaboration.

Calf of Man as Nature Reserve

MR. F. J. DICKENS of Silverdale, Carnforth, Lancashire, is presenting the Calf of Man to the National Trust. This gift should prove a very valuable addition to the island bird sanctuaries of the British Isles. The Calf, with the rocks to the south of it and Chicken Rock Light, have provided invaluable facilities for bird migration study, and as it is proposed to have the property managed by a committee of ornithologists and Manxmen, there is a unique opportunity for erecting another ringing station or bird observatory of the Isle of Man and Heligoland type there. Covering some 616¾ acres, more than four hundred of which are healthy pasture, and including steep cliffs, a marsh, farm, ponds, a dam, and a glen, the Calf of Man as a bird reserve would preserve the nesting sites of some thirty species of bird including such birds as the chough which, declining in Cornwall and Devon, is increasing in the Isle of Man, the peregrine falcon, the shag, puffin, guillemot, razorbill, raven, kittiwake, rock-pipit, etc. There is a farm where a few house-sparrows, starlings, and blackbirds find a living, and wrens inhabit the caves. On migration, many warblers visit the Glen, etc., and forty-eight species of birds have been noted at the Chicken Rock Lighthouse (so named by sailors from the abundance of the storm-petrel or Mother Carey's chicken off that low rock). There may no doubt be need for some scientific control of the bird numbers, as in recent years the greater black-backed, lesser black-backed and herring gulls have increased their nesting areas, and these rapacious birds are often a danger to more interesting, but less vigorous, species. The flora has not been worked so thoroughly, but some three hundred or more plants occur, including the yellow-petalled 'ochrocyanea' variety of wild radish near the farm, wild hyacinth in a curious marshland habitat near the landing Sound, and sundew.

Bird Migration and Air Currents

AT the annual conference of the International Faculty of Sciences, held in London on January 29–30, Capt. B. Acworth presented a paper entitled "New Light on Bird Migration". But the paper contains nothing of importance that was not set down lucidly and with similar diagrams in his "This Bondage" in 1929. There is the same useful insistence upon the effects of wind currents upon the movements of birds, and alas, the same errors are repeated. For example, Capt. Acworth insists that the permanent winds of the tropics form impassable barriers; that consequently "the species of birds found in particular temperate zones must have had *separate origins*"; and that these facts "seem to demolish . . . the theory of evolution as it affects the common origin of birds." But surely the fact that every autumn and spring in the Old World and the New birds do actually cross, as a matter of routine, the "impassible barrier" of the equatorial currents demolishes the whole argument. Again, the exact knowledge of the writer of the Book of Exodus in describing how "the east wind brought the locusts" is contrasted with the ignorance of biologists, anatomists and embryologists; but records of insect migrations show that the wind is not the directive factor in a large percentage of cases. Lastly, "*seasonal* winds have always ensured the translation of birds to parts of the world agreeable to the essential needs of the appropriate species", which, if it means anything at all, means that wind and no biological factor has settled the agreement between birds and their environment.

Agriculture in Tanganyika

THE annual report of the Department of Agriculture in Tanganyika for 1935 has now been published (Dar-es-Salaam: Government Printer, 1936). From the economic point of view, the past five years have been the most critical in the history of the Territory, and 1935 can be regarded as the culminating point of the effort to place it in a position of economic security. The volume of total exports attained has never before been approached, in spite of the fact that record figures for most crops had been reported during the four previous years. In the year under review, records for the export of the three premier industries, sisal, cotton and coffee, have been achieved, while high figures are again reported for ground-nuts, bees-wax and sesame. Copra alone has yielded disappointing results. The soundness of the policy of increasing production in a territory which has not reached the limits of development seems to have been vindicated, as the standard of living and purchasing capacity of the native peoples have been markedly improved, and also a rise in the value of exportable commodities obtained. As regards non-native agriculture, the excellent price secured for sisal-hemp stimulated the rejuvenation of estates, re-equipment of factories and a general re-organization of the industry. Much too large a proportion of planters, however, still rely on a one-crop policy, and the adoption of a more diversified farming is advocated. Native development is making sound progress, successful concentration of population now being possible in districts which quite recently were poverty-stricken tsetse areas. Questions of irrigation and natural water supplies play a vital part in African life, and important developments are already in hand following the recommendations of the special inquiries completed during the year under review.

Progress in Grass Drying

AT the second Congress of Mechanised Farming held at Rhodes House, Oxford, on January 5–8, when recent developments were described, a paper by Mr. E. J. Roberts on "A Year's Progress in Grass Drying" excited much interest. A résumé of this paper is published in *Engineering* of February 5. The author points out that whereas there were only six driers in operation in 1935, there were 46 by the end of the 1936 season. The engineering difficulties in connexion with drying plant have been successfully overcome. This is confirmed by papers at the Congress giving the experience of users. We know that inventors are busy developing new methods and rapid progress in this direction will doubtless soon be made. For the year just closed it is expected that the production will be 10,000 tons. In the United States for the same period, it was 50,000 tons. In countries abroad the usual practice is to dry the grass in large centralized units. In Great Britain, in general, only small localized units are used. This is a pity as it is not the most economical method. In a paper read at the conference by Prof. J. A. Scott Watson, it was shown that the remaining problems are to bring down the cost of the drying plant, the fuel cost and the labour cost and to increase the output. Mr. Roberts in his paper stated that one large drier evaporated 9 cwt. of water with 1 cwt. of coal for a short period and worked at a normal figure of 8 cwt. Smaller driers give efficiencies of 3¼–5½ cwt. of water per cwt. of coke. If we take the calorific value of the coal to be 14,000 B.Th.U. and that of the coke to be 13,000 B.Th.U., the advantage lies greatly in favour of the large drier.

Testing Broadcasting Receivers

AT an informal meeting of the Wireless Section of the Institution of Electrical Engineers held in November 1935, Dr. R. L. Smith-Rose opened a discussion on the methods of examining the performance of wireless sets used for the reception of broadcasting. No specification was then available of the standards of performance at which it was desirable to aim in the production of such receivers. Quite recently, however, the Radio Manufacturers Association has published a "Specification for Testing and Expressing Overall Performance of Radio Receivers", and a discussion on this specification was opened by Mr. Stuart Hill at a meeting of the Wireless Section of the Institution of Electrical Engineers held on February 3. The above specification is in two parts, dealing respectively with electrical and acoustic tests. The first part describes laboratory methods of measuring the sensitivity and selectivity of a receiver, and also its susceptibility to noise and the performance of its automatic volume control. The second part describes the corresponding methods of measuring frequency response, acoustic sensitivity, hum and acoustic output. In each case the proposed methods of expressing the results are described and illustrated by means of typical graphs included in the specification.

THE discussion at the Institution indicated that the initiative shown by the R.M.A. in producing this specification is very generally appreciated, although some criticism was offered on matters of technical detail. In so far, however, as Mr. Hill stated, the specification has been drawn up by manufacturers for manufacturers, its useful purpose is somewhat limited at the present time. Furthermore, it does not contain a suggested standard of performance, and this might very usefully be added after consultation with representatives of the users of such receivers and of the B.B.C. and other Government departments interested in the matter. In fact, the time would now seem to be opportune for such a body as the British Standards Institution to take up the subject by setting up a representative committee for the purpose of drafting a specification dealing not only with methods of testing, but also with the standards of performance to be attained by the various types of modern radio receiver. Such a standard specification has long been needed; it would be of great benefit to the radio industry as well as to the general public; and the labours of the drafting committee will now be considerably lightened by the pioneer work already accomplished by the Radio Manufacturers Association.

Standards of Radio Frequency

MODERN electrical measurements are conspicuous for the fact that the frequency of alternating currents can be measured to a very high order of accuracy. In order to provide a standard of frequency for scientific and technical workers, the National Physical Laboratory undertakes the emission of two types of frequency of reference from its own radio transmitting station. One of these is in the form of a modulation frequency of one kilocycle per second superimposed on a carrier wave of 396 kilocycles per second, while the other is a simple carrier wave of frequency 1,780 kilocycles per second. The programme incorporating the first frequency is emitted on the second Tuesday of each month at 10.40–12.00 G.M.T., while the second is emitted on the first Tuesday in March, June, September and December at 21.00–22.00 G.M.T. The modulation frequency employed in the first programme is derived from one or other of two oscillators, which are maintained in continuous operation at the National Physical Laboratory. One of the oscillators is an electrically maintained tuning fork vibrating at its natural frequency of 1 kilocycle per second; while the other is a quartz ring oscillator generating a frequency of 20 kilocycles per second, with the necessary attachment for selecting the required frequency of one twentieth of this value. In both cases, the accuracy with which the frequency is maintained is one or two parts in 10 million, but during each emission the exact frequency is measured at the Laboratory, and the correct value is announced at the end of the programme. For the second standard frequency emission, a separate quartz crystal oscillator is employed; in this case, no correction is announced, the frequency emitted being accurate to within one part in a million. A revised programme giving full details of these transmissions can be obtained on application to the Director, National Physical Laboratory, Teddington, Middlesex.

Lead Sheaths of Electric Cables

LEAD is a very suitable metal for providing a watertight covering to an electric cable buried in the earth. The weight of the lead sheaths made per annum in Britain alone is 64,000 tons. Taking into account the much larger quantity that must be used in the many cable factories throughout the world, it will be seen that an improvement in the technique of the manufacture of lead sheaths is one which seriously concerns both users and manufacturers. Of recent years, much thought has been given to this problem and very many patents have been taken out for improvements. In a paper by Dr. P. Dunsheath, read to the Institution of Electrical Engineers on December 3, a method for the continuous extrusion of lead sheaths over cables is described which is being widely adopted by manufacturers. Hitherto, the extrusion of the lead has been done by the ram of a hydraulic press. In Dr. Dunsheath's method, the pressure required to extrude the lead is obtained by means of a motor-driven screw member. In 1929 the first lead pipe was extruded by a continuous process, and the development has continued steadily up to the present. A defect of cable sheaths made on hydraulic presses is the inclusion in the finished pipe of welds between separate faces of metal, which at some stage in the process have been exposed to the air and therefore become slightly oxidized. Provided sufficient time is allowed to elapse and sufficient pressure applied at a sufficiently high temperature, two separate masses of lead will weld together completely into one homogeneous mass if the faces are clean and free from oxide.

Air Raid Precautions and Air Disarmament

A PAMPHLET entitled "Defence that is no Defence", by Dr. C. E. M. Joad, issued by the National Peace Council, directing attention to the inadequacy of the Government proposals for defence against air raids and the impossibility of devising any adequate protection against simultaneous attack by gas, explosive and incendiary bombs, quotes the warning against this barbarous perversion of science and industry in the tendency to accept the use of aircraft for unrestricted bomb and gas attack on civilized populations uttered by leading scientific workers when the Government schemes were first introduced. Subsequent events have only confirmed the prediction that acceptance of this position must rapidly lead to the breakdown of civilized life. Dr. Joad, while emphasizing the futility of the measures so far proposed by the Government and also the difficulty of its position, urges that the Government should work strenuously for abolition of the bombing aeroplane and for disarming in the air and placing civil aviation on an international basis, as affording the only security against destruction of our cities by attack from the air. He also urges a policy directed towards the removal of economic tensions which are endangering peace, and suggests a definite lead from Great Britain in regard to access to raw materials and equalizing of opportunities for trade which might be provided by an extension of the mandates system, the lowering of tariffs and removal of economic barriers.

Scientific Management and Economic Problems

IN an address to the Engineers' Study Group on Economics on January 19, Major L. R. Urwick spoke on the contribution of scientific management to the solution of present economic difficulties. He outlined the development of the principles of scientific management from the pioneer work of Charles Babbage and F. W. Taylor to such recent manifestations as "Stakhanovism" in Russia. Scientific management means essentially not the multiplication of efficiency experts but the adoption by both employers and employed of a new mental outlook, based on exact measurement and not on opinion, and more interested in increasing the output of industry than in haggling about its division. Resistance to Taylor's ideas had largely been due to those of his followers who had adopted his methods piecemeal while neglecting the underlying philosophy. Scientific management has spread much faster on the productive side of industry than on the distributive, or in finance, and the machinery of Government has also profited far less than it should have from the available knowledge of management problems. The first part of a chapter on "The Division of Labour and the Pricing System" has recently been forwarded in draft, and the chapter on "Money and Banking" has been discussed at a recent meeting of this Group.

Analytical Control of Foods and Drugs

Extracts from the annual report of the Ministry of Health and abstracts of reports of public analysts upon the analytical control of foods and drugs for 1935 have been issued as a separate pamphlet (Sale of Foods and Drugs. H.M. Stationery Office, 1936. 3*d*. net). No less than 143,831 samples were analysed by public analysts in England and Wales, of which 7,972, or 5·5 per cent, were reported against. The number of samples of milk examined was 78,674, of which 5,798 samples were reported to be adulterated or not up to standard. Several samples of canned products were found to be contaminated with tin, lead, copper or zinc. A few samples of sugar contained sand, and one of icing sugar rancid fat and dead flies. Adverse reports were made on a number of 'cream' cakes and pastries on the ground that the filling consisted wholly or partially of fat other than milk fat, and a number of 'chocolate' rolls and cakes contained no chocolate. The reports of the public analysts are abstracted in a series of tables.

National Institute for Research in Dairying, Reading

IN the annual report for 1935 of this Institute, which has recently been issued, the research and other activities are summarized. The research work includes such varied subjects as winter feeding of young dairy cattle and artificial insemination of cows, investigations on the chemical composition of typical milk and of taints of milk, the lactic acid bacteria and cheese-ripening studies, and on pasteurization and tubercle bacilli in milk. Cases of contagious abortion among the Institute's herd of cows gave an opportunity for investigating *Brucella abortus* infection. Bacteriological testing of milk samples and market milk investigations have also been carried out, and the phosphatase test for efficiency of pasteurization has been re-examined. The financial condition of the Institute is considered, and an appeal is made for further funds to enable an extension of the work to be made.

Oxford and Present Needs in Science

Referring to the leading article in Nature of February 20 under this title, a correspondent writes as follows: "As some readers may not be familiar with the names given to certain buildings in Oxford, it may be helpful to state that the 'Ashmolean Museum' now means the Museum of Art and Archæology, chiefly classical, established in Beaumont Street in 1890, whereas the 'Museum of the History of Science' means the ancient scientific collections in the Old Ashmolean Building, which was the only science museum from 1683 until 1860. In this building Ashmole's old museum room is now full to overflowing of historic instruments and specimens; and money is needed for its extension. The changes contemplated in the various scientific departments of the University make it more than ever necessary to provide for the preservation of things of historic value that might otherwise be scrapped".

Early Man in Minnesota

Prof. A. E. Jenks, of the University of Minnesota, reporting recently on "Minnesota man", a female skeleton found in ancient lake deposits in 1931, attributes to it an age of approximately 20,000 years, and regards it as the oldest specimen of early man to be found in America. The teeth had all erupted, with the exception of the wisdom teeth, but as the long bones appear to be still immature, the age of the girl was probably about fifteen years. The teeth are larger than normal in prehistoric man. In summing up the characters of the skeleton, Prof. Jenks, it is stated by Science Service, regards it as *Homo sapiens*, of an early type of evolving Mongoloid, forecasting the aboriginal American, especially the Eskimo, rather than the modern Mongol. It has been computed that the Lake Pelican deposits, in which the skeletal remains were found, antedate those of the glacial Lake Agasiz by some two thousand years, thus warranting this increase in the age usually admitted for early man on the American continent.

Sanitary Aviation in Soviet Russia

The sanitary aviation service maintained by the Red Cross and Red Crescent Society of the U.S.S.R. is fast becoming a regular institution for medical aid, particularly in outlying regions of the Union. Sanitary aeroplanes are kept in readiness in all parts of the Union to answer urgent calls for medical aid. In 1936, more than 400 patients were carried by air to hospitals and more than 500 specialists were taken by air to various places where they performed some fifty major operations and treated about four thousand seriously ill persons. In 1936 also, the sanitary aeroplanes of the Red Cross and Red Crescent Society carried more than 2,000 kilograms of medical supplies to different points of the Union.

Biochemistry in the U.S.S.R.

We have received the first five numbers of the first volume of a new Russian journal, devoted to biochemistry. It is entitled *Biochimia*, and is edited by A. N. Bach and W. A. Engelhardt. The papers are in Russian, but each is provided with a summary in English or German. The average size of each number is about 120 pages. The papers deal with work on vitamins, enzymes and other biochemical problems. The journal should enable workers in other countries to gain some idea of the work which is being carried out in Russia in biochemistry.

Comets

A new comet was discovered by Dr. F. L. Whipple at Harvard on February 7. Its magnitude was 12 at the time of discovery, and it was described as diffuse with a central condensation, and a tail less than 1° in length. Dr. Whipple computed the following parabolic orbit:

$$\begin{array}{lll} T & 1937\ \text{Jan}\ 22{\cdot}070\ \text{U.T.} & \\ \omega & \left.\begin{array}{rr} 111^\circ & 27' \\ 127 & 4 \\ 41 & 4 \end{array}\right\} & 1937{\cdot}0 \\ \Omega & & \\ i & & \\ q & 1{\cdot}6610 & \end{array}$$

It is now about 1·5 units from the earth, which it is approaching, but it is not likely to become a conspicuous object. Mr. Simizi in Japan detected Daniel's Comet, 1909 iv, 1937 *a*, on January 31. Its magnitude was 13 and it was diffuse without any central condensation. Mr. Hirose computed an orbit the elements of which are given below. It is receding from the earth, and is now more than 1·4 units distant.

$$\begin{array}{l} T\ 1937\ \text{Jan.}\ 27{\cdot}940\ \text{U.T.} \\ \left.\begin{array}{lrr} \omega & 6^\circ & 1' \\ \Omega & 70 & 19 \\ i & 19 & 50 \end{array}\right\}\ 1937{\cdot}0 \\ q\quad 1{\cdot}587 \\ \text{Period}\ 6{\cdot}825. \end{array}$$

The Night Sky in March

During March, the duration of night in the latitude of London decreases by nearly two hours. On March $21^{\rm d}\ 1^{\rm h}$ the sun enters the sign Aries (Spring Equinox). The moon is new on March $12^{\rm d}\ 19{\cdot}5^{\rm h}$ and full on March $26^{\rm d}\ 23{\cdot}2^{\rm h}$. No bright stars are occulted during the month, but the following disappearances may be noted: 108 Tauri (mag. 6·2) on March $18^{\rm d}\ 19^{\rm h}\ 39{\cdot}0^{\rm m}$ when the moon is 6 days old, and *e* Leonis (mag. 5·1) on March $25^{\rm d}\ 21^{\rm h}\ 54{\cdot}4^{\rm m}$, the moon being 13 days old. The planet Venus, which does not set until about $22^{\rm h}$, is a striking object and reaches its greatest brilliancy on March 12; the area of the illuminated crescent is then 0·28 that of the whole apparent disk. Mercury, being in superior conjunction with the sun on March 16, is not accessible to observation. Mars rises at about midnight and is about 1½° preceding the third magnitude star, β Scorpii. The planet brightens during the month from $+0{\cdot}4^m$ to $-0{\cdot}3^m$, its greatest brightness being reached in May. Jupiter, of stellar magnitude $-1{\cdot}6$ to $-1{\cdot}7$, will be found low down in the morning sky. Saturn, being in conjunction with the sun on March 16, is above the horizon almost wholly in daytime. On March 8, Neptune (mag. 7·7) in Leo is in opposition; the planet's distance from the earth will then be nearly 2,714 millions of miles. The zodiacal light may be looked for on clear evenings after sunset at the beginning and end of the month. On or about March 3 and March 30, the night sky may also be scanned for any appearance of the aurora; auroras were observed 27 and 54 days earlier in northern England and Scotland respectively, and this 27-day sequence may possibly be continued in March. In any event, auroral displays may now be looked for generally on account of the active state of the sun, and there is also a higher frequency of magnetic disturbances at about the equinoxes. The following positions at 0^h U.T. of Comet Whipple (1937 *b*) are given in Circular No. 636 of the *Bureau Central des Télégrammes Astronomiques*:

	R A.		Dec.	
	h	m	°	′
March 4	13	49·9	+45	42
„ 8		54·3	47	25
„ 12		58·3	49	6
„ 16	14	1·8	50	44

Announcements

The new ultra-centrifuge in the Department of Biochemistry of the University of Oxford will be inaugurated at 4 p.m. on February 27. The Vice-Chancellor of the University, the president of the Royal Society and Prof. The Svedberg, of the University of Uppsala, will be present.

At the annual general meeting of the Quekett Microscopical Club, held on February 9, the following officers were elected: *President*, W. E. Watson Baker; *Vice-Presidents*, E. A. Robins, J. T. Holder, Dr. C. Tierney, and Chetwynd Palmer; *Treasurer*, C. H. Bestow; *Secretary*, W. S. Warton; *Reporter*, A. Morley Jones; *Librarian*, W. E. Stone; *Curator*, C. J. Sidwell; *Editor*, W. P. Sollis. *New Members of Committee*: F. C. Grigg, N. I. Hendey, A. E. McClure, F. E. J. Ockenden, C. C. Swatman.

At a meeting of the president and fellows of Harvard College in Boston, held on January 18, it was voted "that the thanks of the President and Fellows be sent to Sir Robert Hadfield for his beautiful and welcome gift of a picture appropriately commemorating in this University the University of Oxford, with which during a period of three hundred years Harvard has enjoyed close associations; and that the picture, with the accompanying gifts of books, scientific papers and other mementos, be gratefully accepted and duly recorded in connection with the recent observance of the Tercentenary of Harvard College". (A note on the picture in question, which gives an unusual view of Oxford from the Sheldonian Theatre, appeared in NATURE of December 12, p. 1005.)

In conjunction with its annual general meeting in May 1938, the Iron and Steel Institute is to organize a symposium on "Steelmaking". Particular attention will be given to acid and basic open-hearth processes. Further information can be obtained from the Secretary, Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

A David Anderson-Berry Gold Medal, together with a sum of money amounting to about £100, will be awarded in July 1938 by the Royal Society of Edinburgh to the person who, in the opinion of the Council, has recently produced the best work on the nature of X-rays in their therapeutical effect on human diseases. A similar award will be made every three years. Applications for this prize are invited. They may be based on both published and unpublished work and should be accompanied by copies of relevant papers. Applications must be in the hands of the General Secretary, Royal Society of Edinburgh, 22 George Street, Edinburgh 2, by June 1, 1938.

The Annual Malaria Control Course for Laymen will be held at the Ross Institute of Tropical Hygiene, Keppel Street (Gower Street), London, W.C.1, commencing on June 21, at 10 a.m., under the direction of Sir Malcolm Watson, director of the Institute. The course lasts five days, and is designed for planters and mining engineers, but it will be of interest to all (including missionaries) who are proceeding to the tropics. Application to attend the course should be sent in as early as possible to the Organizing Secretary at the above address. Admission is free.

The Medical Society of Vienna will celebrate the centenary of its foundation in conjunction with the Union for Postgraduate Instruction on May 19–29.

The next congress of the Society of German Men of Science and Medicine will be held at Stuttgart in 1938.

A national medical council on birth control has been formed in the United States to control and supervise medical policies of the American Birth Control League, and to initiate, encourage and carry out appropriate scientific research in the medical aspects of birth control.

The American Association for the Study of Goitre offers the Van Meter Prize of 300 dollars and two honourable mentions for the best essays on experimental and clinical investigation of the thyroid gland. The award will be made at the next annual meeting of the Association, which will be held at Detroit, Michigan, on June 14. The MSS., which should not exceed 3,000 words, must be presented in English, and a type-written double-spaced copy sent to the secretary, Dr. W. Blair Mosser, 133 Biddle Street, Kane, Pennsylvania, not later than April 1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 376.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Effects of Traces of Metallic Ions on Films at Interfaces and on the Surface of Water

IT appears advisable at this time to direct the attention of workers in the field of surface chemistry to recent work on the effects of minute traces of metallic ions on the behaviour of monomolecular films on the surface of water, since serious consideration of such results brings into question some of the data published on monomolecular films, particularly those data on films formed by substances with acidic groups in the molecule, spread on a neutral or basic aqueous layer.

Early in 1935, while at the Johns Hopkins University, one of us (R. J. M.) noticed an apparently abnormal behaviour of monomolecular films of palmitic acid on fresh distilled water. A heavily paraffined brass trough and a film-balance of the Langmuir type were used. It was found that when water was distilled directly from a quartz still into the trough, and a force-area determination made on the palmitic acid within a few hours after the distillation, quite expanded *liquid* films were obtained ($a_0 = 25{\cdot}0$ A.^{2}), which collapsed at relatively low pressures. If, however, the water were allowed to stand overnight in the trough, or if the distillate had been first caught in glass vessels, the usual *solid* condensed films ($a_0 = 20{\cdot}5$ A.^{2}) were obtained. The effect of the glass vessel was correctly attributed to minute traces of calcium ions, but the contamination of zinc and copper ions from the paraffined trough was unfortunately overlooked. The peculiar behaviour of palmitic acid had been noticed earlier by Adam[1], who also was at a loss to account for the difference between what he called 'old' and 'fresh' distilled water. Due to the press of other work, the experiments were not continued further at the Johns Hopkins University, but have been resumed at the University of Chicago, where the troughs now in use are plated with gold, rhodium, or both, while the newer apparatus is being constructed of quartz.

Such effects have been known for years, as in the remarkable action of calcium ions on the interfacial tension between solution of oleic acid in benzene and sodium hydroxide solutions, found by Harkins and Zollman in 1925[2]; these effects are due to the formation in the film of various mixtures of the organic acid with its sodium and calcium or other similar soaps. The phenomenon was discovered by Bancroft and Clowes[3] in their work on the inversion of emulsions.

Recent work by Langmuir, Schaeffer and Miss Blodgett[4] has apparently identified the curious results of Myers with the formation of mixed copper and zinc soaps, caused by solution of the brass trough, though heavily paraffined. Langmuir has also indicated that minute traces of calcium ions convert stearic acid films into calcium stearate, as a result of which the area per molecule is 20 sq. A. as compared to a very large area on dilute sodium hydroxide. Also, they find that the films are solidified upon the addition of calcium, a fact noted earlier by Harkins and Zollman.

While Langmuir has *implicitly* emphasized the effect of dissolution of the brass trough upon the characteristics of monomolecular films, it appears worth while to point out the great significance of these effects of minute traces of metallic ions in some of the published or unpublished work on monomolecular and polymolecular films.

First, it seems reasonable to expect similar startling differences in the behaviour of films when proteins, lipoids and similar substances are examined. Thus, in the interpretation of published work, it is necessary to qualify conclusions regarding the behaviour of fatty acids, lipoids and proteins, when films of these substances have been examined near the neutral point or on the basic side of their isoelectric point, unless troughs of quartz or similar material have been used, and chemicals, free from bivalent or trivalent impurities, have been employed. In particular, unless suitable precautions have been taken, such films should be referred to not as 'stearic acid' or 'protein', but as "mixed copper and zinc (or calcium) stearates", and 'mixed proteinates'.

Secondly, in the future, research workers who examine films of molecules which contain acidic groups should operate in quartz, or at least *very* heavily paraffined glass troughs. Further, salts used in the substratum should be exceedingly pure, in order that the phenomena which are observed may not be caused by spurious quantities of bivalent or trivalent ions. In view of the expensive nature of quartz and the ease with which metal apparatus may be fashioned, we have undertaken, together with an extensive study of these ionic effects, a study of various electrodeposited metals to determine whether troughs other than quartz may be used without error. Preliminary experiments conducted by us have indicated that under certain conditions even paraffined glass vessels may contaminate solutions contained in them. At Cornell University, Nutting, Long and Harkins are beginning work with troughs made wholly of paraffin.

Thirdly, it may very well be that the negative results of many experimenters who have tried to correlate surface activity with other variables, such as hydrogen ion concentration, have been caused by the formation of insoluble calcium or copper compounds due to the presence of traces of these ions in the substratum. All studies on interfacial tensions in systems containing substances of this character must be qualified due to the presence of calcium ions from the glass apparatus employed. It is quite possible that there will be found a remarkable difference in the contact potentials of films, when great care has been exercised to remove these interfering ions.

In fact, only when strongly acid solutions have been employed, can we be reasonably certain that the presence of calcium or similar ions in the substratum has had no influence on the behaviour of the film. Gorter[5] has found large differences in the area per molecule of ovalbumin films when sodium or calcium ions are present in the substratum. From other papers of Gorter, in which a glass trough was used, it appears reasonable to conclude that this work was also done in glass.

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Jan. 4.

[1] Adam, N. K., *Proc. Roy. Soc.*, A, **99**, 336 (1921).

[2] Harkins, W. D., and Zollman, H., *J. Amer. Chem. Soc.*, **48**, 69 (1926).

[3] Clowes, *J. Phys. Chem.*, **20**, 408 (1916).

[4] Langmuir, I., *J. Franklin Inst.*, **218**, 143 (1934). Langmuir, I., *Science*, **84**, 379 (1936). Blodgett, K., *J. Amer. Chem. Soc.*, **57**, 1007 (1935). Langmuir, I., and Schaeffer, V. J., *J. Amer. Chem. Soc.*, **58**, 284 (1936).

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Glucolysis without Phosphorylation in the Chick Embryo

DURING the course of last year, a preliminary communication[1] in these columns gave an account of experiments on the chick embryo in the first week of its development, which suggested that glucolysis proceeds in these young tissues without phosphorylation. We wish now to give further details strongly indicating that this is so.

As was there reported, the embryo exhibits a marked substrate-preference, attacking glucose and mannose, but not glycogen or the phosphorylated hexoses. When phosphorus-transporters such as adenylic acid or cozymase are added to embryo (intact or *Brei*) in presence of glycogen or hexosediphosphate, a certain breakdown of these substrates may occur, but it is always small, transient, and not regularly demonstrable. Nevertheless, aldolase (zymohexase), which converts hexosediphosphate into triosephosphate, is present in as active a form in the chick embryo as in mammalian muscle extract. Hence triosephosphate accumulates steadily so long as the experiment lasts. The failure of the embryo to carry hexosediphosphate breakdown further than this cannot be remedied by addition of cozymase and pyruvate; it must therefore be due to lack or inefficiency of the enzyme system effecting the change.

However, all the enzymes concerned in the breakdown of phosphoglyceric acid are present in the embryo. Dephosphorylation of phosphopyruvic acid by adenylic acid is found in full strength in the earliest stage examined (23rd hour), before the neural folds have closed. The Parnas reaction, however, occurs in full strength only from the 43rd hour (beginning of cardiac activity). Only creatine phosphate, never arginine phosphate, is formed. Esterification of glycogen can at no stage be demonstrated. All the enzymes of phosphorylation which could be demonstrated in the embryo at all could be had in cell-free extract, in sharp contrast to the glucolytic system proper. This fact is important when conclusions on glucose breakdown are drawn from the behaviour of extracts of muscle or brain.

The rate of glucolysis itself, on the other hand, cannot be affected by the addition or removal of any of the phosphorus-transporters. Nor could any esterification of glucose be observed in a wide variety of conditions. The relation of fluoride concentration to inhibition is also different according to the system studied. Thus at $M/200$ sodium fluoride, the conversion of phosphoglyceric to phosphopyruvic acid is completely suppressed, while the glucolysis of the same *Brei* at the same time is only 40 per cent inhibited. Inhibition by *dl*-glyceraldehyde is powerful and specific; it is not shown by other aldehydes (for example, propionaldehyde, pyruvic aldehyde, etc.). By dialysis of embryo *Brei*, glucolysis may be inactivated. It may then be restored up to 80 per cent by the addition of rather large amounts of glutathione (cf. the work of Geiger[2] on adult tissues), larger amounts than are required for the reactivation of methylglyoxalase. Further, if glucose and synthetic methylglyoxal, in sufficient amounts to saturate the enzymes, are suddenly given together to a fresh embryo *Brei*, the subsequent summation of lactic acid formation which occurs is almost perfect. Methylglyoxal, as obtained by chemical synthesis, is therefore not an intermediate in embryonic glucolysis.

The two routes of breakdown may be further elucidated by the combined use of hexokinase (the enzyme of yeast which phosphorylates glucose), and fluoride or glyceraldehyde. In all cases, inhibition by these substances is of the same order whether hexokinase is present or not. Glucose could never be shunted into the phosphorylation route, even by the addition of hexokinase to embryo *Brei* in which the cell integrity had been abolished.

All these facts, and those summarized in the previous communication, are brought together by the hypothesis that in the chick embryo there are two separate routes of carbohydrate breakdown:

(i) A non-phosphorylating glucolytic mechanism, very active, and closely bound to the cell-structure, in which
  (*a*) glutathione is necessary;
  (*b*) methylglyoxal, dioxyacetone and glycerol are not intermediates.

(ii) A phosphorylating mechanism closely similar to that in muscle, dealing with glycogen and hexosediphosphate, but of low activity because deficient at four distinct places:
  (*a*) the enzyme esterifying glycogen;
  (*b*) the enzyme system dismuting triosephosphate with pyruvate to phosphoglyceric and lactic acids;
  (*c*) lack of adenylpyrophosphate;
  (*d*) lack of cozymase.

It would thus appear that in early embryonic development the phosphorylation machinery has not yet been fully laid down, and it is of interest that a similarly incomplete system has been described for some tumours[3]. Whether the non-phosphorylating glucolysis here described is the same as that suspected[4,5] in adult tissues such as brain, heart muscle, etc., remains for further investigation.

Lastly, attention may be directed to a correlation which seems to exist in embryo, brain, tumour, etc., between (i) relatively high anærobic glycolysis,

(ii) preference for glucose as substrate without the addition of hexokinase, (iii) sensitivity to glyceraldehyde inhibition, (iv) inefficiency of phosphorylation, (v) the Pasteur effect without the Meyerhof cycle.

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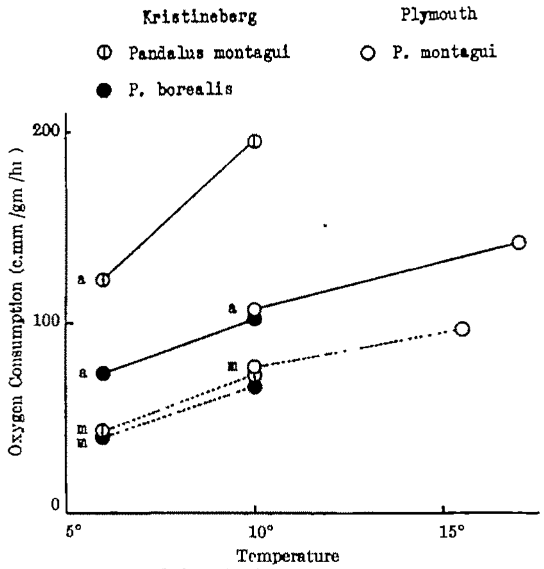
Rate of Tissue Metabolism of Marine Cold-blooded Animals in Different Latitudes

IN previous communications to NATURE[1] the activities and metabolism of arctic and English marine invertebrates were compared. It was shown that English species consume more oxygen, at the temperatures at which they live, than nearly related arctic species at the lower temperatures of their habitats. Since the locomotory activities of the English species are apparently no greater than those of their arctic cousins, the hypothesis was proposed that the greater oxygen consumption of the former is due to a greater non-locomotory metabolism. We have now tested this hypothesis for prawns living in the two waters by measuring the oxygen consumption of thin isolated muscles as well as that of the whole animals. The dorsal extensor muscles of the abdomen were used.



a, whole animals; *m*, isolated muscles.

Fig. 1.

Fig. 1 shows that *Pandalus borealis* from the cold water at Kristineberg[1] and *P. montagui* from Plymouth fully bear out the hypothesis. The oxygen consumption values for the whole animals fall on a single curve rising with temperature, and those for the muscles fall on another single curve parallel to the first. At every temperature the excess oxygen consumption of the whole animals over that of the muscles is the same.

But for *Pandalus montagui* from Kristineberg the situation is not so clear. Fig. 1 shows that while the oxygen consumption of its isolated muscles is almost identical with that of the muscles of *P. borealis*, the oxygen requirements of whole animals of the former species are almost double those of the latter. This suggests greater activity. Indeed the oxygen consumption of whole animals of *P. montagui* at the low temperatures of Kristineberg is seen to be as great as, or greater than, that of the same species at the higher temperatures of Plymouth.

In other ways, too, *Pandalus montagui* from Kristineberg behaves as a different physiological variety from the same species at Plymouth. The heart and scaphognathite rates at Kristineberg and at Plymouth show differences parallel to the oxygen consumptions of the whole animals in the two localities. Moreover, the Kristineberg variety will not survive an aquarium temperature above 11°, whereas the Plymouth form can be kept alive at 17°.

These results will be published in the *Proceedings of the Zoological Society*.

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[1] H. Munro Fox, NATURE, **137**, 903 (May 30, 1936); and **138**, 839 (November 14, 1936).

Effect of Ultra-centrifuging on the Egg of *Ascaris megalocephala*

EGGS of *Ascaris megalocephala* (= *equorum*) var. *monovalens*, like those of *Ascaris suum*[1], may develop normally after being subjected in the uncleaved condition to great centrifugal forces over long periods.

However, cytological examination of eggs which have been kept in the air turbine ultra-centrifuge at 150,000 times gravity until after control eggs have undergone several cleavages, shows that the nucleus has divided, but no cleavage of the cytoplasm has occurred. If one cleavage has been suppressed, there are four centrosomes and four chromosomes in the egg cell at the next metaphase (Fig. 1). In most of such cases the chromosomes are undiminished, but frequently diminution has occurred (Fig. 2). Such tetrapolar mitoses usually result in four cells, in all of which chromatin diminution has taken place before the next division is completed. Very rarely, the cleavage planes are so oriented that one of the resulting cells contains most of the material from the animal pole of the egg; chromatin diminution may take place in this daughter cell but not in the others. If two cleavages have been suppressed, there are eight centrosomes and four nuclei (eight chromosomes) in the egg cell. When such eggs are in metaphase, all the chromosomes have undergone diminution. In a few late prophases, however, all the chromosomes appear to be undiminished.

It seems clear that Boveri's explanation[2] of chromosome diminution, although valid in its reliance on cytoplasmic rather than nuclear control, is inadequate for the observations reported here. The mere presence of an inert material which either prevents (or causes) diminution can not account for the fact that it may take place in eggs when cleavage has been suppressed, although nuclear divisions and, presumably, other changes have occurred. It is these other changes which take place independently of cleavage but ordinarily correlated with it, to which attention must be turned in seeking an explanation; therefore, the following hypothesis is suggested: Chromatin diminution in *Ascaris megalocephala* is caused by the formation of 'diminisher', D, during the early cleavages of the egg. This 'diminisher' is produced from a cytoplasmic substance, S, which is more concentrated at the pole (which normally gives rise to somatic cells only), than at the anti-pole (which normally gives rise to both somatic and germinal cells). S changes to D slowly, but, before the concentration of D can become critical, the first cleavage usually occurs, thus segregating the greater portion of $S \rightarrow D$ into the polar cell (AB) which is destined to undergo chromatin diminution when it divides or at the next following division of its two daughter cells (A and B). The smaller portion of $S \rightarrow D$ is passed into the antipolar cell (P_1), but, before the concentration of D becomes critical, the cell divides (into P_2 and $EMSt$), most of $S \rightarrow D$ going into one of the daughter cells ($EMSt$) which undergoes chromatin diminution, the other (P_2) remaining undiminished.

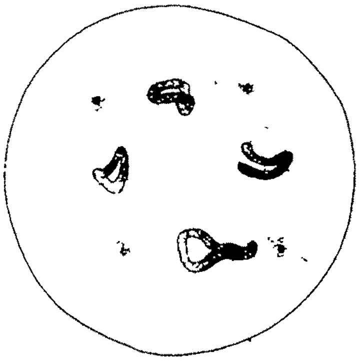
Fig. 1.

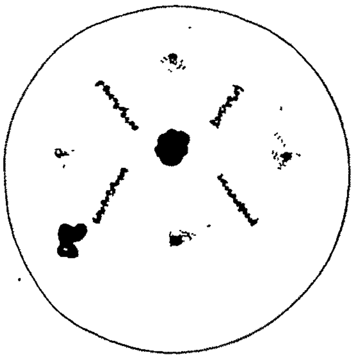
Fig. 2.

This differential partition of $S \rightarrow D$ is repeated until there is none, or at any rate, not enough, left in the primordial germ cell to cause chromatin diminution. Neither S nor D are to be identified as any visible inclusion in the cytoplasm. The process $S \rightarrow D$ is not disturbed by centrifuging, so that when the first cleavage has been suppressed by centrifuging, the concentration of D may become sufficient to cause diminution before the multipolar cleavage segregates the greater part of $S \rightarrow D$ into one (or more) cells. Even when such cleavage does take place, diminution usually follows in the four (or, less frequently, three) cells which result. If both the first and second cleavage are suppressed, diminution usually takes place in the uncleaved egg.

Diminution, then, is an example of chemo-differentiation; the rate of formation of the 'diminisher' depends upon the different concentration of the material producing it, in various regions of the cell. During cleavage, these regions are isolated by cell division, so that the process may occur in one daughter cell and not in the other.

This investigation was aided by grant from the Rockefeller Foundation for research in cellular biology.

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An Air-borne Plant Virus

In a recent publication[1], an account is given of an unusual plant virus which is found in the roots of normal-looking plants of different species growing in the insect-proof glasshouse under conditions usually considered proof against virus infection. It is shown that this virus is water-borne to the soil, whence it reaches the roots of the plants.

The fact that the virus could still be detected in the roots of tobacco plants growing in autoclaved soil and watered only with boiled tap water, suggested that there was an alternative method of spread for the virus. Experiments were therefore planned to find out if the virus was also air-borne. Three types of suction apparatus were employed to test the air of the glasshouse. The first two were unsatisfactory, and gave negative results. The third type, designed by Mr. J. P. Doncaster, consisted of an electric pump connected by rubber tubing to six gas-washing bottles placed in different parts of the glasshouse. Each bottle contained a pad of moist cotton wool through which the air of the glasshouse was drawn. The cotton wool was tested for virus at 48-hour intervals by rubbing it on to the leaves of the French bean (*Phaseolus vulgaris*), which is an extremely sensitive test plant for the virus. This method was more successful, and, in three separate experiments, the virus was isolated from the cotton wool pads.

It is not perhaps surprising that such a minute virus (average particle diameter, 20–30 millimicrons), and one capable of withstanding complete desiccation, should be present in the air of the glasshouse. The interesting fact is rather that the virus should be able to spread by this means, without the aid of an insect vector or any apparent wound in the host plant. The smallest quantity of virus which reaches the soil seems eventually to enter the roots of a plant growing therein.

This discovery of an air-borne plant virus may possibly throw light on the mode of dissemination of other plant and animal viruses which are spread by some means at present unknown.

I have much pleasure in acknowledging the valuable assistance given me by Mrs d'Oliveira in carrying out these experiments.

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Cultivation of *Histomonas meleagridis* from the Liver Lesions of a Hen

'Blackhead' (entero-hepatitis), a widespread and generally fatal disease of turkeys, was attributed to a protozoon, *Amœba meleagridis*, by Theobald Smith[1]. Later, Tyzzer confirmed its presence in cæcal lesions and renamed it *Histomonas* (gen. nov.) *meleagridis* Smith[2]. Although there is no difficulty in infecting young chickens experimentally with *H. meleagridis* (Tyzzer[3]) the disease produced is not severe, and the chickens soon recover clinically, though they may remain 'carriers', passing Protozoa in their fæces, for long periods. Theobald Smith[4] saw *Amœba* (= *Histomonas*) *meleagridis* in liver sections from diseased fowls, and Tyzzer[5] found similar lesions in a two-year-old hen. Although Drbohlav[6] and afterwards Tyzzer[7] cultivated *Histomonas meleagridis* from the cæcal discharges of experimentally infected chickens, all attempts to cultivate the parasite from diseased tissues from either turkeys or chickens failed (Tyzzer[7]).

Hitherto, the disease had been considered rare in mature fowls, but during the past year it appears to have occurred in several localities in England amongst laying stock, and in chickens on the farm belonging to one of us (H. P. B.). On December 3, 1936, we received a Rhode Island Red hen from a farm in Shropshire. Examination revealed focal necrosis of the liver and cæcal lesions which were macroscopically and microscopically similar to those occurring in turkeys suffering from 'blackhead'. Material taken with aseptic precautions from the necrotic areas in the hen's liver was inoculated into a tube containing an inspissated whole-egg slope covered with inactivated horse-serum diluted 1 : 8 in Ringer's solution to which a little solid, sterile rice starch had been added. Other similar tubes were inoculated with cæcal contents and scrapings. On incubation at 37° C., *Histomonas* appeared within 24 hours in the tube inoculated from the liver lesions. This strain of *Histomonas* from the liver is now in its twelfth subculture and is growing excellently on the above-described medium and on other media. In addition to *Histomonas*, the cultures contain a mixture of bacteria. These may be contaminants introduced when the primary inoculation from the liver was made, or, more probably, bacteria present in the lesion. Although according to Smith[4] bacteria are rare in liver lesions of turkeys killed at the height of the disease, they are not unknown, and they are not rare in smears made from the liver a few hours after death. It is possible that the presence of compatible bacteria has made the cultivation of the parasite possible. Cultures were made from the liver lesions of three turkeys, but these remained sterile bacteriologically and were negative for *Histomonas*.

The above-described strain of *Histomonas* from the hen's liver ingests starch and bacteria, and both flagellate and amœboid forms occur. It appears similar morphologically to the strains isolated from cæcal discharges by Tyzzer[7].

In the tubes inoculated with cæcal content and scrapings from the cæcal wall of the hen, *Blastocystis*, *Trichomonas* and *Chilomastix* appeared, but *Histomonas* was never seen; the growth of *Blastocystis*, however, was very heavy.

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[2] Tyzzer, E. E., *J Parasit.*, **6**, 124 (1920).
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[4] Smith, T., *J. Med. Res.*, **33**, 243 (1915).
[5] Tyzzer, E. E., *J. Med. Res.*, **40**, 1 (1919).
[6] Drbohlav, J. J., *J. Med. Res.*, **44**, 677 (1924).
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Effects of Colchicin and of *Viscum album* Preparations upon Germination of Seeds and Growth of Seedlings

THE investigations of A. P. Dustin and his school[1–5] have revealed an elective and extremely powerful karyokinetic action of the alkaloid colchicin upon the cells of certain specific organs and, in general, in all the germinative zones of animals, as well as upon the malignant tumours of the same. Dustin has also shown that this karyokinetic impetus is followed by an equally energetic karyoclasic effect upon the same tissues, and that this effect is specially marked in tumour cells, which are ultimately caused to collapse to a great extent under the influence of this alkaloid.

In a previous communication[6], I have given an account of the effects of several *Viscum album* preparations—containing as one of their active principles the alkaloid viscalbin (Leprince)—on plant tumours of the crown gall type (phytocarcinomata) which regressed and collapsed to a very marked extent when treated with these preparations.

In the preliminary experiments outlined in this note, I have investigated, at the suggestion of Prof. A. P. Dustin, the extent to which a parallelism can be found between the reactions observed in animals treated with colchicin and between the responses of plants treated with the same substance. I have also tried to ascertain whether these responses can be stimulated or inhibited by simultaneous applications of different preparations of *Viscum* according to their content of the above mentioned alkaloid.

Pure line Wilhelmina wheat, kindly given me by W. H. Parker of Cambridge, was germinated on filter paper in Petri dishes. 3–5 ml. of aqueous solutions of colchicin (Merck) or a dialysate of *Viscum* (Zyma)—free from the alkaloid viscalbin—or the pressed sap of *Viscum*, rich in viscalbin (kindly prepared and preserved in an atmosphere of carbon dioxide according to my prescription, by Zyma, Ltd.; Nyon), or a combination of one or the other of these *Viscum* preparations with colchicin were added daily to the Petri dishes. The technique used was otherwise the same as that described in previous communications[7,8]. No tables and measurements can be given here, but the following remarks are based both upon these and the general behaviour of the seedlings throughout the experimental period.

The experiments have shown that, in the concentrations used, colchicin exerts at the beginning of its application a definite stimulating effect on the rate of development of the roots and root-hairs. This effect is followed in 5–8 days by a very marked depression of the growth-rate of the roots, and in another day or two their growth is completely arrested. The growth-inhibiting influence of colchicin on the shoots begins even earlier. Synergetically, a *dialysate* of *Viscum* (containing no alkaloid) added to colchicin had, from the beginning to the end of the experiment, a more powerful growth-inhibiting action than the same quantities of either dialysed *Viscum* or colchicin, being applied separately. The simultaneous administration of colchicin and of the *pressed sap* of *Viscum* (containing the alkaloid viscalbin) had no such effects, and actually increased, in one of the concentrations used, the total weight of the shoots as compared with that of the seedlings treated with either *Viscum* sap or colchicin alone. Similar observations were made as regards the relative growth-rate of the roots.

The most specific effects of colchicin appear to consist, however, in (1) a bulbous hypertrophy of the root-cap, indicating an enhanced activity of the caliptrogen; and (2) a bulbous hypertrophy of the coleoptile and the thickening of its walls, accompanying the lignification of certain parenchymatous elements. The resistance thus presented by the coleoptile to the elongation and breaking through of the shoot also appears to cause the mechanical compression of this last, resulting in a bulbous deformation of the bases of the shoots.

These findings are further supported by the cytological examination of the regions affected, and appear to give, in the present state of the investigations, evidence of a parallelism between certain specific responses of plants and of animals when treated with colchicin.

The final interpretation of these observations must depend, however, upon further work.

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Gamma Ray Excitation by Fast Neutrons

THE emission of gamma rays from substances traversed by fast neutrons was at first studied by Lea[1], using neutrons produced by bombarding beryllium with alpha rays. The subject was also studied by Kikuchi, Aoki and Husimi[2], using homogeneous neutrons from the deuteron-deuteron reaction. The same experiment has been repeated more accurately and using more elements than before, the result being shown in Fig. 1. [On account of the difficulty of finding space below the atomic number axis for the symbols of all the elements examined, a few only have been inserted as a guide.—Ed. NATURE.]

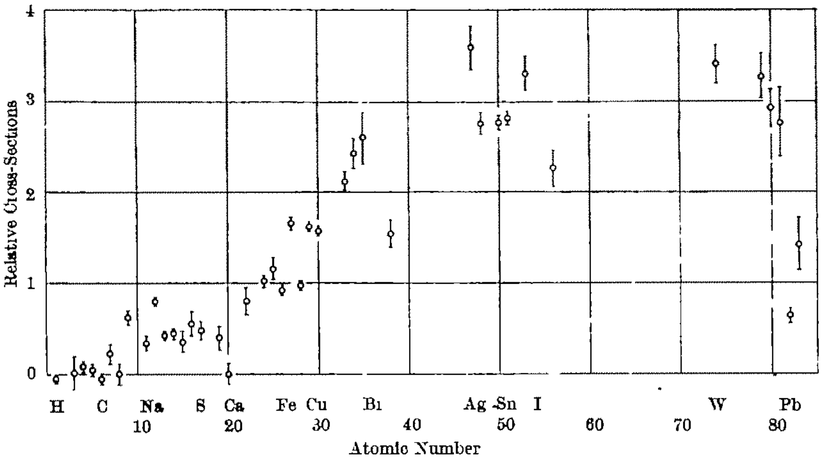

Fig. 1.

The experimental procedure was the same as before. In the present case, however, any substance near the neutron source was removed as far away as possible to suppress the secondary gamma rays which constitute a part of the background radiation to the counter, and also to avoid the possible change of energy spectrum of initially homogeneous neutrons.

In Fig. 1, the ordinate indicates relative atomic cross-sections, which were determined by the intensities of gamma rays from radiators so thin that the absorptions of neutrons and the emitted gamma rays were negligible. The cross-sections have not been corrected for the efficiency variation of the counter with the energy of gamma rays. The wall of the counter was made of aluminium, 3 mm. in thickness. In all cases, no gamma ray was observed after the neutron irradiation ceased.

Fig. 1 shows that the sudden jump of the cross-sections at Z (atomic number) $= 9$ is conspicuous, but discontinuities near $Z = 17$ suggested formerly can scarcely be recognized. It is quite interesting to note that the points are distributed roughly on a smooth curve which ascends in the region of lower atomic number and becomes horizontal at $Z = 50$, and probably falls again above $Z = 80$ (that is, in the region of radioactive elements). The deviations of points from this smooth curve are far in excess of the experimental errors.

These gamma-rays may be emitted by nuclear excitation by the 2·4 m.e.v. neutrons used, although we have no positive proof of this. Scarcity of secondary electrons with energy more than 2·4 m.e.v. is a strong support for this hypothesis.

The dependence of the cross-sections on the atomic number shown in Fig. 1 is different from that of absorption scattering cross-sections of fast neutrons obtained by Dunning[3]. From this fact we know that the emission of gamma rays is only part of the result of absorption and scattering of fast neutrons by nuclei. There may exist many other types of interaction; for example, disintegration of nuclei or the emission of β-rays from substances traversed by neutrons, which was reported by Kikuchi, Aoki and Husimi[4]. Absorption cross-sections of fast neutrons were determined by Collie and Griffiths[5], who detected neutrons by induced radioactivities by fast neutrons, and they obtained a constant value for several elements including copper, lead, etc. It is probable that these absorptions result from gamma ray emission, but the gamma ray excitation cross-sections in Fig. 1 are not constant for these elements. However, it must be taken into account that the energies of the neutrons are different in this case and from that of Collie and Griffiths.

It is natural to relate the emission of gamma rays to the production of slow neutrons by heavy nuclei. Collie and Griffiths observed that lead produces about the same number of slow neutrons as copper when reduced to the same number of atoms, but the cross-section for gamma ray excitation of lead is distinctly smaller than that of copper. The energy determination of emitted gamma rays is very interesting in this respect.

A detailed report of this work will be published shortly in *Proc. Phys. Math. Soc. Jap.*

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Jan. 1.

[1] *Proc. Roy Soc*, A, **150**, 637 (1935).

[2] NATURE, **137**, 398 (1936), and *Proc Phys. Math Soc Jap*, **18**, 115 (1936)

[3] *Phys. Rev.*, **45**, 586 (1934)

[4] NATURE, **138**, 841 (1936).

[5] *Proc Roy Soc.*, A, **155**, 434 (1936).

Mechanical Tracer for Electron Trajectories

THE paths of electrons in vacuum devices have been in recent years objects of intensive study. The problem involves in general the solution of a partial differential equation for the field, and if the field is known, the solution of an ordinary differential equation for the motion of the electron. The first problem is usually solved experimentally, by constructing a large-scale model of the device, which is immersed in an electrolyte, and exploring the field with a probe. The second step is either to construct the electron paths by some graphical method in a map of the potential lines, or to introduce the data derived from probe measurements into certain approximative differential equations, as developed by H. Busch, W. Glaser, O. Scherzer *et al.*

An apparatus has been designed which makes it possible to trace the electron paths without mapping the potential field, and without calculation. Its principle, in the case of space-charge free electrostatic fields and plane electron paths, is as follows:

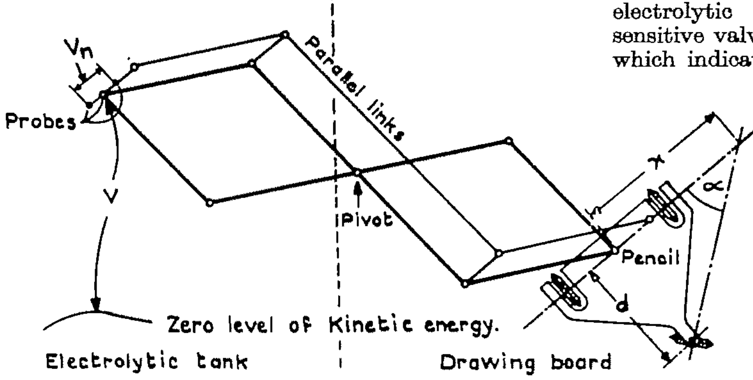

Fig. 1.

The curvature radius of the electron path is $r = 2V/E_n$, where V is the potential drop in which the electron has acquired its energy and E_n the field intensity normal to the path. In the electrolytic model the electron is represented by a probe and V is its potential with respect to the zero level of electron energy. E_n is measured by side probes, placed closely at either side of the main probe, at equal distances. The connecting line of these probes is kept always perpendicular to the path by the mechanism shown in Fig. 1.

The pencil tracing the electron path on a drawing board is carried by a trolley with three sharp-edged wheels. The pencil is connected with the main probe by means of a pantograph, and the trolley is linked with the side probes in such a way that their connecting line is always parallel to the leading wheels of the trolley, and therefore perpendicular to the path.

The trolley is steered by its third wheel, which can turn around a vertical axis. If the steering angle is α, the curvature radius of the pencil trace is $r = d \cot\alpha$. The pencil draws the true electron path if $\tan\alpha = k.V_n/V$, where V_n is the voltage between the side probes and k is a constant of the device. This steering angle is determined without any calculation by a special bridge, shown in Fig. 2:

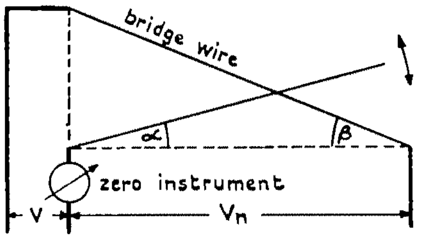

Fig. 2.

This bridge is set to zero if $\tan\alpha = \tan\beta . V_n/V$. If $\tan\beta$ is made equal to k, the steering angle is found by balancing V on a second bridge and simultaneously balancing the 'tangent bridge'. This angle is transmitted to the steering wheel automatically by means of a differential gear and parallel links. The trolley is moved on in small steps, keeping the bridges in balance all the time, and the pencil traces the path of the electron (or of any other charged particle).

In order to obtain the high accuracy required in electron-optical work, an improvement has been introduced in the bridge method as hitherto used in electrolytic model experiments. An extremely sensitive valve-wattmeter is used as zero instrument, which indicates zero, not if the slider of the bridge which indicates zero, not if the slider of the bridge has the same potential as the probe (a condition which cannot be fulfilled in general), but if the voltage vector between them is perpendicular to a fixed voltage chosen as 'base'. Thus one time-component of the potential vectors is sorted out. This has the advantage that it not only reduces the random error to negligible proportions, but also eliminates at the same time the systematic error, introduced by the polarization capacities at the electrodes.

The first apparatus of this particular kind has recently been completed in the Research Laboratories of the British Thomson-Houston Co. Ltd, Rugby. I wish to acknowledge my grateful thanks to my colleagues in the Research Laboratory, and to Mr. H. Warren, chief of the Laboratory, and the directors of the B.T.H. Co. Ltd. for permission to publish this note.

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Jan. 16.

Condensation Coefficients of Various Substances

THE ratio of the number of gas molecules *condensing* on a surface per second to the total number *incident* on the surface may be defined as the 'condensation coefficient' (*f*) of the gas at the surface. It has usually been assumed that this coefficient has the value unity; in other words, that every gas molecule striking the solid surface remains attached to it for some time before returning to the gas phase.

Some years ago, however, it was shown[1] that the condensation coefficient of water vapour at a liquid water surface and that of ethyl alcohol vapour at the corresponding liquid surface were considerably less than unity ($f = 0{\cdot}036$ for water), and recently Lennard-Jones and Devonshire[2], having examined the problem of condensation at a crystal surface theoretically, have shown that values of *f* less than unity are sometimes to be expected.

I have now measured this coefficient for (*a*) iodine vapour at the surface of an iodine crystal, (*b*) naphthalene vapour at the surface of a naphthalene crystal, (*c*) camphor vapour at the surface of a camphor crystal, and (*d*) benzoic acid vapour at the surface of a benzoic acid crystal.

The results are shown in the accompanying table, which also includes the values of *f* for the liquids examined earlier and that for mercury as determined by Knudsen[3].

Substance	Condensation coefficient
Iodine	1·0
Naphthalene . ..	1·0
Benzene	1·0
Carbon tetrachloride .. .	1·0
Mercury	1·0
Synthetic camphor .	0·17
Benzoic acid . .	0·29
Water	0·036
Ethyl alcohol ..	small

Owing to the powdery surface of the solid benzoic acid, the true surface area must be greater than the apparent area. In obtaining the value of *f* given above, no allowance was made for this, so that the true value of *f* must therefore be smaller than that given.

It will be seen that, while *f* is equal to unity for iodine and naphthalene, it is comparatively small for camphor and benzoic acid. It is also to be noted that all those substances examined the molecules of which have a zero dipole moment have a condensation coefficient of unity; on the other hand, the substances the molecules of which have large dipole moments have small values of the coefficient *f*.

T. ALTY.

University, Glasgow.
Jan. 28.

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[1] Alty, *Proc Roy. Soc*, A, **131**, 553 (1931), A, **149**, 104 (1935).

[2] Lennard-Jones and Devonshire, *Proc. Roy. Soc*, A, **156**, 6 (1936)

[3] Knudsen, *Ann. Phys*, **47**, 697 (1915).

Molecular Distillation of Petroleum Lubricating Oils

IN some preliminary distillations of lubricating oils carried out in this laboratory, we have encountered results quite contrary to those anticipated, and as we believe them to be unlike any results hitherto reported, we deem them worthy of notice, even at this early stage of our investigations.

So far, the distillation of two oils, a Scottish shale oil and a Persian oil, using a specially designed molecular still, has been carried out. This still is based on the principles set forth by Hickman and Sanford[1]. The temperature control, and to some extent the pressure regulation, were not very constant (the temperature varied ± 3° C.), but even so the results are consistent. The most striking result, allowing for the lack of good temperature control, to our minds, is the inversion that has taken place in the change in the physical properties as we go up the temperature scale. Thus, instead of the first fractions showing low refractive indices and densities, they actually gave figures higher than those of the original oil, with gradually descending values from fraction 4 as the temperature is raised. The accompanying table makes this clear.

MOLECULAR DISTILLATION OF SHALE OIL NO. 55
(ALL CHARACTERISTICS AT 25°)

Fraction	Density	Refractive Index	Refractivity	Viscosity (centipoises)	Temperature (approx.)
Original oil	0·8935	1·5039	0·5640	51·86	
1	0·8961	1·5092	0·5682		40
4	0·9070	1·5151	0·5679	33·29	59
6	0·9018	1·5109	0·5665		60
10	0·8929	1·5038	0·5642	50·21	65
15	0·8805	1·4950	0·5622	66·25	95
Residue	0·8996	1·5064	0·5629	228·6	

We, ourselves, are specially interested in the carcinogenicity of these molecular distillates as compared with the products obtained by use of solvents. For example, all samples of petroleum oils we have treated with alcohol have provided residues of lower carcinogenicity than the original oil, but while index and density were always lower, viscosity was sometimes higher than that of the original oil. All these experiments have a bearing on the important question of the interrelation of index and viscosity to activity on injection, and thereby carcinogenicity when applied to the skin.

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[1] *J. Phys. Chem*, **34**, 637–653 (1930).

Variable Magnetic Moments of Cobaltous Compounds

IN the course of an investigation on the magnetism of cobalt compounds, we have found a notable difference between the magnetic moments of the blue and violet forms of *bis*pyridylcobaltous chloride, ($Co2PyCl_2$). The violet form, which is stable at room temperature, was first prepared in 1894 by Reitzenstein[1]; the blue form was obtained in 1927 by Hantzsch and Schlegel[2] by dissolving the violet form in chloroform and precipitating the substance by dilution with ligroin. The blue form can also be prepared by heating the stable form to 120°; it is unstable at room temperature and reverts to the violet form in a few days. Much work has been done on the absorption spectra, molecular weight, and conductivity of these substances[3].

Fahlenbrach[4] measured the susceptibility of solutions of cobaltous chloride ($CoCl_2$) in pyridine; below $-20°$ the $1/\chi, T$ curves were linear and gave $\mu_{\text{eff.}} = 5{\cdot}0$ Bohr magnetons over a range of dilutions. These red solutions probably contain $[Co6Py]^{++}$. From $-20°$ to $+35°$ the solutions were violet and the $1/\chi, T$ curve was not linear. Above 35° the solution was blue but the slope of the $1/\chi, T$ curve varied with dilution, and it was clear that a change in the magnetic moment of the carrier was taking place.

By using the pure solid compounds with two molecules of pyridine, we have found a large difference in moment between the two isomerides. The stable violet form gives at room temperature $\mu_{\text{eff.}} = 5{\cdot}34$. The blue form, prepared by heating to 120° for a few hours and cooling rapidly with solid carbon dioxide gave in successive experiments $\mu_{\text{eff}} = 4{\cdot}62$, $4{\cdot}58$ when measured at 20°. The true value may be slightly lower since conversion to the violet form soon caused a marked increase in moment, which rose to 5·3 in a few days.

The magnetic moment of most of the elements of the first transition series is close to that predicted for electron spin only[5,6]. Bivalent cobalt compounds are an exception to this rule and usually possess moments greater than that predicted for an electron spin of 3/2, namely, $\mu_{\text{eff.}} = 3{\cdot}87$. Some orbital component seems to be conserved and the degree of conservation may depend upon the symmetry of the environment of the magnetic atom[7]. If the violet form has the structure $[\text{Co4Py}]^{++}(\text{CoCl})_4^{=}$ then the cobalt atoms have a more symmetrical environment than in the unionized structure $[\text{Co2PyCl}_2]$, which may represent the blue form. This interpretation leads, however, to difficulties in connexion with the magnetism of other cobalt complexes which will be described elsewhere.

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[1] *Lieb. Ann.*, **282**, 267 (1894).

[2] *Z. anorg. Chem.*, **159**, 273 (1927).

[3] Rohde and Voigt, *Z. phys. Chem*, B, **15**, 358 (1932); Werner and Schmoilow, *Z. anorg. Chem.*, **15**, 23 (1927); Brode, *J. Amer. Chem. Soc.*, **53**, 2457 (1931).

[4] *Ann. Physik.*, **13**, 265 (1932)

[5] Bose, *Z. Phys.*, **43**, 864 (1927).

[6] Stoner, *Phil. Mag.*, **8**, 250 (1929).

[7] van Vleck, "Theory of Electric and Magnetic Susceptibilities", (Oxford Univ. Press, 1932, p. 287).

Dissociation of N_2^+

WITH reference to communications on valency and electronic structure published in this journal from time to time[1], we wish to direct attention to the spectrum of N_2^+ and particularly to the term $(C)\ {}^2\Sigma$ (3·52 e.v. above $(B)\ {}^2\Sigma$) found by Watson and Koontz[2] some time ago. This term, being the second excited level of ${}^2\Sigma$ type, is produced by the excitation of the unpaired $3s\sigma(2p)$ electron of the ground state $(X)\ {}^2\Sigma$, to the group $3d\sigma(3s)$.

The extrapolation of the vibrational levels shows that in this state N_2^+ dissociates into atoms one of which is excited by 11·28 e.v. (or 10·20 e.v. if the cubic term of the equation is employed). This value agrees perfectly well with the energy of excitation of nitrogen from its ground state $2s^2\ 2p^3\ {}^4S$ to the level $2s^2\ 2p^2\ 3s\ {}^4P$ (= 10·20 e.v.) which is indeed the lowest term in which N possesses a $3s$ electron. The energy of dissociation or formation of the molecule in this state is about 50 per cent bigger than that for the ground level. This shows that a more stable chemical linkage is produced in N_2^+ if the unpaired electron is removed to the next shell by excitation, the conditions being very similar to those in NO, discussed earlier[1]. There is, however, one significant difference. In NO the unpaired electron is in a promoted, or antibonding group. In N_2^+ the odd electron is a non-promoted or bonding electron.

This constitutes the first example which unambiguously shows that a single unpaired electron does not act as bonding but weakens the linkage, even if it is in a bonding orbital. Further, the large increase in dissociation energy as the molecule is excited from $(X)\ {}^2\Sigma$ to $(C)\ {}^2\Sigma$ state, directly contradicts the general identification of non-promoted with bonding and promoted with antibonding electrons. This evidence and other experimental results, which are mentioned earlier, are to our mind incompatible with the latter hypothesis.

A more detailed discussion will be given in connexion with considerations on the applicability of the Birge–Sponer method of vibrational extrapolation in a forthcoming paper, in the *Proceedings of the Indian Academy of Science* (Bangalore).

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Muslim University, Aligarh.
Jan. 25.

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[1] Hunter, R. F., and Samuel, R., NATURE, **138**, 411 (1936), and literature mentioned there.

[2] Watson, W. W., and Koontz, G. P., *Phys. Rev*, **46**, 32 (1934).

Recent Auroræ and Magnetic Disturbances

WITH reference to the displays of aurora on January 7 and February 3, reported in NATURE of February 13 and 20, pp. 277 and 318, the following further details may be of interest. The aurora of January 7 was noted by an observer in the vicinity of Preston, who reported seeing it between 19h. and 19½h. U.T. On this occasion, the magnetic records of Stonyhurst Observatory show a moderate disturbance between 18h. and midnight, the most notable movements being a fall of 27′ in westerly declination between 19h. 15m. and 19h. 32m., followed by a sharp rise of 28′ between 19h. 32m. and 19h. 42m., whilst horizontal force rose by 140γ between 19h. 22m. and 19h. 34m. and then fell by 180γ between 19h. 36m. and 19h. 43m. It may be noted that on this occasion the minimum value of *D* almost coincided with the maximum value of *H*. On February 3, however, these conditions were reversed, the minima in *D* and *H* being almost, but not quite, coincident in time. On this occasion, declination fell by 70′ between 18h. 58m. and 19h. 12m., whilst horizontal force fell by 225γ between 18h. 56m. and 19h. 09m., each element rising by corresponding amounts in the next ten minutes.

From fifty accounts received from observers of the aurora on the latter occasion, there can be little doubt that the most brilliant part of the display occurred during the easterly swing of the declination magnet. Of the fifty observers, eight first noted it between 18h. 40m. and 18h. 45m., and seven gave the end as 19h. 25m. or 19h. 30m., whilst no fewer than twenty-five reported first seeing it between 18h. 55m. and 19h., and twenty-nine gave the end as 19h. 10m. or 19h. 15m., the rest giving intermediate times for the first and last observations. It seems clear that whilst some observers noted the fainter glows near the beginning and end, the majority saw only the more vivid portions of the display. Two observers first noted it at 18h. 57m., two others note an increase in brilliance at 18h. 58m., one gives the end as 19h. 12m., and one other the duration as from 18h. 57m. to 19h. 12m.

This circumstance, of the display being chiefly during an easterly swing of the declination magnet, seems to apply also to the single local observation of

January 7, and a similar coincidence was noted by me in an observation of the aurora on December 20, 1930. On January 7 last, Mr. Craig in northern Scotland noted conspicuous features between 19h. 30m. and 19h. 45m., and a rapid decrease within a few minutes of the latter time, and it is worthy of note that another sharp fall of 14′ in declination was recorded from 19h. 35m. to 19h. 45m., after which minor oscillations occurred.

These observations seem to indicate that the aurora is chiefly manifest whilst a current of negatively charged ions is traversing the upper atmosphere in a direction with a south to north component. If the direction is north-east, the horizontal force would fall concurrently with the declination; whilst if it is north-west, the opposite condition would hold. It would be most useful if observers of the aurora would make careful note of the times when important changes take place, and especially of the time when the phenomena fade out. To get the time of actual commencement of a display is more difficult, as it will in general have been in progress for some time before being noticed. As the same disturbed region of the sun to which both the recent displays must be attributed will be on the central meridian on February 26, and was at the time of writing (February 20) showing a spot just inside the eastern limb, there is a possibility of a recurrence of the phenomena after the 27-day interval, on March 2, and it will be well worth while to keep a look-out on that evening, and on the preceding and following ones. It may be mentioned that the night sky was observed to be unusually bright with auroral light on February 6, 23h.—24h., February 9, 21h., when clouds prevented further observation, and on February 10, 23h.—24h., on all of which occasions moderate magnetic disturbances were in progress.

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Feb. 20.

Points from Foregoing Letters

THE presence of traces of calcium, copper and zinc affects considerably the properties of surface films, and Dr. R. J. Myers and Prof. W. D. Harkins consider that the results of many previous experiments reported in the literature (apart from those carried out in strongly acid solutions) are likely to have been vitiated by such contamination. They advise future investigators to use quartz or very heavily paraffined glass troughs, and to make sure that all salts are exceedingly pure.

Further experiments supporting the view that the oxidation of glucose to lactic acid can proceed in the chick embryo without the intermediate mechanism of phosphorylation are adduced by Dr. J. Needham and H. Lehmann. In this reaction, glutathione is necessary. The ordinary phosphorylation mechanism of carbohydrate breakdown operating in muscle through the intermediary of hexosediphosphate, is but of low activity in the chick embryo.

Prof. H. Munro Fox and C. A. Wingfield have measured the oxygen consumption of isolated muscles of prawns from different latitudes to test the hypothesis that the greater oxygen requirements of English compared with arctic invertebrates, each at the temperature of their habitat, is due to a higher non-locomotory metabolism in the former.

Diagrams showing the effect of ultra-centrifuging on the eggs of the horse round-worm are submitted by Dr. R. L. King and Prof. H. W. Beams. The authors connect the diminution observed in the size of the chromosomes with the suppression of cleavage walls, and postulate the presence in the cytoplasm of a ‘diminisher’ causing diminution of chromatin.

Dr. Kenneth Smith describes the discovery of an air-borne plant virus. This is the first time a plant virus has been shown to spread in this way.

Drs. H. P. Bayon and Ann Bishop report the cultivation *in vitro* of the protozoon *Histomonas melagridis*, from the liver of a diseased chicken showing symptoms similar to those occurring in turkeys suffering from ‘blackhead’. This disease is generally attributed to *Histomonas*, but the parasite has not yet been found in the liver of turkeys nor has it hitherto been successfully cultivated *in vitro*.

Relative cross-sections of 41 elements for gamma ray excitation by 2·4 m.e.v. neutrons have been determined by H. Aoki. The cross-sections plotted against the atomic number are distributed roughly on a smooth curve which rises with atomic number in the region of lower atomic number and probably descends again when the atomic number exceeds eighty.

An apparatus for tracing the paths of electrons in electrostatic fields is described by Dr. D. Gabor. The tracing pencil is moved mechanically on a drawing board, according to indications derived from probe measurements in an electrolytic model. Special precautions are taken to avoid the error introduced by polarization phenomena.

The unusual behaviour of certain petroleum lubricating oils on distillation is described by R. Lyth, who finds that the fractions first distilled have higher densities and refractive indices than the fractions that distil at higher temperatures.

A difference in the magnetic moments of the violet and the blue forms of *bis*pyridylcobaltous chloride has been found by E. D. P. Barksworth and Prof. S. Sugden, who indicate its relation to the symmetry of environment of the magnetic atom.

A discussion of the correlation of the ground level and the second excited level of the molecule N_2^+, Dr. R. K. Asundi and Prof. R. Samuel state, shows that an unpaired electron weakens a chemical bond even though it is in a non-premoted or bonding orbital. They consider this as a further experimental proof against the identification of non-premoted and bonding electrons, and therefore as an argument in favour of Heitler and London's pair-bond theory of valency.

L. Havas finds that colchicin (the active principle of the autumn crocus) exerts at first a stimulating effect upon the rate of development of the roots and root-hairs of wheat seedlings, followed by inhibition. The effect of mistletoe preparations (with and without the active principle viscalbin), separately and in conjunction with colchicin, are described.

Research Items

Control of Secondary Sexual Characters in Birds

MUCH information regarding the secondary sexual characters of birds, their alteration by experimental means and their bearing on the theory of evolution is given in a summary by Dr. Emil Witschi (*Scientia*, 60, No. 11). Many cases of male and female plumage in birds and their alteration by injections or castration are cited. The variety of conditions indicates that male and female plumage types are not necessarily always secondary sexual characters. In some species, plumage types are controlled by genetic factors, in others by hormones from different glands. Gonad hormones appear not to influence seasonal dimorphism. The hypophysis releases small quantities of gonadotropic hormones during sexual inactivity and large quantities in the breeding season. Ovarian hormone inhibits the development of cock plumage, but thyroid hormone appears to do the same. Ornamental plumages render the individual less fit for ordinary survival, but sexual selection cannot be considered the cause of the basic variations from which sex dimorphism has arisen; nor does it throw any light on the complicated hormonal and genetical control mechanisms. It is suggested that the change from hormonic to genic control may have happened through the hormones acting as messengers from soma to germ plasm.

Primitive Arthropods

THE Cawthron Lecture for 1935, delivered by the late Dr. R. J. Tillyard, has recently been published by the Cawthron Institute, Nelson, New Zealand. The subject of the lecture, "Tracing the Dawn of Life further Backwards", is one of special interest since it embodies the results of recent palæontological discoveries among the ancient rocks of the Adelaide series. These were the outcome of many years of work by the late Sir T. W. Edgeworth David, and the rocks in question form the Proterozoic series of Australia. They are stratified deposits supposed to have been laid down in Pre-Cambrian times. Among the fossils disclosed, none is more remarkable than those described by David and Tillyard as belonging to the Arthrocephala. This name is given by them to a new Arthropod class which included creatures with four moveable head segments each bearing appendages. The address is accompanied by two plates which represent restorations of these creatures, and are taken from the original memoir lately published by the two writers mentioned.

Melanophores of the Paradise Fish

THE melanophores of the paradise fish, *Macropodus opercularis*, show two different phases in their reactions to light. The primary phase, according to G. Tomita (*J. Shanghai Sci. Inst.*, Sept. 1936), lasts from their first appearance in the embryo until the eyes have begun to function. In darkness the animals are pale, and in bright light they are dark. The expansion of the melanophores is related to the intensity of the light. The functioning of the eyes is followed by the secondary phase, in which in darkness or in light the fish are pale or dark to correspond with their surroundings, but the reaction becomes slower with increasing age. The destruction of the eyes in the early larvæ has no effect on the reactions in the primary phase, but later larvæ in the secondary phase when so treated revert to the primary phase. Similar reversion is exhibited also by the newly born young of *Lebistes reticulatus*, *Gambusia affinis* and *Xiphophorus helleri*.

Pest and Plant

UNDER this title, Messrs. A. G. Bebbington (Empire Cotton Growing Corporation) and W. Allan (Department of Agriculture, Northern Rhodesia) have a very interesting discussion (*Empire Cotton Growing Rev.*, 14, Jan. 1937) of a thesis previously enunciated in the *Review* by Sir Albert Howard that "insects and fungi are not the real causes of plant diseases and only attack unsuitable varieties or crops improperly grown". Against this dictum, Messrs. Bebbington and Allan marshal convincing evidence, from their experience in Northern Rhodesia, of cotton crops in which the damage from bollworm and stainer attack is clearly the greater as the suitability of the locality for the crop increases, as also the care expended in its cultivation. They show also that with one stainer, *Dysdercus fasciatus*, the governing factor in determining its ravages on cotton is the extent of the fruit crop available on its chief host plant in that locality, the tree *Thespesia rogersii*. With the other stainer, *D. superstitiosus*, the story is more complicated, because it has a series of short-lived plants as its hosts and these vary in different regions, so that the incidence of attack varies in the same season from region to region. In all cases, however, both with bollworm and stainer, they produce remarkably strong evidence that, whilst neglected and poor crops of cotton struggle through to harvest with little damage from these pests, side by side with them well-grown plants, instead of yielding good crops, may be nearly ruined by their depredations.

Dermatophyte Fungi

A CASE of maduromycosis, a fungus disease affecting the legs of human beings, has recently been described from Canada by Drs. R. M. Shaw and J. W. Macgregor (*Canadian Med. Ass. J.*, 33, 23–28; 1935). A clinical history of the disease, which is known as 'madura foot', is given, and the causal fungus has been identified as *Monosporium apiospermum*. Dr. Eleanor S. Dowding also examined the fungus, and her account follows that cited above (*ibid.*, 28–32). The mycelium has the swellings and 'racquet hyphæ' typical of many dermatophytes, and its conidiophores are undifferentiated from the other hyphæ when submerged in the medium. They have a typical erect habit, often with tapering sterigmata, when borne aerially. A species of *Geomyces*, isolated from soil in Alberta, though similar to some of the fungi causing maduromycosis, was found to be non-pathogenic. Dr. Dowding and Dr. H. Orr have also studied the peculiar 'mosaic fungus' which appears in certain tissues parasitized by ringworm fungi. They consider that it is due to the breakdown of the dermatophyte fungus *Trichophyton gypseum*.

The Sudbury Nickel Irruptive

In his third paper on the life-history of the great Sudbury intrusion-complex, W. H. Collins describes the evidence bearing on the age relationships of the 'younger granites' to the 'nickel irruptive' (*Trans. Roy. Soc. Canada*, (4), 29; 1936). Dr. Collins and his co-workers have been unable to reach positive conclusions as to the relative ages of the rocks under investigation, though in the case of the Murray granite there are good grounds for the inference that it intruded the norite of the nickel irruptive. The Creighton granite, however, presents many puzzling features. Locally the norite becomes fine-grained against the granite and at one place stringers of a black chilled equivalent of the norite penetrate the granite for five feet. On the other hand, a stringer of granite was found extending from the main granite-mass into the chilled norite; moreover, a series of crooked and branching dykes of porphyritic granite, up to eight feet across where they leave the Creighton granite, has been traced for forty feet into the norite. After a careful discussion of all the possibilities, it is concluded that the apparent contradiction can be accounted for only by the hypothesis that the Creighton granite, though really older than the nickel irruptive, was mobilized by heat and pressure so that it was enabled to flow into cracks developed in the cooling norite. Collins is unable to support this hypothesis by many well-authenticated examples of the same phenomena Reference may therefore be made to the fact that at the top of the Portrush Sill (near the Giant's Causeway) several occurrences have been found by N. Harris of veins of mobilized hornfelsed Lias which pass downwards into the chilled margin of the Sill from the roof. Other veins in the dolerite of the Sill consist of syntectic rocks derived from the hornfelsed Lias by metasomatism and transfusion due to the action of magmatic emanations from the dolerite magma (Nature, 138, 984, Dec. 5, 1936).

Recent Earthquakes at Helena (Montana)

The destructive shocks of October 18 and 31, 1935, have directed attention to the earthquakes of the sparsely inhabited State of Montana. Mr. F. P. Ulrich has given (*Bull. Seis. Soc. America*, 26, 323; 1936) a brief description of these earthquakes, and has also compiled a list of all known shocks since 1805. Semi-destructive earthquakes occurred on December 10 and 11, 1872, and December 20, 1908, and a destructive earthquake, felt over about 300,000 square miles, on June 27, 1925. After a period of inactivity, the recent series began on October 3, 1935. On October 12, a semi-destructive earthquake was felt at least 200 miles from its centre. It was followed on October 18 and 31 by destructive earthquakes, between which 506 slight shocks were felt, the total number in the series up to the end of March 1936 being 1,794. The two great earthquakes were felt over an area of at least 200,000 square miles. Visible waves were reported by several observers. After each destructive earthquake, the ground at Helena was left crossed by stationary waves, the distance from crest to crest being 24–28 in. and the maximum depth 2–4 in.

Negative Ion Formation

F. L. Arnot has found that in mercury vapour negative ions are frequently formed by a positive ion extracting two electrons from any negatively charged electrode to which they are driven. The resulting negative ion is repelled from the electrode. A new paper by Arnot (*Proc. Roy. Soc.*, A, 158, 137) extends this work to hydrogen, nitrogen, oxygen and carbon dioxide. In all these cases negative ions were formed by the new process described above. Only monatomic ions were found in hydrogen and nitrogen, oxygen gave monatomic and diatomic ions, carbon dioxide gave CO_2^-, CO^-, O_2^-, O^-, and C^-. No negative ions produced by electron attachment could be observed, though this process has in the past been assumed to account for negative ion formation. The probability of conversion of positive to negative ions increases with the incident kinetic energy of the ion incident on the surface. For 180-volt ions it lies between 10^{-3} and 10^{-5}. The energy distribution of the positive ions rebounding as negative ions from a nickel surface has been measured, and the 'accommodation coefficient' defining the fraction of the kinetic energy of the ion lost on collision with the surface has been determined. This coefficient is not single valued, but has a most probable value such that the positive ion after reflection retains a few volts energy. In the case of hydrogen, there are two maximum values of the accommodation coefficient.

Scattering of Protons by Protons

M. A. Tuve, N. P. Heydenburg and L. R. Hafstad (*Phys. Rev.*, 50, 806) have made a careful study of the scattering of protons in hydrogen gas The protons were obtained from a high-voltage accelerating tube driven by an electrostatic generator with special arrangements for steadying and measuring the accelerating voltage, which was varied from 600 to 900 kv. The scattered particles were counted by an ionization chamber and linear amplifier. The results are compared with Mott's formula, which assumes the inverse square law of force. At 600 kv. the numbers observed at all angles are about two thirds of the Mott values. At higher voltages, the angular distribution is markedly different from that given by the formula, and the authors were able to assure themselves that the anomaly was real and not instrumental. The field around the nucleus must differ strongly from the inverse square field at distances of the order 10^{-13} cm. A paper by G. Breit, E. U. Condon and R. D. Present (*Phys. Rev.*, 50, 825) investigates the nuclear field by wave mechanical methods, and shows that the observations agree with scattering by a 'potential wall' in which the symmetrical de Broglie wave is distorted in a way corresponding to an attractive force overpowering the Coulomb forces at short distances. The magnitude of the interaction determined agrees with that used by Bethe in the calculation of mass defects of light nuclei. It appears to be identical with the proton-neutron interaction as determined from the scattering and absorption of slow neutrons.

Absorption Bands in the Spectrum of ψ-Isocyanine Dyes

Dr. E. E. Jelley recently reported (Nature, 138, 1009; 1936) that 1 : 1′ diethyl-ψ-cyanine chloride exhibited a characteristic narrow absorption band and a fluorescence of wave-length very close to that of the absorption band, when it was precipitated from aqueous solution. This he considered to be due to the existence of the substance in a transitory molecular state, intermediate between the dissociated and crystalline states. Scheibe, Kandler and Ecker (*Naturwiss.*, 25, 75; 1937) find such an absorption band and accompanying fluorescence in aqueous solutions of 1 : 1′ diethyl-ψ-isocyanine chloride of certain concentrations, and believe it to be due to a reversible polymerization of ions of the dye. In support of this view they quote the fact that there is a considerable increase in the viscosity of the solution in the concentration range in which the narrow absorption and fluorescence occur. The polymerization is completely reversed by raising the temperature by about 30°. The phenomenon is much affected by dilution, when viscosity, absorption and fluorescence disappear together. In heavy water the position of the absorption band is the same as in ordinary water. The absorption spectrum of the dye when adsorbed on various surfaces such as glass, quartz, gypsum and mica has been examined, and whilst the narrow band is obtained in all cases, its position is slightly different from that of the band observed with aqueous solutions. The fluorescence is also slightly shifted. Freshly split fluorspar and polystyrol do not adsorb the dye.

Secretions of Essential Oils in Plants

IN a report presented at the Annual Conference of the International Faculty of Sciences held in London on January 29–30, Prof. J. Politis discusses recent work in his department in the National University, Athens, on the morphology and physiology of certain plant glands. Glands on the leaves and, to a less extent, on the stems of the true artichoke (*Cynara Scolymus*) are responsible for the characteristic bitter taste. The gland originates from a single epidermal cell. The cell divisions taking place during development are described in detail, and the mature gland is figured. The characteristic bitterness of *Jurinea mollis* is found to be due to secretions from glands located on the stem, leaf and under-surface of exterior petals and bracts. Their origin, development and mature structure are also described and figured. Glands have also been found on the cardoon (*Cynara cardunculus*). Reference is made to the physiology of the secretive process, and micro- and macro-chemical tests of the substance secreted are given in detail. No further clues to their chemical nature have so far been obtained, however, but the author considers these bitter substances are essential oils which have been derived from glycosides by enzyme action.

Pure Oleic Acid

ALTHOUGH oleic acid is perhaps the most common of the naturally occurring fatty acids, the pure acid is still one of the rare chemicals. Oleic acid always occurs in fats and oils associated with saturated acids and usually with varying amounts of linoleic acid and acids of higher unsaturation. The methods of purification usually start with olive oil and proceed through the purification of the lead and barium soaps, and they are extremely tedious. J. B. Brown and G. Y. Shinowara (*J. Amer. Chem. Soc.*, 59, 6; 1937) show that oleic acid of high purity may be obtained by direct crystallization of the acids of olive oil from acetone. The saturated acids are removed by precipitation at − 20°, and the remaining unsaturated acids are crystallized from acetone at − 60° four or more times, this treatment being followed by a partial crystallization of the resulting products from acetone at − 35° to remove small amounts of palmitic acid not taken out in the original treatment at − 20°. The three specimens obtained, distilled at 15 mm. pressure, all melted at 13·0°; the iodine numbers were 89·63–90·04, and refractive indices n^{20} 1·4585–1·4586.

'Marmite'

THE Marmite Food Extract Co., Ltd., London, E.C.3, has recently issued a booklet describing the medicinal uses of its well-known preparation, 'Marmite'. This autolysed yeast extract contains in 1 gram about 30 units of vitamin B_1 and is also a good source of vitamin B_2. Marmite has been found of value in diseases caused by a deficient intake of the B vitamins such as beriberi or pellagra, or when they are incompletely assimilated, as in alcoholic polyneuritis. Insufficiency of vitamin B is also associated with many vague conditions of ill-health, especially those accompanied by gastro-intestinal symptoms: whilst an increased intake is required during pregnancy and lactation. Sufficient evidence has accumulated during the last few years to demonstrate that Marmite possesses anti-anæmic properties. It has been found of value in tropical macrocytic anæmia, in the pernicious anæmia of pregnancy and in the anæmias associated with cœliac disease, sprue, malaria and hookworm infestation. It has also been used successfully in the treatment of certain cases of Addison's pernicious anæmia, probably because it acts as a source of the 'extrinsic' factor: it does not contain a substance of the nature of the liver active principle. The booklet contains a table of the recommended dosage in the different conditions for which Marmite is indicated.

Shape of Road Aggregate

IN *Road Research Bulletin* No. 2 (London: H.M. Stationery Office. 6*d.*) a novel research is described to discover a method of classifying the shape and measuring the dimensions of the material that is placed as a covering on the surface of roads. Rightly or wrongly, surveyors and road engineers have thought that flaky and elongated material is undesirable for road construction. Although there are no records of actual failures that can be directly attributed to flaky material, there is a widespread unanimity of opinion that this material is unsatisfactory. In the British Standard Specifications for rolled asphalt, for example, it is stated that the stones have to be "angular and not flaky", thus hinting that flaky material is inferior. The Department of Scientific and Industrial Research and the Ministry of Transport have co-operated in preparing the bulletin under notice. The shape characteristics of broken stone and other similar materials have been measured and practical applications of the methods devised from the results have been considered. In view of the fact that the degree of flakiness permissible in an aggregate must depend at present on the judgment of the engineer, and since, in practice, deliveries will normally be compared with 'approved samples', no limits governing the maximum percentage of long and flaky material acceptable have been suggested. It is pointed out that flakiness in a crusher-run aggregate commonly varies with size. This fact, which is obviously of importance, is generally overlooked.

British Industries Fair

THE range of scientific exhibits, or of exhibits having some specific scientific interest, at the Olympia section of the British Industries Fair, was this year wider than ever, and it becomes increasingly difficult, if not indeed impossible, each succeeding year to attempt anything like an adequate survey of the exhibits likely to be of direct interest to scientific workers or to other readers who have an interest in scientific matters. All that can be attempted within the necessarily limited space is to direct attention to certain novel features of this year's exhibits. Perhaps one general observation that may be made is that, as the years go by, one is increasingly aware of how scientific instruments, at one time only of academic or quasi-academic interest, are steadily invading the domain of industry and finding industrial applications not even dreamt of until recently.

The chemical industries were, as usual, well represented, and showed an extraordinarily varied range of products. A large section of the exhibit of Boot's Pure Drug Co. Ltd. was devoted to a biological display, showing in particular a complete X-ray outfit for assaying vitamin D preparations, such as 'Decrose' (glucose with calcium glycerophosphate and vitamin D). They showed, as new products of particular interest to medical men, 'Ovostab' and 'Luteostab', prepared from the active principles of the female reproductive organs. Among their exhibits, British Drug Houses, Ltd., showed, in the hormone group, 'Anahæmin', which is the anti-anæmic principle of liver. It is issued as a solution in ampoules and rubber-capped vials. The Gas Light and Coke Co. exhibited a 'Premix' emulsion, a slow-breaking emulsion of tar, adapted for treating clean-graded road aggregates in an ordinary concrete mixer, producing a material which can be laid cold and gives a non-skid road surface of great durability. On the stand of Thorium Ltd. were samples of electromagnetically concentrated monazite sand from Travancore, South India. This sand contains about 9·5 per cent of thoria and 60 per cent of other rare earths. It is the raw material for the production of thoria and thorium salts, especially the nitrate.

Among the new developments in the British chemical industry during the past year attention may be directed to the preparation of crystalline soda by a new process, the commencement of commercial production of oxalic acid and the manufacture of metallic magnesium. The development of oil from coal processes has continued, and an entirely new angle in this development is the production of methanol instead of petrol. Interesting developments in the dye-stuffs field are the introduction of a new range of dye-stuffs for leather, for which advantages are claimed, and of a new range of dye-stuffs for the direct dyeing of acetate rayon.

Coming to the scientific instruments section of the Fair, one may note what has been noted before, namely, the enormous advantage obtained from a combined exhibit and also, alas, the continued absence of some firms whom anyone familiar with British scientific instruments would expect to find represented. Nevertheless, great credit is due to the organizers of this section of the Exhibition for a most impressive and widely varied display. Chance Bros. and Co. Ltd. produced a striking effect by exhibiting under strong illumination a broken mass of optical glass as it leaves the pot. There was this year perhaps an even better display than usual of microscopes, photographic lenses, epidiascopes and cameras. In addition to their usual massive model, Ross Ltd. exhibited a classroom epidiascope. This instrument is designed for small classroom work and is very portable. It has a 500–watt lamp, and the change-over from episcope to diascope is instantaneous. The maximum 'throw' of the picture is about twenty feet. Charles Baker showed an 'introscope', an instrument for inspecting the interiors of boiler tubes, ship shaftings, oxygen bottles and aeroplane spars, etc. By means of this instrument, it is possible to illuminate and examine microscopically surfaces which cannot easily be inspected in other circumstances. The instrument is made in lengths from 2 feet up to 33 feet.

A remarkable camera was shown by W. Vinten, Ltd. This camera takes 3,000 pictures per second and holds 400 feet of film, which is exhausted in 2½ seconds. The movement is continuous and at top speed reaches 120 miles per hour, the spool centres rotating at 15,000 revolutions per minute. There is a battery of 38 lenses, mounted on a rotating disc which runs at very nearly the same speed as the film. This camera is being used, among other purposes, for the study of important experiments in high-speed engines.

Among the chemical balances shown by L. Oertling, Ltd., there was a prismatic reflecting microbalance, which gives direct readings to 0·001 mgm. on the scale at the top of the balance case. It is claimed that this is the only balance in the world to read direct to 0·001 mgm. The capacity of the balance is 10 gm. and it is being much used in cancer research and in other problems of micro-chemistry. Kalee Ltd. exhibited a new production, namely, a high intensity reflector arc lamp, for use in cinematography. It is claimed that this lamp provides maximum illumination with comparatively low current consumption. Among the distinguishing features of this lamp may be noticed the embodiment of a short-focus, elliptical mirror. This provides for light collection from a wide angle, and has a further virtue that it dispenses with the use of the usual condenser lens for the focusing of the light on the film. Very thin carbon rods are used, and the mountings for the carbon rods are similarly reduced in size, so as to give the minimum interference with the projected light. The revolving sector is placed between the mirror and the projection lens system, instead of in front of the lenses, and thus helps to reduce the quantity of light entering the lenses with detrimental heating effects. On the stall of Theodore Hamblin, Ltd., an exhibit of novel interest was a binocular polarizing pool gazer. It is well-known that, when a fisherman looks at the surface of a pool of water, light from the sun and sky is frequently reflected from it as a dazzling glare, which prevents objects in the water from being seen. By the use of the polarizing binocular, these reflections are eliminated, and the pool gazer has a clear view of what lies beneath the surface. One must not forget to direct attention to the great developments that have been made within the last year in the applications of 'Perspex', the synthetic product having the appearance and most of the properties of glass, without its defects, to which reference was made last year. A new method has been devised of making optical lenses from this material (see NATURE, February 20, p. 336), and it will be a matter of much interest to watch how far it can be used in optical instruments of precision.

On the whole, one's impression is that those industries which may be regarded as more or less specifically scientific are in step with the general advance of industry and, in particular, alive to the opportunities created for new and, in some cases, striking developments.

Figures of the Earth and Moon

A RECENT paper by Dr. Harold Jeffreys (*Mon. Not. Roy. Astro. Soc.*, **97**, 1; 1936) deals with some well-known articles by de Sitter (*Bull. Astr. Soc. Neth.*, **2**, 55; **4**, 129. Also *K. Akad. Wetens. Amst.*, **17**). De Sitter assumed hydrostatic stress in the earth's interior, and computed the ellipticity and related constants from the precessional constant. On comparing the results with the motion of the moon's node and perigee, the greater part of which can be explained by Brown's theory, there is a balance depending upon the figures of the earth and moon. The former was taken by de Sitter to be calculable from his theory, and the small balance he attributed to the moon's ellipticities. As Jeffreys points out, however, the assumption of hydrostatic stress in the interior does not agree with other data. For example, accepting his solution, the probable error of the difference between gravity at the poles and at the equator is 1 milligal (0·001 cm./sec.^{2}), but Heiskanen's ellipticity of the equator alone gives a variation of 38 milligals at the extremes. In addition, the relativity correction was applied by de Sitter with the wrong sign, a fact which he pointed out to Jeffreys about five years ago, and this produced errors in some of the constants.

Jeffreys deals with the problem in a very thorough manner, certain geophysical information being now available which was unknown to de Sitter, and arrives at some interesting results. Although de Sitter made use of erroneous data which rendered his theory of the figure of the earth a little unsatisfactory, nevertheless the main ellipticity effects do not show much departure from his theory. The ellipticity of the earth is found to be 1/296·38 ± 0·51, and the corresponding gravity formula is

$$g = 978{\cdot}051\ \{1 + (0{\cdot}005282 \pm 0{\cdot}000006)\sin^2\varphi - 0{\cdot}000007 \sin^2 2\varphi\}.$$

He thinks that the accuracy of the formula is genuine so far as the term in $\sin^2\varphi$ is concerned. Other formulæ may suffer from greater inaccuracies because the methods of analysis may fail to allow for other terms.

Dealing with the moon, Jeffreys finds that the ellipticity of the equator is only about one-sixth that of the disk, and from this he concludes that when the moon solidified it was in a state of free rotation, the period being 3·5 days. In "The Earth" (second ed., pp. 228–9) he finds that the moon last adjusted itself to the hydrostatic state when its distance from the earth was about 87,000 miles, and its period of revolution and rotation 6·3 days. However, as he points out, the solution providing 3·5 days is only an *ad hoc* hypothesis. La Place's suggestion that the excess ellipticity may be due to random changes during solidification is probably as near the truth as Jeffreys's hypothesis. Obviously further research will modify some of the results which have been attained.

Hydrides of Boron

IN the December issue of the *Berichte der deutschen chemischen Gesellschaft*, Dr. E. Wiberg reviews at considerable length the experimental evidence from which the structure of the puzzling hydrides of boron may be deduced. That considerable difficulty has been encountered during the last decade in formulating the electronic structure of these compounds will be apparent from the fact that such unsatisfactory devices as singlet linkages, polyvalent hydrogen, a co-ordination number of five for boron, electronic septets, even the sharing of *K*-electrons, a new but unexplained kind of 'electrostatic-electromagnetic' valency and inequality of the two boron atoms, have all been requisitioned at various times in order to find plausible explanations of the existence of the simple compound known, perhaps wrongly, as boroethane, B_2H_6.

Recent work has thrown new light upon this problem, which has been greatly simplified. The author brings forward both chemical and physical evidence to show that, instead of ethane, one should rather regard ethylene as the carbon analogue of diborane (boroethane), since it possesses an unsaturated character; but the analogy should not be pushed too far, since the boron hydrides are also acids. Their acidic character has been rather concealed by the fact that their salts are very easily decomposed by water, but they combine with ammonia to form true salts. Thus diborane combines with two and tetraborane with four molecules of ammonia to form salts, which are electrolytes when dissolved in liquid ammonia although water decomposes them. That they are indeed ammonium salts rather than ammines is shown by the fact that an ammoniacal solution of borontrimethylmonoammine is non-conducting. Thus diborane is a dibasic, tetraborane a tetrabasic acid, and they may be formulated thus: $H_2[B_2H_4]$ and $H_4[B_4H_6]$.

The unsaturated character of these hydrides has been proved by both spectroscopic and chemical evidence. Thus diborane and ethylene give similar absorption bands, where ethane shows none at all, in the region between 210 and 186 μμ. Moreover, when shaken with alkali amalgam, the boranes react additively with the alkali metals thus:

$$B_2H_6 + 2K = 2K^+[B_2H_6]^{--}.$$

A molecular weight determination deduced from measurement of its diamagnetic susceptibility shows that the borane molecule has not been ruptured into simpler molecules in this reaction. The resulting potassium salt can be sublimed unchanged at about 400° C., so that the bivalent negative *ion* $B_2H_6^{--}$ with an ethane-like structure is much more stable than the unsaturated 'ethylenic' molecule B_2H_6, for which the formula $2H^+ [BH_2 : BH_2]^{--}$ must now be adopted.

The unsaturated character of diborane accounts also for its reactions with water and with hydrogen chloride, since in both cases the additive products which are first formed split off hydrogen to produce a new unsaturated product; this then reacts further in the same way until we arrive at boric acid or boron polyhalides as final products. Some of the intermediate compounds have even been isolated. Similarly, the formula of tetraborane is written thus:

$$4H^+ [BH_2 : BH{\cdot}BH : BH_2)^{----}.$$

Two different groups of hydrides have been recognized, corresponding with the general formulæ B_nH_{n+4} and B_nH_{n+6}. At present, only the first members of each group have been investigated experimentally, but in both cases the chemical evidence has been supported by that based on measurements of parachor, dipole moments, magnetic properties and ultra-violet absorption spectra.

Plankton Research and Sea Fisheries

A RECENT publication by R. E. Savage and R. S. Wimpenny ("Phytoplankton and the Herring", Part 2 (1933 and 1934), *Min. Agric. Fish., Fishery Invest.*, Ser. II, **15**, No. 1 (1936), pp. 1–88. London: H.M. Stationery Office, 1936. 4*s*. 6*d*.) gives detailed information on the plankton conditions in the southern North Sea and their relations with the herring fishery in the years 1933 and 1934. This is a continuation of work already begun in 1921 and follows on a previous report for the years 1921–32.

The year 1933 was remarkable for unusually dense patches of the diatoms *Rhizosolenia styliformis* and *Biddulphia sinensis*. The former is associated with the current system in the neighbourhood of the south-west Dogger Bank Swirl; and the unusual degree of production in 1933 appeared to owe its origin to a strong incursion of oceanic bottom water, from the north, rich in nutrient salts. The arrival of the East Anglian herring shoals was delayed by these diatom patches in October 1933. A remarkable condition is recorded in May 1933, when a large area was covered with masses of the diatom *Coscinodiscus concinnus* to a depth of four feet, in which several guillemots and puffins were found floating dead. This was apparently being eaten by fulmar petrels.

Increasing attention to detail in this long-continued plankton programme is producing indications of new lines for research. The relation between the distribution and drift of the plankton with the water circulation is gradually being disclosed, as well as certain interrelationships between the phytoplankton and the zooplankton which call for further observation. Notable among these is evidence that higher proportions of the eggs and young stages of plankton animals are to be found within the diatom patches than in the surrounding areas. Adult plankton animals and herrings also appear to be massed against the edges of the phytoplankton patches. Evidence is forthcoming that the distribution of the young stages of the animals may be associated with the high oxygen content of the diatom patches.

The authors intend to investigate this problem further, but whatever be the true significance, it is clear that this continued routine research is developing on expanding lines which will lead to a better understanding of the biology of the plankton in the future. The work is carried on throughout in close collaboration with the hydrographers.

University Events

LONDON.—The title of professor of biochemistry in the University has been conferred on Dr. A. C. Chibnall in respect of the post held by him at the Imperial College—Royal College of Science.

The title of emeritus professor of mining geology in the University has been conferred on Prof. C. G. Cullis, on his retirement from the University professorship of mining geology at the Imperial College—Royal College of Science.

Dr. F. G. Gregory has been appointed as from October 1 to the University chair of plant physiology tenable at the Imperial College—Royal College of Science. Since 1931, he has been assistant director of the Research Institute of Plant Physiology at the Imperial College.

The following have been appointed fellows of King's College: Prof. F. A. P. Aveling, professor of psychology since 1931; Miss Agnes S. Paul, lecturer in classics since 1932; Col. G. S. Szlumper, assistant general manager of the Southern Railway, and a vice-president of the Engineering Branch of the Old Students' Association; Mr. S. J. Worsley, academic registrar and acting principal of the University.

Prof. Raymond Pearl, professor of biology in the School of Hygiene and Public Health of Johns Hopkins University, has been appointed Heath Clark lecturer for the year 1937.

The degree of D.Sc. in mathematics has been conferred on A. C. Offord, of University College, and that of D.Sc in physiology on Miss M. M. A. Murray, a recognized teacher at Bedford College.

OXFORD.—Prof. A. G. Tansley, Sherardian professor of botany and fellow of Magdalen College since 1927, is retiring under the age-limit as from July 31, 1937. Applications for the vacant professorship should reach the Registrar by April 17. The Board of the Faculty of Biological Sciences has recommended that the new professor should be primarily an ecologist.

The Nuffield professors, Prof. H. W. B. Cairns, Balliol, and Prof. R. R. Macintosh, Pembroke, and also Dr. S. Zuckerman, Christ Church, have received the degree of M.A. by decree.

Science News a Century Ago

Tunnels and Health

THE following extract is taken from a report issued on February 21, 1837, by Dr. John Ayrton Paris, Dr. Thomas Watson, Mr. William Lawrence, Mr. R. Phillips and Mr. W. Owen Lucas on the Primrose Hill Tunnel on the London and Birmingham Railway, which they had examined in order to ascertain the probable effect of such tunnels upon the health and feelings of the passengers: "We found the atmosphere of the Tunnel dry, and of an agreeable temperature, and free from smell; the lamps of the carriages were lighted; and in our transit inwards and back again to the mouth of the Tunnel, the sensation experienced was exactly that of travelling in a coach by night, between the walls of a narrow street The noise did not prevent easy conversation, nor appear to be much greater in the Tunnel than in the open air. Judging from this experience and knowing the ease and certainty with which thorough ventilation may be effected, we are decidedly of the opinion that the dangers incurred in passing through well constructed Tunnels are no greater than those incurred in ordinary travelling upon an open railway or upon a turnpike-road; and that the apprehensions which have been expressed that such Tunnels are likely to prove detrimental to the health, or inconvenient to the feelings of those who may go through them, are perfectly futile and groundless." This report was not published in a contemporary medical journal, but is to be found among the reports in the library of the Royal Society of Medicine

A similarly favourable report was issued the same day by Dr. John Davy and Dr. R. W. Rothman, and on February 19 by Dr. James Williamson on the Tunnel on the Leeds and Selby Railway.

Alexander Burnes in Sind

AT a meeting of the Royal Geographical Society held on February 27, 1837, a paper was read by Captain (afterwards Sir) Alexander Burnes (1805–41) on his exploration of Scindè (Sind). After describing the River Indus, and the character of the surrounding country, Burnes gave an account of the people. The inhabitants, he said, were chiefly Mohammedans, about one fourth being Hindus. Syúds and fakirs were respected to veneration; many doubtless were virtuous, but the bulk he feared were hypocritical fanatics. The mendicants were more numerous than in any other country in Asia. They could scarcely be called beggars, for they demanded tribute in crowds and by threats and with great arrogance. The Government was despotic and oppressive; trade and agriculture languished under it.

It was the disordered state of Scinde which led to the expedition of General Sir Charles Napier (1782–1853) in 1842 and the annexation of the province.

Clarke's Electrical Measuring Instruments

WRITING on February 28, 1837, from the Laboratory of Science, Lowther Arcade, London, to William Sturgeon, the founder of *Sturgeon's Annals*, E. M. Clarke said: "As almost every scientific inquirer is at present directing his attention to the construction of electric batteries, and as in my opinion there is no correct measurer of their relative merits, I beg leave to submit to the notice of your very numerous readers two instruments which I have constructed for that purpose."

The first of the instruments Clarke described he called a thermo-electrometer. It consisted of a length of platina wire about 1/90 in. in diameter stretched between two terminals supported on the upper edge of a scale marked in feet and inches. The current flowing from the battery was measured by the length of wire made red in darkness, or burned.

The second instrument was described as an electro-gasometer, the current being measured by the amount of gases given off when the current was passed from one platina plate to another in water. This instrument Clarke said he had constructed "from having seen a very imperfect one at the Royal Institution made out of a two-necked bottle with platina electrodes passing through the holes drilled in the graduated glass tube". Descriptions and sketches of the instruments are given in vol. 1 of *Sturgeon's Annals*.

An Investigation into Animal Magnetism

A CERTAIN M. Berna having set forth claims regarding animal magnetisms somewhat akin to those previously made by Friedrich Anton Mesmer (1734–1815), the author of the doctrine of animal magnetism, or mesmerism, the Royal Academy of Medicine, Paris, appointed a commission under the presidency of M. Roux to inquire into the claims of M. Berna. The first of the meetings of the commission took place on March 3, 1837, and the commission reported to the Academy in August 1837. The report was printed in the "Annual Register", 1837. In the concluding paragraph it said that with reference to M. Berna's claims: "Those facts which he promised to show us are all known to you; you know as we do that they are anything but conclusive in favour of the doctrine of animal magnetism, and that they can have no relation either with physiology or with therapeutics."

Education at Oxford

A LEADING article in the issue of the *British Annals of Medicine* for March 3, 1837, contains the following comment on contemporary medical education at Oxford: "Our readers cannot fail to have drawn some ominous conclusions from the facts detailed in the correspondence relative to Oxford, which has appeared in our pages. It is a fact, we believe, undeniable that several years ago the classes at that University were well attended, in the usual acceptation of the term, that of late the attendance has been gradually decaying and now threatens to convert the professorships into sinecures; that is, to take the professors away from Oxford, for we think this must soon occur if the signification of the term professor is not altered; as hitherto, at every university at home and abroad, so far as we can learn, the title of professor is alone bestowed on those who engage in the active duties of teaching literature and science. Even at present it does not appear that one half of the professors at Oxford ever lecture at all. These are melancholy facts, it may be admitted, but how are they to be remedied? A remedy can only be found by the agency of the professors themselves or by the agitation of those who are aggrieved. The former would effect the most speedy cure; their united complaint would not fail to be listened to by the Legislature. The Government could institute an inquiry by means of impartial agents."

Societies and Academies

London

Royal Society, February 18.

E. N. da C. Andrade and R. C. Parker: A standard source of sound and the measurement of minimum audibility. A source of sound has been constructed of which the energy output can be measured in absolute units. The air in a tube is maintained in vibration by means of a loudspeaker unit attached to one end: the other end is open, and serves as the source. The energy output is found by measuring the length of the traces of smoke particles at an antinode, the method being thus a very direct one. One of the difficulties is to ensure that a given current flowing through the speaker unit shall always produce the same amplitude. The source was calibrated in terms of the current supply by determining the currents corresponding to various measured amplitudes at fixed frequencies. It has been used to determine the least pressure variation detectable by the ear, under conditions free from background noise and unwanted reflections.

C. J. Milner: The magneto-resistance effect in cadmium at low temperatures. Apparatus is described for measuring the increase of electrical resistance of specimens of cadmium, at low temperatures, in magnetic fields up to 26 kgauss. At temperatures above 20° K., Kapitza's observation, that for strong fields a linear variation of resistance with field strength replaces the initial square law, was confirmed. At helium temperatures a new effect was found. In addition to the linear effect mentioned, a square-law increase was observed, producing a very large increase of resistance in pure specimens. The increase of resistance could be represented as $a.H^2 + b.H$, where b is constant, and a is inversely proportional to the residual resistance of the specimen. a is constant at the lowest temperatures, but falls rapidly above 4° K. to negligible values; b varies only slightly with the temperature. The a-effect is absent when the magnetic field is parallel to the current, and the curve then shows a saturation effect, at helium temperatures. It would seem that the a-effect has previously been observed, though not recognized, in other metals of the non-cubic groups: but that the effect is absent or much smaller in the cubic metals, copper, silver, gold and aluminium.

Edinburgh

Royal Society, February 1.

James Kendall: Ions and isotopes. No separation of isotopic ions was obtained by running a solution a considerable distance along a series of tubes; hence ionic mobility is fundamentally dependent upon *volume*, not upon *mass*. Many difficult separations, however, such as pairs of rare earth elements or radium from barium residues, were readily achieved by ionic migration. A slight separation of the isotopes of mercury by fractional electrolysis was obtained in 1923. Work on hydrogen was begun in 1930, but pure 'heavy hydrogen' was first isolated in America two years later.

A. Graham: Ciliary currents on the gills of some Tellinacea (Lamellibranchiata). The relationship between the lamellibranch *Solecurtus* and the Tellinacea, evident on morphological grounds, is stressed by the arrangement of the frontal ciliary tracts on the outer gills, which in both groups beat towards the ctenidial axis instead of to the free margin of the gill as normally. This supports the interpretation of the outer gill of Tellinacea as homologous with the supra-axial extension of other lamellibranchs and that of *Solecurtus* as a reduplication of the same structure.

Paris

Academy of Sciences, January 25 (*C.R.*, 204, 201–304).

Emile Borel: The imitation of chance.

Antonin Gosset and Léon Binet: The increase of the proportion of glutathione in the liver by treatment with sulphur compounds.

Jean Baptiste Senderens: The catalytic decomposition of halogen-substituted acetic acids, in liquid systems. Details of the decomposition products of trichloracetic, tribromacetic and dichloracetic acids when heated below their boiling points with various catalysts. The nature of the reaction varied with the catalyst; thus trichloracetic with thoria gave phosgene, hydrochloric acid and carbon monoxide, while with activated carbon the products were carbon dioxide and chloroform.

Maurice Gignoux and Franck Bourdier: The Rhodanian fluvio-glacial formations in the neighbourhood of Bellegarde (Ain) and the neo-Würmian ice period.

Marc Courtand: Left curves of the fourth order.

Max Eger: Canonical systems of an algebraical variety.

Jean Louis Destouches: Spaces with finite character.

Louis Pasqualini: The conditions of convexity of a V_p-1 variety of $p-1$ dimensions immersed in Euclidian space R_p of p dimensions.

G. Avakumović: Theorems relating to Laplace integrals on convergence boundaries.

Ny Tsi-Ze: The so-called circular transversal vibration of a hollow quartz cylinder.

Léon Beschkine: Corrections to be applied to the general theorems utilized in resistance of materials when the displacements are not negligible.

Emile Sevin: Cosmic radiation and the stars of the principal series.

Jean Cichocki: The latent energy of solid solutions.

Jules Géhéniau: The production of electromagnetic waves by means of neutrinos.

Albert Grumbach and Pierre Vidal: A new method of preparing semipermeable membranes. The copper ferrocyanide membrane is formed by a special technique on a glass filtering plate, after the pores of the latter have been reduced by deposition of gelatinous silica.

Marcel Pauthenier and Charles Martin: The limiting electric charge of very small particles.

Jean Crussard and Louis Leprince-Ringuet: Study with the large Bellevue electromagnet of the passage through screens of the particles of cosmic radiation.

Mlle. Suzanne Veil: Some batteries with unlike electrodes.

Mlle. Marguerite Perey: The spectra of barium and strontium.

Pierre Barchewitz: The absorption spectra of amines in the near infra-red. (6000–95,000 A.)

Georges Déchene: The extreme ultra-violet emitted by electrical discharges in air under reduced pressure.

T, Nicolas Panay. The continuous flame spectrum of potassium.

Paul Soleillet : The mean duration of life of the zinc atom in the state 2^3P_1 and the method of total absorption. Discussion of the interpretation of the experiments of W. Billeter.

Mlle. Yvette Cauchois : Weak emissions in the *L* spectrum of rhenium (75).

Pierre Auger, Paul Ehrenfest, jun., André Feorn and André Fournier : The angular distribution of hard corpuscular cosmic rays.

Jacques Errera and Pol Mollet : The (OH) band of monomolecules of alcohol in the region of 3μ.

Mme. Marie Freymann : The absorption spectra in the near infra-red of mixtures of amines and alcohols. The formation of ammonium compounds.

René Delaplace : The thermal conductivity of unsaturated hydrocarbons at low pressure.

Hubert Forestier and Richard Lille : The variation of the catalytic power of ferromagnetic bodies at the Curie point. Studies based on the reaction $CO_2+H_2=CO+H_2O$ in the presence of various ferromagnetic oxides as catalysts. The variations of the catalytic activity of the three oxides used were shown to be related to the electronic phenomenon at the Curie point.

René Perrin and Jean Lamberton : Contribution to the study of the equilibria between metals and slags. Discussion as to the applicability of the law of mass action to metals in contact with slag.

Emile Cherbuliez and Mme. Anna Herzenstein : The detection and estimation of colloidal sulphur and of polysulphide sulphur in sulphurous waters.

Georges Darzens and André Levy : New researches on the condensation of dichloracetic ester with ketones and aldehydes by magnesium amalgam.

J. D. H. Donnay and David Harker : The generalization of the law of Bravais.

B. Choubert : Graphical expression of regional metamorphism.

Franck Bourdier : New observations on the extension of the ancient glaciers in the lower valley of the Isère.

Gérard Waterlot : The age of the folds and faults of the Cambrian massif of Rocroi.

Louis Dubertret : Fragments of tectonic breccia at the surface of the green Syrian rocks.

Henry Hubert : Observations of detail on the bar of Dahomey.

Pierre Gavaudan : The final condition of the nucleole during mitosis and its general relations with the thymonucleic chromatin.

Theodor Solacolu and Démètre Constaninesco: Tumours with neoplacic characters formed on plants by the action of β-indolylacetic acid.

René Souèges : The embryogeny of the Dipsacaceæ. The development of the embryo in *Scabiosa Succisa* L.

Alfred Balachowsky : The experimental rupture of the diapause in the caropcapse or 'vẹr des pommes' (*Laspeyresia pomonella*).

Gabriel Guignon and Mlle. Anne Raffy : The influence of the points of heating presented by the wings of diurnal Lepidoptera exposed to solar radiations on the power of flight of these insects.

Mladen Paić : The identification of the pigment elaborated by the diphtheria bacillus.

Maurice Doladilhe : A property of the viscous protein of syphilitic sera. It is shown that the substance imparting to a syphilitic serum characters of flocculation enabling it to be differentiated *in vitro* from a non-syphilitic serum, is localized in the viscous protein.

André Boivin and Mme Lydia Mesrobeanu : The nature and biological properties of the toxins produced by the Shiga bacillus and by the Flexner bacillus.

Cracow

Polish Academy of Science and Letters, December 7.

S. K. Zaremba : Remarks on the approximate integration of differential equations.

K. Koziel : Gibbs's formulæ for the ratios n_1 and n_2 of the areas of triangles.

A. Kotecki : New fluctuation bands in the spectrum of cadmium vapour.

Mlle. A. Wrzesinska : Influence of the concentration on the distribution of the intensities in the photo-luminescence spectrum of glycerol solutions of trypaflavine.

S. Dobinski and J. Wesolowski : The coefficient of viscosity of liquid selenium. The viscosity-temperature curve does not show the irregularities found some time ago by Pelabon in his study of the electrical conductivity of selenium. Liquid selenium belongs to the second class of associated liquids according to Andrade's theory of viscosity.

L. Marchlewski and Mlle. R. Grünbaum : Absorption of the ultra-violet rays by certain organic substances. (42) Datiscetin, morin and quercetin.

Mme. J. Dyakowska : Researches on the velocity of the fall of pollen of several species of trees.

S. Krzemieniewski and J. Kovats : Action of iron and of molybdenum on the fixation of nitrogen by *Azotobacter*.

Mme. Z. Malaszynska-Suchoitz : Cytological researches on the tegumentary glands of the crayfish, and considerations on the role of the plasmatic structures.

R. Towarnicki : Structure of the hooked apparatus in the anterior part of the body of the larva of the blowfly (*Calliphora vomitoria*).

Rome

Royal National Academy of the Lincei

(*Atti*, 23, 721–806 ; 1936).

W. Blaschke : Contribution to integral kinematics.

G. Zwirner : Integration of a matrix according to Volterra.

G. Lampariello : A theorem of statics of van den Dungen.

B. Finzi : Dispersion of a vortex in a plastic medium.

E. Frola : Certain integrals capable of resolving the dynamic problem of bent beams (1). The equation $(C(x)y'(x)')=-\lambda\,M(x)\sin\,y(x)\,;\,y(0)=y(1)=0(2)$.

G. Krall : Vibrations induced by inert and lightened loads which are in motion on a bridge.

L. Gialanella : Meridian observations of Jupiter and of Vesta in 1935.

L. Castelli : Equivalent widths and central intensities of absorption lines in the solar spectrum at the centre and at the edges.

G. C. Wick : Diffusion of slow neutrons.

P. Guareschi : Calculation of latent heats of evaporation.

G. Centola : Structure of acetyl cellulose soluble in acetone, or 'cellite'.

F. Penta : Fossil carbon in the Mesozoic of Longobucco in Calabria.

G. Landra : The tricocicloforus of Sergio Sergi and its first application. The use of this instrument for measuring dimensions of hair in anthropological studies is described.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, March 1

Museums Association, at 5.—Peter Holm: "The Old Town: a Folk Museum in Denmark".*

University of Leeds, at 5.15.—Prof. A. H. Gibson: "The Use of Working Models in Engineering".*

Royal Geographical Society, at 5.30.—G. C. Schluter: "On Safari in East Africa" (Geographical Film).

Swiney Lectures on Geology, at 5.30—(at the Imperial College of Science, Exhibition Road, South Kensington, S.W.7).—Dr. Frederick Walker: "Ice Ages" (succeeding lectures on March 3, 5, 8, 10, 12, 15, 17, 19, 22 and 24).*

King's College, London, at 5.30.—Dr. W. A. J. M. van Waterschoot van der Gracht: "The Sub-Surface Structure and the Sediments of the Great Basin of North-Western Europe (including the North Sea and Eastern Lowlands of England)" (succeeding lectures on March 2 and 3).*

Royal Society of Arts, at 8.—F. I. G. Rawlins: "The Physics and Chemistry of Paintings" (Cantor Lectures. Succeeding lectures on March 10 and 15).

Tuesday, March 2

Royal Society of Arts, at 4.30.—R. E. H. Baily: "The Anglo-Egyptian Sudan."

Gresham College, London, E.C.2, at 6.—A. R. Hinks, F.R.S.: "Studies of the Solar System" (succeeding lectures on March 3, 4 and 5).*

Institution of Civil Engineers, at 7—(at the Royal Geographical Society, Kensington Gore, S.W.7).—Symposium on "Research in Connexion with Motor Vehicles".

Wednesday, March 3

Institution of Electrical Engineers (Wireless Section), at 6.—Commander F. G. Loring, W. L. McPherson and W. H. McAllister: "A Survey of Marine Radio Progress, with Special Reference to R.M.S. *Queen Mary*".

Thursday, March 4

Royal Society, at 4.—Discussion on "Beta Transformations of Atomic Nuclei", to be opened by Prof. C. D. Ellis, F.R.S.

University College, London, at 5.30.—Prof. K. von Frisch: "The Sense of Hearing in Fishes".*

Chemical Society, at 8.—Prof. H. S. Raper, F.R.S.: "Some Problems of Tyrosine Metabolism".

Friday, March 5

Royal Society of Arts, at 4.30.—Dr. E. J. H. Mackay: "Excavations at Chanhu-daro".

Society of Public Analysts and Other Analytical Chemists, at 5.45—(in the Chemical Society's Rooms, Burlington House, Piccadilly, W.1).—Annual General Meeting.

Prof. G. Barger, F.R.S.: "The Alkaloids of Ergot".

Bedson Club (Armstrong College, Newcastle-upon-Tyne), at 6.30.—W. T. Astbury: "The X-Ray Interpretation of Protein Structure" (Thirty-seventh Bedson Lecture).

Geologists' Association, at 7.30—(at University College, Gower Street, London, W.C.1).—Annual General Meeting.

P. McIntyre: "Between the Forth and the Tay".

Royal Institution, at 9.—Prof. G. I. Finch: "Electron Diffraction and Surface Structure".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Lecturer in Chemistry, Biology and Physics in the Doncaster Technical College—The Secretary, Education Offices, Doncaster, Yorks. (March 5).

Assistant Curator in the Plymouth Museums and Art Galleries—The Town Clerk, Municipal Buildings, Plymouth (March 9).

Principal Teacher of Mining in the Batley Technical College and the Huddersfield Technical College—The Director of Education, Education Offices, Batley (March 9).

Consulting Physicist at the Royal Northern Hospital, Holloway, London, N.7—The Secretary (March 12)

Assistant Keeper (Industrial Engineering) in the Science Museum, South Kensington, London, S W 7—The Director (March 15).

Regius Professor of Materia Medica in the University of Glasgow—The Private Secretary, Scottish Office, Whitehall, London, S W 1 (March 31)

Sherardian Professor of Botany in the University of Oxford—The Registrar, University Registry, Oxford (April 17).

Lecturer in Geography in University College, Rangoon—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1.

Official Publications Received

Great Britain and Ireland

The National Smoke Abatement Society Seventh Annual Report, 1936–7. Pp. 28. (Manchester: National Smoke Abatement Society.) [261

Technical Publications of the International Tin Research and Development Council. Series A, No. 49: Discoloration and Corrosion in Canned Cream. By C. J. Jackson, G. R. Howat and T. P. Hoar. Pp. 10+2 plates. (London: International Tin Research and Development Council.) Free. [261

Memoirs of the Royal Meteorological Society Vol. 4, No 39: World Weather, VI. The Discussion by Sir Gilbert T. Walker; and the Tabulation by E. W. Bliss. Pp. 119–140. (London. Royal Meteorological Society.) 2*s*. 6*d*. [22

Other Countries

Smithsonian Miscellaneous Collections. Vol. 95, No. 19: Cycles in Tree-Ring Widths. By C. G. Abbot. (Publication 3402). Pp. ii+5. (Washington, D.C.: Smithsonian Institution.) [271

Proceedings of the United States National Museum. Vol. 84, No. 3005: The Nest of *Odynerus tempiferus* var. *macio* Bequaert, with Notes on the Habits of the Wasps. By Austin H. Clark and Grace A. Sandhouse. Pp. 89–95. (Washington, D.C.: Government Printing Office.) [271

Ministry of Agriculture, Egypt: Technical and Scientific Service, Bulletin No. 44: The Propagation and Cultivation of Citrus Trees in Egypt. By Thos. W. Brown. Second edition, revised and put up to date by the Author and Dr. Abbas El Sawy. Pp. xi+96+73 plates. (Cairo: Government Press.) 15 P.T. [281

The Science Reports of the Tôhoku Imperial University, Sendai. First Series. Anniversary Volume dedicated to Prof. Kôtarô Honda on the completion of Twenty-five Years of his Professorship. By his Friends and Pupils. Pp. xix+1126. (Tôhoku and Sendai: Maruzen Co., Ltd.) [281

Memoirs of the Kyancutta Museum No. 3: Further Notes on Cyathospongia (Archæocyathi) and other Organisms from the Lower Cambrian of Beltana, South Australia. By R and J. Bedford. Pp. 21–26+plates 21–26. (Kyancutta: Kyancutta Museum.) 2*s*. [22

Report of the Botanical Survey of India for 1934–35. Pp 18. (Calcutta: Government of India Press.) [22

Kungl. Svenska Vetenskapsakademiens Handlingar Serien 3, Band 15, No. 6: Une méthode nouvelle de l'optique géométrique. Par C. W. Oseen. Pp. 41. Serien 3, Band 16, No. 1: On the Morphology of Triassic Stegocephaliens from Spitsbergen, and the Interpretation of the Endocranium in the Labyrinthodontia. By G. Säve-Söderbergh. Pp. 181+22 plates. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [22

Proceedings of the United States National Museum. Vol 84, No 3003: Two New Species of Hawks from the Miocene of Nebraska. By Alexander Wetmore. Pp. 73–78. Vol. 84, No. 3004. A New North American Mason-Wasp from Virginia, with Notes on some Allied Forms. By Joseph Bequaert. Pp. 79–88. (Washington, D.C.: Government Printing Office.) [22

U.S. Department of Agriculture. Technical Bulletin No 530: Selenium Occurrence in certain Soils in the United States, with a Discussion of Related Topics. Second Report. By Horace G Byers. Pp 79. (Washington, D C: Government Printing Office.) 10 cents. [22

Catalogues

Iodatol: Prepared specially for use in Radiological Diagnosis and in Iodine Therapy. Pp. 12. (London: The British Drug Houses, Ltd.)

Neuerscheinungen 1936. Mathematik: Physik. Pp. 28. Chemie: Chemische Technologie Pp. 24. (Berlin und Wien: Julius Springer.)

Das neue Buch 1936. Pp. 24. Das neue Buch 1937, Erste Liste. Pp. 6. (Berlin: Ernst Rowohlt.)

Ovarian Hormones in Clinical Practice. Pp. 20. (Nottingham: Boots Pure Drug Co., Ltd)

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The Civil Population and Air Attack

SINCE the issue of the circular to local authorities in Great Britain by the Air Raids Precautions Department in July 1935 urging them to co-operate in schemes of passive defence, public attention has been continuously engaged with this subject, but despite the growing activities of the Department it cannot be said that public opinion is at all happy upon the question. It is increasingly aware of the concern with which informed scientific and technical opinions regards the proposed measures, and the decision of the Government to transfer the shell-filling and other explosives supply departments of Woolwich Arsenal to four centres in the west and north of the country, which are regarded as less vulnerable to air attack, tends to increase rather than to dispel alarm.

While many local authorities have accepted the suggestions of the Government in regard to the organization of air raid precautions and defence, and many large firms are giving the matter active consideration, other local authorities have only accepted the suggestions so far as they relate to the training of fire brigades or police, while a few have refused to co-operate. At first sight, this latter attitude appears somewhat indefensible. The precautions professedly are purely humane in their intention and effect. The five handbooks already issued by the Department outline comprehensive schemes dealing with protection against gas, either in the way of first-aid services, the establishment of the requisite preliminary organization in large commercial or industrial firms and the like, precautions for merchant shipping and methods of decontamination of materials. It is common sense to take every reasonable precaution against so appalling a danger, however remote the probability may be. When the danger is one that can be aggravated so seriously by panic, the support of measures likely to promote order and discipline in the event of attack may reasonably be urged as a public duty.

While this is so, and while it is obvious that effective safety measures cannot be improvised at a moment's notice, a body of opinion, strongly supported by some scientific workers apparently qualified to express views on this subject, has offered important criticism or objection to the proposals on at least four grounds. These objections are summarized in a series of reports which from time to time since August 1935 have been distributed by the National Peace Council, and the present position has been summarized in No. 27 of these reports, by Dr. A. F. W. Hughes, issued in December last.

In the first place, the plans of the Air Raid Precautions Department are regarded as inadequate both in degree and in kind to afford protection for the people from air attack. The main measures of defence advocated are those against gas attack, and the most important criticism is that the danger from gas attack is far less than from attack by high explosive and incendiary bombs, from which there is no protection whatever except properly constructed shelters either underground or with a heavily reinforced roof. The main defence suggested by the Department is that of a gas-proof room with windows and chimney blocked, and to be used for no other purpose. It is obvious that only a minority of the population will be able to set aside a room specially for this purpose. Of the remainder, many live in crowded areas, sometimes in houses insufficiently protected against the weather. Although officials of the Department have publicly admitted the inadequacy of the ordinary house to provide any shelter at all, in October last, Commander Franks, of the Department, was still advising those who could reach their homes to take shelter in them. Moreover, although expert opinion to some extent appears to believe in the possibility of creating bomb-proof buildings as well as gas-proof structures, the need of research in this field has been admitted freely, notably by the Parliamentary Secretary to the Ministry of Health, who stated in July last that an influential committee had been set up to advise on the Air Raid Precautions Handbook "Structure Precautions against Bombs and Gas" which is in preparation. Experiments are still required to establish data in regard to the effect of various types of bombs and gas, and also the resisting power of the miscellaneous materials used in a modern building Even the possibilities of air-conditioning as a defence against gas have as yet scarcely been explored.

These facts in themselves are sufficiently disturbing. The efficiency of the gas mask has also met severe expert criticism. Apart altogether from the psychological difficulty of inducing unskilled workers to wear them—a difficulty with which the industrial chemist is only too familiar—or the attendant discomfort, there is the practical problem of devising a mask effective against any gas which the enemy might possibly use. Without such knowledge, use of a gas mask may be quite ineffective and even engender a false confidence. On the other hand, while that very confidence, whether well founded or not, may help to sustain morale and diminish casualties by avoiding or diminishing panic, the fact should not be overlooked that air raid drill and practice with gas masks may have an effect on the health of the population quite opposite to that intended. The use of the mask may, in fact, engender hysteria and nervous strain that may more than outweigh all the advantage gained against panic.

The second main ground of criticism of the proposals is that they are an essential part of war preparation and have as their avowed object not directly the saving of life or the prevention of suffering, but the strategic necessity of maintaining the public morale and so decreasing the danger in war time of a craving for peace. There is little room for doubt that Government policy in Germany and in Italy is fairly open to this charge, but so far in Great Britain there is little evidence to disentangle this criticism from opposition to the Government defence policy really based on political grounds. At least it can be urged that those who take this view should show that the drawbacks to the gas mask proposals, for example, outweigh its advantages on psychological, apart from technical grounds. There is scarcely any evidence that the whole outlook of the people of Great Britain is other than fundamentally pacific, and those who bring this charge against the Government policy would have a much stronger case if they also attacked that section of the Press which consistently fosters a war mentality and pillories all constructive effort for peace.

None the less, it must be admitted that the third objection to the precautions policy of the Government that, whatever their intention, the precautions cannot fail to create a war mentality which is in itself the most mischievous danger to peace, undoubtedly holds some truth. The nation, however reluctantly, has accepted the Government's defence policy, but is still far from the frame of mind which regards war as inevitable. It would be foolish, however, to ignore the tendency of the whole tenor of recent events in Europe to encourage the mental outlook which will accept conflict as a welcome release from the strain of suspense. It is only too easy to slip insidiously and unconsciously from mere repugnance to war to acquiescence in it on the principle of knowing the worst rather than remain in suspence.

What is equally untoward is the check which the intensification of preparations for war has given to almost all effort designed to deal with the fundamental problem of the elimination of the causes of war. The important discussions which have taken place in the daily Press regarding the future of the mandates system, raw materials, population and the German colonial claims, are only a few examples of directions in which impartial investigation or research is required to provide a satisfactory basis for settlement or to demonstrate the speciousness of merely partisan or propagandist arguments. Despite Sir Samuel Hoare's statement at Geneva in August 1935 regarding an impartial inquiry into raw materials and colonial questions, no steps have apparently been taken to implement the inquiry. The whole spirit of the present defence measures has apparently paralysed such effort. No single action of the Government, however, could do more to disarm the foregoing criticism of its air defence proposals than an emphatic demonstration in some such way of its willingness to make constructive contributions to the elimination of the causes of war by the initiation of these or similar inquiries which might diminish international friction.

Positive action of this type would also offer a weighty reply to the fourth main ground of serious objection to the air raid precautions in which most scientific workers are agreed, that the precautions conceal the truth that there is no possible protection of civilian population from air attack other than the abolition of bombing from the air. Those who realize the limitations of a policy of evacuation or even of the replanning and rebuilding of great cities with an eye to defence against attack by air, as in the Middle Ages they were built against attack under different defence conditions, carry a heavy responsibility if they fail to inform public opinion of those limitations.

Only so can we secure that widespread and intelligent public support for proposals such as the control of national air forces, the organization of an international air force or of effective collective security upon which alone the future safety of civilization appears to depend. Nor can we reasonably doubt that, if the public once realized how limited is the protection available even for those who can afford it, there would be forthcoming that large volume of informed public opinion which, while realizing the inevitability at the present moment of pressing on with measures for national defence, would insist that simultaneously no effort was spared to explore every possibility of international understanding and co-operation in the search for the causes of war itself.

Papuan Pygmies and Art

(1) Walkabout:
a Journey in Lands between the Pacific and Indian Oceans. By Lord Moyne. Pp. xxvi + 366 + 97 plates. (London and Toronto: William Heinemann, Ltd., 1936.) 18*s.* net.

(2) Art and Life in New Guinea
By Dr. Raymond Firth. Pp. 126. (London: The Studio, Ltd.; New York: The Studio Publications, Inc., 1936.) 10*s.* 6*d* net.

(1) THOSE interested in Pacific affairs may recall the unusual and stimulating collection of ethnographical specimens, predominantly from New Guinea, exhibited by Lord Moyne in his London house last summer. His volume, "Walkabout" (Pacific 'pidgin' for travel beyond the tribal territory), records the experiences of the expedition upon which this fine series of objects was collected and also tells us something of the animals brought back to the Zoological Gardens at Regent's Park, London, and of the difficulties of getting them there. But while the collecting of animals and ethnographical specimens was one of the major objects of the expedition, its chief aim seems to have been to study a group of relatively light-skinned pygmies who were said to inhabit the foothills on the north-eastern slopes of the Bismarck Range in Mandated Territory.

The volume sets out in vivid fashion how far the party were successful, and the misfortunes (they came near being something worse) endured in carrying out the programme, in which they succeeded to the extent of bringing home a magnificent series of photographs of pygmies taken by Lady Broughton. These photographs and their discussion constitute the backbone of the book, and the discovery of the Aiome pygmies is no doubt the most important result of the voyage. These pygmies differ entirely from the darker riverain natives, as they do from those of the Aiome foothills, who are still darker than the River people. Twelve males measured by Lord Moyne had an average stature of 54½ in. (extremes 52½ in. and 58 in.), while three women varied from 50½ in. to 53 in. The photographs show that they vary greatly in facial characters, nevertheless certain generalizations can be made:

> "Their upper lips were fleshy, projecting and sometimes everted, with rather pendulous lower lips and receding chins. Brow-ridges were not noticeable. The noses generally were straight and broad, the roots being clearly marked The ends of the nostrils were set square and not diagonally, the bulbs being made to stand out by a bird's quill or as many as four fine sticks cut from the fronds of a sago-palm and worn right through the septum."

Like other New Guinea pygmies, they are skilful gardeners, and it seems impossible to bring their culture into close alliance with any of the Indonesian pygmy groups with which we are acquainted. Who then are these New Guinea pygmies? Are they local groups of 'Papuans' of very low stature, or are they part of a vanishing pygmy negroid stock, whose other representatives are the Aeta of the Philippines and the Semang of Malaya? Where Dr. Haddon, who writes the introduction, leaves us in doubt no one will wish to dogmatize, but the reviewer may record his impression that with a single exception (Plate LIII) the faces of the pygmies here reproduced might equally well be those of natives he knew years ago in the area formerly called British New Guinea, now the Territory of Papua.

So much for the Aiome pygmies, but the book might almost be regarded as a traveller's manual to Pygmydom, for Lord Moyne and his party also visited the Andamanese and the Semang, and again Lady Broughton's camera produced most admirable results.

An appendix by Dr. Cave gives an account of the crania collected, prefaced by a general statement as to the races of mankind. These are correctly given according to current classification, but is it not likely to mislead the layman to tabulate Mediterraneans, Alpines and Nordics as if they were primary divisions of mankind in the same sense as are the Mongoloids, Negroids and Australoids? If Dr. Cave will not have the term Caucasian, surely it should have been indicated that the first three 'races' mentioned belong to a single greater unit (or subspecies) comparable with Negroids and Mongoloids—the White Race.

(2) Dr. Firth's pleasant volume is one of those treats which the proprietors of *The Studio* provide for us from time to time. It consists of about one hundred photographs of objects and typical scenes from New Guinea, the former predominating. Among the representations of village life are a number from the negatives presented by Captain F. R. Barton, a former Governor of British New Guinea, to the Royal Anthropological Institute. To those who, like the present writer, know something of this magnificent series, it will be a treat to see it at last emerging from the disuse into which it had fallen. The life scenes are accompanied by an adequate commentary by Dr. Firth. The reviewer would particularly like to emphasize his agreement with the author with regard to the futility of trying to bring into line surrealism and such objects of native workmanship as are figured in this volume. C G. S.

Geography and European Society

Environment and Nation:
Geographical Factors in the Cultural and Political History of Europe. By Prof. Griffith Taylor Pp. 571. (Toronto: University of Toronto Press; London: Oxford University Press, 1936.) 17*s*. net.

PROF. GRIFFITH TAYLOR holds an honourable place in the society of geographical investigators, and in his research—especially that part concerned with the interrelations of climate and human settlement—he has demonstrated the power of his observant eye. His certainty of touch is most dependable when he is engaged in the study of Australasia, a region with which his name will always be intimately associated. An earlier volume—"Environment and Race"—discussed, in relation to environmental conditions during successive epochs, the evolution of some of the main groups of mankind outside Europe, and it is, therefore, not unexpectedly that we find the present volume devoted to the European communities by whom the idea of nationality was first conceived.

In these days, there are few who claim to understand the intricacies of the political and social fabric of Europe without appreciation of the conditions of physical and human geography which have prevailed during the evolution of the nations. Prof. Taylor attempts this study in historical geography, or geography in retrospect, and finds it—as many other students have done—a particularly difficult subject to interpret. The essential requirement is to know how to employ the records furnished by the historian so as to associate the historical events and trends with the circumstances of geographical environment. On one hand is the temptation towards 'geographical determinism', a conception of history as being determined by geographical laws; on the other, is the danger of indiscriminating use of the historian's materials and the neglect of geographical factors. A very valuable contribution which the historical geographer can make is the reconstruction of the climatic and vegetational environment at successive periods, for it is only by the light of such knowledge that the trends in the prehistory and early history of Europe are made intelligible.

No doubt the author is fully aware of these requirements, but his arguments suffer by being clogged with historical detail. Instances of this are over-abundant and include lengthy reference to ancient Greece and Rome in which there is much military history and singularly little concerning the social and economic geography of the Mediterranean region in past times. The complexity and antiquity of civilization in Europe impose an enormous burden of reading on him who undertakes the study, and it would have been surprising if the author had been able to keep abreast of the literature in so many different fields, including archæology. Recent research in the prehistoric civilizations of Britain and Ireland, in particular, has received little attention. In the case of the smaller country, there is no recognition of its place and significance in the Bronze Age of western Europe.

Some day the genius will arrive who will satisfy our need for an adequate statement of the part that geography has played in the shaping of European society. As a whole, the volume now before us falls short in achievement of the ambition which inspired the author when he began his task, although in one or two chapters, particularly one devoted to Russia, there are instances of satisfactory fulfilment. Throughout, the author seems to be reminding himself that nationality is a product of 'place' rather than of 'race', but repeatedly he wanders into historical and ethnological descriptions, leaving the geographical factors unexplained and sometimes ignored. Least satisfactory are the chapters devoted to the nation-states of France and Britain in which, by unnecessarily lengthy reference to invasions and annexations, he distracts attention from the coalescence or welding together of regions, each with its own 'personality', out of which statehood and nationality evolved. It is a matter for notice, though not indicated by the author, that in each country mentioned above the establishment of the State preceded the development of national consciousness, whilst in the case of Germany the idea of nationality was widespread long before its political expression was fully achieved.

In matters of detail there is the opportunity for much careful revision, in readiness for a second edition, and it is essential that an adequate bibliography should be added. W. F.

World Power Statistics

Statistical Year-Book of the World Power Conference

No. 1: 1933 and 1934. Edited, with an Introduction and Explanatory Text, by Frederick Brown. Pp. 111. (London: World Power Conference, 1936.) 20*s.* net.

COMPILATION of a volume containing comparable statistics of resources, production, stocks, imports and consumption of power and power sources of all countries of the world would appear to be a superhuman task, bearing in mind the present lack of international classification of power types and widely different methods of collecting and recording data employed by countries and public bodies throughout the world. The International Executive Council of the World Power Conference has for a number of years past sponsored the systematic compilation of inventories of power resources by national committees and by Government and other organizations, and has so far as possible ensured their return in comparable form by the circulation of definitions of each power type. This action on the part of the Council has now made possible the issue of a year-book relative to the years 1933 and 1934.

It is admitted in the introduction that the volume is capable of improvement in subsequent editions, and that the work of collection of statistics has by no means reached finality. The criticism might also be levied that the wealth of annotation, sub-division and definition (admittedly appended solely in the interest of strict accuracy) is cumbersome to the reader who strives in his own mind to form a concise idea of the approximate world resources of a given fuel, but who is continually thwarted by observations such as that made in the case of coal. . . . "The largest areas for which no estimates are presented are in Africa, Asia, and Central and South America; it is known that coal reserves exist in many countries in these areas but, . . . exploitation of these resources has hardly begun, and their magnitude has not been even approximately estimated". Nevertheless, in spite of manifest drawbacks, the book probably embodies the most comprehensive collection of power studies as yet published.

Power types are divided into five major classes —solid fuels, including coals, brown coal, lignite, peat and wood; liquid fuels, sub-divided into petroleum, benzoles, alcohols; gaseous fuels (natural gas), and water-power and electricity. In each case a note is given of the scope and meaning of the statistics. This is followed by a table of Continental and world totals, and finally by standard definitions applicable to the particular section. The tables themselves give resources of the power type, listed under continents and countries, and annual statistics of production, imports, exports and consumption for the years 1933 and 1934 wherever available.

It is to be hoped that this volume will be followed by other editions which will justify more fully the tremendous amount of time and energy put forward by its promoters. It would also be desirable, if possible, to reduce the price of later editions, as twenty shillings is excessive for a year-book of this character.

Micro- and Macro-Analysis

(1) Semi-Micro Qualitative Analysis

By Prof. Carl J. Engelder, Tobias H. Dunkelberger and Dr. William J. Schiller. Pp. x+265. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 13*s* 6*d*. net.

(2) Semimicro-Methods for the Elementary Analysis of Organic Compounds

By Prof. Dr. Eduard Sucharda and Boguslaw Bobranski. Authorised translation by Dr. George W Ferguson Pp. vii+52. (London: A. Gallenkamp and Co., Ltd., 1936.) 6*s*. net.

(3) A Textbook of Elementary Quantitative Analysis

By Prof. Carl J. Engelder. Second edition. Pp. xiv+270. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 13*s*. 6*d*. net.

(1) FOR many years, analytical chemistry had maintained a fairly static state; dependable methods of detecting and estimating the more commonly used elements had been worked out, and these were adhered to in a more or less rigid manner. During the past two decades, however, there has been a remarkable revival of interest, new methods have been adopted and a nearer approach made to the ultimate ideal of one specific procedure for each cation or anion. This movement has been due partly to the use in industry of a larger number of the chemical elements, especially the so-called rarer elements, partly to the discovery of increasingly sensitive reagents and partly to the desire of the analyst to know more and more about less and less. The two latter causes have conspired to give birth to microchemistry, a subject which has advanced so rapidly that it will undoubtedly play a large part in future schemes of analysis. For that reason, the authors of the work under review have deemed it wise that students should have practical acquaintance with some of the technique of micro-analysis. They have therefore developed a scheme whereby drop-reaction methods are applied to the ordinary system of qualitative analysis, and for which 1–2 c.c. of solution containing some 20 mgm. of material suffices for the usual group separations and confirmatory tests.

The book is divided into four sections, the first of which deals with the theoretical principles underlying qualitative analysis. This is written in an interesting manner and covers a remarkably wide field. In the second part there is set forth the reactions of the cations appearing in the various analytical groups, and included here are many 'spot' tests employing organic reagents. A similar treatment is then applied to the commoner anions, while the last section deals with the systematic analysis of mixtures.

The work provides an excellent introduction to drop-systems of detection and will be found useful both to students and to the more advanced worker. Its value is further enhanced by numerous references to the literature of qualitative micro-analysis.

(2) Micro-methods of organic analysis are now well established and are gradually displacing the macro systems. Nevertheless, they suffer from one disadvantage in that they require a special balance which, in turn, needs a suitable place for its erection. Many workers have therefore sought to develop semi-micro or centigram methods for which an ordinary balance accurate to 0·1 milligram can be used. In this book, Prof. Sucharda and Dr. Bobranski outline such a scheme for the estimation of carbon and hydrogen, nitrogen and the halogens, using 20–30 mgm. of material. In addition, there is also described a semi-micro ebullioscopic determination of molecular weights.

The technique of these elementary analyses is based almost entirely on that of Pregl, although in the carbon-hydrogen determination there is one notable refinement. In order to ensure a constant excess of oxygen during combustion, use is made of an automatic regulator whereby the size of the flame causing the vaporization of the material is controlled by the pressure inside the combustion tube. Consequently there is no need to count bubbles or read a manometer; indeed the presence of the analyst is superfluous during this part of the operation.

Halogen compounds are burnt in oxygen with the aid of platinum as catalyst, but, in the case of chlorine or bromine, the halogen is absorbed in heated barium carbonate. Iodine is taken up in sodium sulphite, but, as the halides formed in each case are titrated argentiometrically, excess of sulphite must be removed as the barium salt.

This monograph has been excellently translated from the original German version, and, although small, it contains adequate details of the procedures employed. These methods should provide a good opportunity for acquiring the technique of micro-organic analysis without incurring the expense of a micro-balance.

(3) Most text-books of elementary quantitative analysis are nothing more than a heterogeneous collection of estimations which the student is expected to carry out, often without knowing the reasons underlying the various processes. The present book, however, does not suffer from this defect, for theory and practice are blended most judiciously.

The manual opens with a section on such fundamental principles as the law of mass action, the use of the balance and the errors and precision of quantitative methods. It then treats of volumetric analysis, this section covering half the book and containing an excellent chapter on the theory of neutralization and the use and selection of indicators. The gravimetric part of the work deals with the usual common precipitations, while there is also a short section on electro-analysis. The text includes numerous problems, and the student who solves them all and carries out the various estimations will have received a sound grounding in quantitative analysis.

The value of the book is best illustrated by the fact that a second edition is called for so soon; this differs but little from the original one and that mainly in the arrangement of the text.

G. R. D.

Training of Engineers

Advanced Laboratory Practice in Electricity and Magnetism

By Dr. E. M. Terry. Revised by Prof. H. B. Wahlin. Third edition. Pp. xiv+318. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 18*s*.

THE layout of this book is so curious that a few words on the purpose of laboratory work for budding engineers must precede our criticism.

Assuming that the purpose of an academic and educational course of training is to make a student think accurately and consistently in a given field of activity, with some overflow of these faculties for living socially with other men, it appears that the time considered adequate for acquiring these attainments is too short to permit contacts with more than a small section of the chosen field. It may or may not be desirable to use little beyond laboratory work in such training, particularly for electrical engineers, but since in laboratory work economy severely restricts the materials and apparatus available for student use, and he cannot spend all his time wandering around works and other commercial examples of modern technique, it is clear that the function of the laboratory must be restricted to illustrate practically but effectively a selection of useful fundamental principles which inculcate faith in the wider field described in lectures and consolidated in exercises and design work. It is clearly the utilization of the most effective means within a given set of conditions, remembering that a student is most teachable when studying fundamental ideas illustrated by applications in which he is interested.

Returning to the book under notice, we find a large number of elementary experiments which are more suited to second year students than third year students as stated, assuming that they take final examinations at the end of the third year, which is not stated. We also find a considerable number of advanced electronic experiments which are more suited to an advanced physics course than an engineering course. We gather that the course is for communication or high-frequency engineers, but experience shows that these require a fair knowledge of the so-called power side, and there is none of this.

While the radio section is good, there is insufficient body in the middle grade of experiment, and the reader must conclude that a student may be left with a superficial idea of the practice in modern electrical communication. For example, the most used bridges in this field, the series-resonant bridge and the capacity and conductance bridge, and the most useful method of impedance measurement, up to very high frequencies, the hybrid-coil set, are not mentioned. In taking this course one would like to feel that every student has taken a certain number of the most important fundamental experiments and then devoted his time to something which is more extended, but selected so as to make a special appeal to him; but this is not suggested. Perhaps the choice is left to the able demonstrators who are always required for an advanced course. L. E. C. H.

Fondamenti della meccanica atomica

Per Enrico Persico. (Trattato generale di fisica a cura del Consiglio Nazionale delle Ricerche.) Pp. iii+510. (Bologna: Nicola Zanichelli, 1936.) 80 lire.

IN the development of a comparatively new subject, such as quantum mechanics, advances are made by a few brilliant pioneers, each working on his own lines. At this stage it is very difficult for a student of average attainments to grasp the subject as a whole. We owe a deep debt of gratitude to Dr. Persico for undertaking the useful task of presenting, in a single volume of reasonable size, a unified account of all aspects of the subject.

The book is divided into three parts. The first, which is very easy reading, describes the fundamental experimental results, and the simple Bohr theory of the hydrogen atom. The second part opens with a mathematical discussion of orthogonal functions, and then develops Schrödinger's wave equation. The applications include the harmonic oscillator, the hydrogen atom, and other problems of a single particle. A good example of the author's skill in correlating his material is the way in which an approximate treatment of the wave equation leads on to the Sommerfeld conditions of the older quantum theory and their application to elliptic orbits. This order violates the historical development, but it makes things much easier for the student.

The third part is the most difficult. It opens with a discussion of functional and Hilbertian space, linear operators and matrices. It then explains Dirac's ideas of observables. After further developments of the matrix method, we pass to the theory of perturbations. Another chapter deals with relativity, spin, and Dirac's linear wave equation, and the final chapter with Pauli's principle. The book concludes with a bibliography and an index.

There are a few places where more advanced students would desire a fuller treatment, but the only serious defect of the book is that it is in Italian. Will some publisher consider the possibility of an English translation? H. T. H. P.

Croydon Natural History and Scientific Society

Regional Survey Atlas of Croydon and District. Pp. 19+12 plates+Locator template. (Croydon: Roffey and Clark, Ltd.; London: Thomas Murby and Co., 1936.) 12*s*. 6*d*.

FOR several decades, the Croydon and District Natural History Society has been to the fore in advocating the importance of regional survey. In the view of Mr. C. C. Fagg, such a survey need never be complete but can continue to record facts on outline base maps and the maps listed and classified according to a scheme which, in its decimal system, recalls the Dewey system for books. A start has been made with the publication of some of the material collected; a substantial binder has been issued together with the classification scheme, specimens of the base maps (one covering a limited area on the one-inch scale, the other a larger area on the half-inch scale, both being reproductions of the Ordnance Survey maps in grey), a geological map and an outline on transparent paper, map of rivers, rainfall map and map of Roman roads. There are valuable notes on each map and a half-tone reproduction of Say's "Plan of Croydon" (1785).

This is a promising start, though regrets must be felt that so much of this material is available in maps of the Geological and Ordnance Surveys. Issues of new maps, to be distributed at a price varying with the cost, are promised from time to time. A glance at the classification scheme suggests that difficulties may arise—thus 82 includes land (tenure, ownership, utilization, value)—and that modifications may be needed. L. D. S.

Easy Methods for the Construction of Magic Squares

By Major J. C. Burnett. Pp. 77. (London: Rider and Co., 1936.) 2*s*. 6*d*. net.

IT is rather difficult to describe this little book. It is in no sense a systematic discussion of the construction of magic squares. Rather it consists of a series of examples to show how, by the method of 'complementary differences', a variety of problems relating to these squares may be solved; and it attempts no general theoretical discussion. Starting with the construction of an associated magic square of the fifth order, that is, one in which the sum of two numbers placed symmetrically with regard to the centre of the square is constant, the author proceeds to discuss bordered squares, magic rectangles and the like, in each case by particular examples. The language of the book is described as non-technical. This is a fair description, in the sense that the book lacks the precision of statement usually expected in mathematical works. For example, the use of the verb "to be" in the definition "Reversions are when the Squares are merely turned round . . ." is surely an archaism; and there are several other places where, though the author's intentions are clear, his explanations do not conform to modern grammatical standards. J. A. TODD.

An Elementary Chemistry

By A. H. B. Bishop and G. H. Locket. Pp 398. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 4*s*. 6*d*.

THIS is a text-book written by teachers who have aimed at making the subject interesting and also are aware of the usual difficulties encountered by young pupils. It includes details of a number of instructive experiments which can be performed in the classroom or laboratory, and the many little hints given in these descriptions show that the authors appreciate the conditions under which the experiments will be successful. All teachers will be well advised to have a copy of this book, if for no other reason than the help they are likely to obtain from the descriptions of the experiments. Emphasis is laid on everyday aspects of chemistry and there are some excellent plates of industrial apparatus, etc. The text is clear and well arranged, and there is a good selection of examination questions. The treatment throughout is from the modern point of view and the arrangement of topics will be found to work well in actual teaching.

The Origin of Fahrenheit's Thermometric Scale

By Dr. J. Newton Friend

THE scientific world has recently paid tribute to the bicentenary of the death of the renowned German instrument maker, Daniel Gabriel Fahrenheit[1], who was born in Danzig in 1686 and died at The Hague on September 16, 1736.

Ever since the general acceptance of his thermometric scale, there has been much discussion as to why Fahrenheit chose such an apparently inconvenient numerical relationship as 32° and 212° for the freezing and boiling points of water respectively. Published opinions have differed widely. Martine, a contemporary of Fahrenheit, believed that, having once fixed his zero, Fahrenheit chose his scale in a purely haphazard manner, as explained later on. On the other hand, an entirely different view is put forward in Chambers' "Encyclopædia"[2], where we read :

> "Fahrenheit took as his zero the lowest temperature then obtainable (from a mixture of salt and ice) and called the temperature of the human body 8°. Each degree was subdivided into 12 parts ; and subsequently these twelfths were taken as degrees. This made the temperature of the body 96° ; and it was found that the freezing point of water was 32°."

These illustrations will suffice.

Fresh light has been thrown on the problem by the recent discovery in the Military Medical Academy at Leningrad of certain letters sent by Fahrenheit to Boerhaave during the period 1718–29. These letters were written in Dutch at Amsterdam, and a literal translation of one of them into German, dated April 17, 1729, is given by the Cohens (*loc. cit.*)[1], which enables us to settle the question fairly satisfactorily.

It may be said at once that Fahrenheit did not choose 32° and 212° for the freezing and boiling points of water ; they were mere incidents on his scale, which was chosen independently of them and was based upon two fixed points, namely, a zero obtained by immersing his thermometer in a mixture of ice and sal ammoniac, and an upper point at blood heat, which Fahrenheit took as 96°.

The purpose of the present article is to attempt to explain :

(i) Why the above mentioned temperatures were chosen as bases of Fahrenheit's scale in preference to the freezing and boiling points of water ; and

(ii) why the upper fixed point was designated as 96°.

In order to answer these questions a knowledge of the early history of thermometry is necessary. A brief résumé is all that can be attempted in these columns.

The term thermometer appears to have been first used by Father Leurechon (1591–1670), a French Jesuit, in his work entitled "Récréation Mathematique", dated 1624. The credit of inventing thermometers with a liquid indicator (actually spirits of wine) hermetically sealed in a glass tube is usually given to Ferdinand II (1610–70), about 1650 ; he was Grand Duke of Tuscany, a liberal patron of science and founder of the Accademia del Cimento at Florence. Prior to these, air thermoscopes or baro-thermoscopes had been used for comparing relative changes in temperature. These were (probably) invented either by Santorio (1561–1656), professor of medicine at Padua and colleague of Galileo, or by Galileo (1564–1642) himself, about 1592. The utility of these thermoscopes was severely limited by their susceptibility to changes in atmospheric pressure. As no standard temperature scale was recognized, it was at first impossible, even with the Ferdinand or Florentine thermometers, to collate the results of different investigators. This very serious defect was soon realized, and steps were taken to find a remedy.

THE LIQUID INDICATOR

It was regarded by some as sufficient to select a single fixed point at an easily reproducible temperature and regard that as the zero or null point. Other temperatures were measured by noting the percentage or other fractional change in volume of the liquid indicator once the null point had been marked off on the thermometer.

Clearly the nature of the liquid medium was a matter of supreme importance, for, if the results of different investigators were to be collated, either the same liquid indicator must be used by all, or one possessed of an identical coefficient of expansion. Halley (1656–1742) directed attention to this, having observed that all liquids do not expand by similar amounts with rise of temperature[3]. Further, the exact volume of the liquid in the bulb of the thermometer must be known in order that the fractional volume change may be calculated and the temperature evaluated.

Boyle (1627–91) proposed *water*. He recommended taking a vessel of water and noting the volume of the liquid at the boiling point. On cooling to a lower temperature, the latter could be registered in terms of the contraction of the water as parts per 10,000 of the boiling volume. But this suggestion did not find favour despite the abundance of water and the ease with which it could be obtained in a pure condition. Water was regarded as an unsuitable liquid indicator, for not only was its coefficient of expansion small as Halley pointed out[4], but also its freezing point was too high for many meteorological purposes, and it was for this kind of work that thermometers were largely required. Its irregularity of expansion with rise of temperature did not much matter; it would scarcely be noticed, for the general experimental error was high.

Newton[5] (1642–1727) used *linseed oil*, noting its volume at the temperature of melting ice and, like Boyle, expressing its change in volume as parts per 10,000. Martine[6] quaintly refers to his experiments as follows:

> "Sir Isaac Newton thought the settling [of] the degrees of heat and cold well worth his notice; and as he carried everything he meddled [*sic*] with beyond what anybody had done before him, and generally with a greater than ordinary exactness and precision, so he laid down a method of adjusting thermometers in a more definite way than had been done hitherto."

But although linseed oil has a low freezing point and a large range of liquidity, its use in thermometry did not become general, despite Newton's fame as an investigator and the fact that the oil could be used at temperatures far above the boiling point of water. This was probably due to the fact, to which Martine directs attention, that, in consequence of its high viscosity, the oil drains very slowly, particularly at the lower temperatures, down the sides of the tube bearing the scale; the thermometer thus takes a long time to adjust itself to new conditions.

Ferdinand (*vide supra*) ordered his thermometers to be made with *spirit*; Boyle was quick to appreciate their merits and introduced them into England. Referring to them, Martine says they "came immediately to be of universal use among the virtuosi in all the several countries, wherever polite learning and philosophy were cultivated". The scale divisions were approximately one fiftieth of the volume of the bulb. Sagredo[7] used 360 divisions, like the graduation of a circle; hence the term degree, as applied to temperature.

The low freezing point and viscosity of spirit were excellent features, but a really serious difficulty lay in the fact that the coefficient of expansion was found to vary greatly with the quantity of admixed water. Réaumur, as we shall presently see, made use of this property when devising his scale some years later.

Fahrenheit favoured the use of *mercury* as well as of spirit; indeed he was the first to bring the mercurial thermometer into general use.

Martine, as has already been mentioned, believed that Fahrenheit chose his scale in a purely haphazard manner, using mercury as indicator. He records that Fahrenheit took a volume of mercury measuring 11,124 parts when cooled in ice and sal ammoniac; 11,156 parts in melting ice—a rise of 32 parts or degrees; and 11,336 parts in boiling water—a rise of 212 degrees *in toto*; whence his scale. Martine[8] then comments on the extremely arbitrary character of the scale, adding, "I confess there might have been a more convenient one fixed upon at first". We agree.

Martine quotes as his authority Hermann Boerhaave (1686–1738), professor of medicine and chemistry at Leyden, from whose work entitled "Elementa Chemiae"[9] the above accounts were taken. There is evidently a misunderstanding here for, in view of Fahrenheit's letter to Boerhaave discussed below, it does not seem at all possible that this could have been the origin of his scale. It is more probable that, if Fahrenheit did carry out this experiment, the particular volume of mercury was deliberately chosen because it would give the necessary expansion to fit in with his own already existing scale.

SELECTION OF FIXED POINTS

Some investigators, Martine included, advocated the use of a thermometric scale based upon two fixed points instead of one only. Any suitable liquid could then be used as indicator, and the necessity no longer existed for determining with great accuracy the volume of the bulb of the thermometer. All that one had to do, and this was comparatively easy, was to note the levels at the two fixed points and divide the distance between them into as many parts or degrees as was held convenient. Newton and Ole Rœmer (see below) appear to have been the first to devise such scales prior to 1703.

Numerous suggestions were made for the selection of fixed points. Boyle[10] recommended the freezing point of oil of aniseed (17°–20° C.) as zero, because it was not necessary to wait for frosty weather before it solidified. Halley thought a cave might be selected where summer and winter temperatures are alike; one such cave was known to Boyle, and Mariotte[11] claimed that the cave under the Royal Observatory at Paris was also isothermal. Newton chose the freezing point of water as his zero.

Boyle[12] was aware that an intense cold could be produced by mixing ice and salt. Ole Rœmer (1644–1710), the Danish astronomer famous for his measurement of the velocity of light from a study of the movements of Jupiter's satellites, used this mixture or a similar one (ice and sal ammoniac, see later) in obtaining his zero, which was regarded as the lowest temperature then attainable in the laboratory. Some years later, Fahrenheit adopted the same zero, and has hitherto, but incorrectly, been regarded as its originator.

Boyle's suggestion is ruled out because oil of aniseed is a natural product and as such does not possess a fixed composition; its melting point is thus liable to vary. For geographical reasons, Halley's idea is impracticable, as a particular cave could not be visited by everyone desirous of checking his thermometer.

Newton's idea appears to be the simplest and most convenient. Why, then, was it not generally adopted?

The reason seems to be that scientific investigators believed the freezing point of water was not constant, but varied with the latitude, Halley and others asserting that, the farther north we go, the more cold is required to freeze the water—to use the then current phraseology.

Martine[13] refers to this, and appears to have been the first to show that such is not the case. He rightly attributes the observed differences in the freezing point of water either to inaccurate observation or to the use of imperfect thermometers. He says that he marked the mercury level on a thermometer at Edinburgh, when immersed in snow and water, whilst a friend did the same with another thermometer in London. They then exchanged instruments and tested them, finding them to agree perfectly. Evidently the difference in latitude between the two cities had not affected the freezing point. Later experiments as far south as Paris and Dijon yielded similar results.

For his upper fixed point Newton chose blood heat; this was regarded as absolutely constant for a healthy person. He designated this temperature as 12°, probably because the number is easily subdivided and remembered, as there are 12 inches to the foot; the decimal system was not in general use in scientific work. As we have seen, his 0° was obtained in melting ice.

In "Adversaria", which was printed in 1910, the MS. having been mislaid for about 200 years[14], Rœmer gives an account of the construction by him of a standard thermometer in 1702–3. The scale of this thermometer was based upon *two* fixed points, the upper one being the boiling point of water, which he designated as 60. In checking his thermometers he used this temperature and, for convenience, possibly also for greater accuracy, the melting point of snow or crushed ice. This latter temperature, however, was not his zero, but fell on his scale at 7½ degrees. According to Fahrenheit, Rœmer also used blood heat in checking his thermometers, presumably when intended for meteorological use, as it was not necessary for these to be graduated to so high a temperature as the boiling point of water. In his letter to Boerhaave dated 1729, to which reference has already been made, Fahrenheit states that he met Rœmer in Copenhagen in 1708 and saw him testing some thermometers by placing them first in ice and water and afterwards into water at blood heat. The scales on the instruments were divided into 22½ parts, beginning at 0. When placed in iced water the reading was 7½; at blood heat, 22½. How the zero was obtained is not definitely stated either in "Adversaria" or in Fahrenheit's letter, but simple calculation shows that it corresponds roughly to the temperature of a mixture of salt and ice. This is supported by the fact that Fahrenheit then goes on to say that he himself later adopted the same temperature scale but with this small difference, namely, that he divided each of Rœmer's divisions into quarters, presumably for ease of reading. Evidently, therefore, Fahrenheit adopted the same zero, and this, he had stated[15] in 1724, was obtained "by the commixture of ice, water and sal ammoniac, or even sea salt". From the fact that he quotes sal ammoniac and sea salt as alternatives we gather that Fahrenheit supposed they yielded the same temperature with ice. We now know that their cryohydric points are − 15° C. (or + 5° F.) and − 22° C. (or − 8° F.) respectively. Nevertheless, Fahrenheit did realize that there was a difficulty in reaching the true zero, for he naively remarks that "if into this mixture the thermometer be put, it descends to 0. This experiment succeeds better in winter than in summer"!

We wonder what the toleration of his thermometers would amount to. Martine mentions[16] that he had occasion to test some Dutch mercurial thermometers, but found them in error by one or two degrees.

Halley[17] recommended, for the upper fixed point, the boiling point of spirit of wine,

> "only it must be observed, that the spirit of wine used to this purpose, be highly Rectified or Dephlegmed for otherwise the differing goodness of the spirit will occasion it to boil sooner or later, and thereby pervert the designed exactness".

Several workers recommended the boiling point of water as the upper fixed point, using the freezing point as zero. Martine favoured this idea and it was acted upon by René de Réaumur (1683–1757), the French scientist, who found that the best spirits of wine of his day expanded by 87½ parts per 1,000 when warmed from melting ice to boiling water[18]. Equal parts of his spirit and water gave an expansion of 67½. He therefore for simplicity chose such a mixture as expanded by

80 parts. Hence the Réaumur scale runs from 0° to 80° between those two temperatures. The choice was not accidental, as we frequently read, but by design.

In 1736 Celsius (1701–44), in contrast to previous workers, favoured the decimal system and divided the same interval into 100, thus giving us the Centigrade thermometer. At first he denoted the freezing point by 100 and the boiling point by 0, but this scale was afterwards inverted.

It was known to Martine[19], to Fahrenheit and possibly also to Boyle that the boiling point of water varies with the pressure. This, however, was not regarded as a serious drawback to its use as a fixed point because, as Martine states,

> "in ordinary changes of the weather, the difference is not very great. And farther, we may avoid all errors that might arise from anything of that sort, if we make our observations on the heat of boiling water, and adjust this term of heat at a middle state of the atmosphere in places near the level of the sea, when the quicksilver in the barometer stands at about 30 inches, or a very little under it. And the same caution will be necessary in judging the heat of boiling spirit of wine, or of the boiling heat of any other liquid."

The Fahrenheit Scale

We have seen that Fahrenheit, on his own admission, based his scale on that of Rœmer. This confirms the conclusion to which Kirstine Meyer[14] had already come in 1910, after examining the scales on some early Fahrenheit thermometers and collating various statements in contemporary literature.

If we ask what were the features of Rœmer's scale that attracted him and led him to reject the freezing and boiling points of water as his zero and upper fixed point respectively, the answer is undoubtedly to be found in the fact that the majority of his thermometers were intended for meteorological purposes.

The freezing point of water is relatively high, and if taken as zero involves the repeated use of negative values for winter temperatures. By using the then lowest attainable temperature as zero—the "absolute zero" of those days—all the meteorological readings would be positive. Fahrenheit probably objected to the conception of a negative temperature, just as we do to-day in regard to our own absolute scale.

As regards the upper fixed point, the temperature of boiling water was rejected as being unnecessarily high for meteorological purposes and inconveniently high for spirit thermometers. Fahrenheit states[20] that he was accustomed to use the same fixed points for all his instruments, whether spirit or mercury, when intended for meteorological purposes.

Fahrenheit went on to say, in his letter to Boerhaave, that in 1717 he felt Rœmer's scale with its fractions to be both inconvenient and inelegant; so instead of 22½° divided into quarters, that is, 90, he decided to take 96° as blood heat. Retaining the same zero, the melting point of ice became 32°, instead of 7½° divided into quarters, or 30. This scale he continued to use and was using at the time the letter was written (that is, in 1729); he added that he had been confirmed in his choice because he found it to agree, by pure coincidence, with the scale marked on the thermometer hanging in the Paris Observatory.

Fahrenheit gave no reason for regarding the number 96 as more convenient than 90. Probably it was due to the fact that 96 is divisible not merely by 3 but also by multiples of 2 and hence by 12. The decimal system was not then in general use in scientific work, otherwise Fahrenheit would no doubt have fixed blood heat at 100°. In that case the freezing and boiling points of water would have been represented by numbers even more awkward and disconnected, namely, 33·3° and 221° respectively. So let us be thankful.

Although we retain a Fahrenheit scale to-day, it is not quite the same as that which Fahrenheit used. The lower and upper fixed points adopted are those deliberately rejected by Fahrenheit, ice being taken to melt at 32° and water to boil under standard conditions at 212°.

In conclusion, I gladly express my indebtedness to Mr. H. W. Robinson, librarian of the Royal Society, to the staff of the Birmingham Public Library and last, but by no means least, to my friend Mr. F. W. Clifford, librarian of the Chemical Society, for their kind assistance whilst I have been examining the early documents referred to in this article.

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[1] See Cohen, E., and Cohen-De Meester, W. A. T., *Kon. Akad Wet Verhand.* (Eerste Sectie), 16, No. 2, pp. 1–37. Amsterdam, 1936. See NATURE, 138, 428 (1936).

[2] New Edition, by Patrick and Geddie, 10 (1927), under "Thermometer". A similar view is put forward by Higgins, *J. Roy. Soc. Arts*, 74, 946 (1926).

[3] Halley, *Phil. Trans.*, Lowthorp's Abridged Edn., 2, 33.

[4] Halley, *loc. cit.*, 2, 34.

[5] Newton, *Phil. Trans.*, 824 (1701). The paper, which is anonymous, is entitled "Scala graduum Caloris", and appears in Latin. See also Brewster, "Life of Sir Isaac Newton", 2, 362–8 (1855).

[6] Martine, "Essays on the Construction and Graduation of Thermometers". (New edition, Edinburgh, 1792.) The first essay, from which these and succeeding quotations are taken, is dated 1738.

[7] Sagrodo See "The Times Century Dictionary" under "Thermometer".

[8] Martine, *loc. cit.*, p. 30.

[9] Two volumes, dated 1732. See 1, 174, also 162–165

[10] Boyle, "An Experimental History of Cold", 39 (1665).

[11] *Phil. Trans.*, Lowthorp's Abridged Edn, 2, 36.

[12] Boyle, *loc. cit.*, 156.

[13] Martine, *loc. cit.*, p. 15.

[14] See Kirstine Meyer, NATURE, 82, 296 (1910); also "Adversaria" by Thyra and K. Meyer (København, 1910), reviewed NATURE, 86, 4 (1911).

[15] Fahrenheit, *Phil. Trans.*, 33, 78 (1724). Printed in Latin. This quotation is from *Phil. Trans.*, Hutton's Abridged Edn., 7, 22–24.

[16] Martine, *loc. cit.*

[17] *Phil. Trans.*, Lowthorp's Abridged Edn, 2, 35.

[18] Réaumur, *Mem. Acad. Roy.*, 452 (1730).

[19] Martine, *loc. cit.*, 10.

[20] Fahrenheit, *Phil. Trans.*, 33, 78 (1724).

The Ancestry of Insects*

By Dr. A. D. Imms, F.R.S.

THE insects are unknown in their original or primitive manifestations and consequently their ancestry is wrapped in obscurity. The subject can only be approached by the co-ordination of whatever evidence may be gleaned from three principal courts of appeal—comparative morphology, embryology and palæontology. Of these, palæontology has, so far, remained almost like a closed book: no annectant forms bearing directly upon the problem have been disclosed in the strata of any geological period. Without this necessary record of the past, the links in the evolutionary chain are deductions based mainly upon morphology and development. For a considerable time past, the two most plausible theories of insect descent have been those which involved either the Crustacea or Symphyla as ancestors. The Crustacean theory, which is based no external structure, is losing ground, while that involving the Symphyla has remained in much the same status that it acquired in the days of Packard.

The most important evidence bearing upon insect ancestry that has come to hand during the last thirty years or more was Silvestri's[1] discovery, in 1903, of the remarkable thysanuran *Anajapyx*; since that date, no revelation of comparable significance has been made. While this discovery added weight to the symphylan theory, Packard's conclusion of 1898[2] still holds good to-day. This writer stated that *Scolopendrella* is the only extant arthropod, which, with the sole exception of being progoneate, fulfils the conditions required of an ancestor of the Thysanura and, through them, of the winged insects. In 1930, Tillyard[3] brought forward a theory which claimed that the Insecta were derived from remote hypothetical nauplioid ancestors ("Protaptera"): they arose separately from the Symphyla and other Myriapoda which, he maintained, had a similar origin. The symphylan theory was rejected by this author owing to the old crux of the segmental location of the gonopore.

The contention of the present communication is that the symphylan theory is substantiated by a larger body of evidence than any other explanation of insect descent. In considering this theory, it needs to be stressed that it is generally accepted to-day that among the Thysanura are found the most generalized of all insects: *Lepisma* and its allies are the forerunners of the Pterygota, while *Anajapyx* and *Campodea* are more nearly related to the ancestral insects. The old phylogenetic importance of *Campodea* has now been largely eclipsed by *Anajapyx* with its greater display of symphylan characters. Since *Anajapyx* provides an essential link in the present theory, these characters need to be recounted. They include simple multi-articulate antennæ: styli and eversible sacs on most of the abdominal segments: cerci bearing the orifices of large posterior glands: mouth-parts built on an essentially similar plan: an identical leg-segmentation with single-jointed tarsi: a simple digestive canal with homologous salivary glands and the same fundamental type of excretory organs. A second link in the chain is provided by embryology. The lower insects pass through a developmental phase revealing fourteen postcephalic segments, each bearing limb rudiments. This phase can only be interpreted as a relic of a former polypodous condition. On turning to the Symphyla, it will be noted that they reveal, in their adult structure, close resemblance in metamerism as evidenced by the appendages: namely, twelve pairs of legs, the thirteenth pair transformed into sensory processes and the fourteenth pair, as in insects, represented by cerci. Thus it seems very possible that the Insecta recapitulate what may be regarded as a symphylan stage in their development.

In the derivation of the Insecta from symphylan ancestors, it would appear that three main evolutionary changes were involved. (1) The development of a segmental tracheal system. (2) Concentration of the locomotory function in the first three postcephalic segments, with the consequent reduction of the appendages of the remaining segments (other than cerci) to a vestigial condition. (3) The development of posterior gonoducts opening between the tenth and eleventh postcephalic segments, together with the atrophy of the original ducts. (1) and (2) require little comment since they are evidenced in the development of the lower insects and in the adult structure of the Thysanura. In connexion with (3), it is noteworthy that a shifting backwards of the genital apertures during development is a common feature among many orders of insects. Furthermore, new (or secondary) genital passages and orifices have been acquired among Lepidoptera, Strepsiptera and in the Hemipterous family Cimicidæ. The postulation of a change from a progoneate to an opisthogoneate condition refers, therefore, to the evolution of a class wherein diverse modifications of the genital conduits are a prominent feature. The Insecta are peculiar in that the egg-follicles are disposed in a linear series forming ovarioles, while at the apex of each ovariole is an end-chamber (or germarium) containing the undifferentiated germ cells. In other arthropods no such arrangement into ovarioles prevails and the germarium is located parietally. It will be evident that structural modifications of the gonads must have been involved during the evolution of the Insecta, and, it is claimed, that these changes occurred in association with the development of posterior gonoducts.

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* The present article is an abbreviation of one bearing the same title (*Trans. Soc. Brit. Entom.*, 1, 1936) the main features of which formed the subject of a presidential address given to the Society for British Entomology, at a congress held in Cambridge on June 26-29, 1936.

So far, the Protura and Collembola have been omitted from discussion: they are side developments off the main line of insect descent. The Protura show a predominance of hexapod features, suggesting that the early evolution of this group was with the rest of the Insecta. Afterwards they diverged as a specialized side branch but retained the primitive trait of anamorphosis. The Collembola display both myriapodan and insectan characters. Owing, possibly, to the paucity of yolk, which has induced holoblastic segmentation, development became arrested and only nine trunk segments formed. In the absence of ovarioles and retention of the parietal germarium, together with the general simplicity of the gonads, the Collembola betray close resemblances to the Symphyla. The possibility that traces of a former progoneate ancestry are revealed in Collembola, as mentioned by Claypole[4], needs further investigation; evidence of such ancestry also requires exploration among other Apterygota.

Re-examination of the symphylan theory seems, therefore, to establish it as the only adequate explanation of insect descent. In view of the many fundamental similarities between the Symphyla and Thysanura, it is claimed that these two groups arose from a common stock, not very different from living forms of Symphyla. Theories involving separate origins for the two groups in question, on the grounds of disparity in the segmental locations of the gonopores, have to fall back upon the improbable hypothesis of convergence to account for their community of structure. If the propositions now advanced serve to focus attention upon aspects of the problem hitherto neglected, they will have fulfilled their purpose.

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[1] *Ann. della Scuola Sup. di Agric. in Portici*, **5** (1903); *ibid.*, **6** (1905).

[2] Packard, "Text-book of Entomology", 22 (1898).

[3] *Pap. Roy. Soc. Tasm.*, 1930; and NATURE, **126** (1930); this theory was partially recast in *Amer. J. Sci.*, **30**, 438 (1935).

[4] *J. Morph*, **14**, 239 (1898).

The Recent Floods in the United States*

By Dr. C. E. P. Brooks

THE Mississippi and its tributaries together drain about half the area of the United States. The Mississippi itself runs through the centre of the country, the Missouri rises in the Rocky Mountains and the Ohio in the Allegheny Mountains. The upper courses of the Mississippi and Missouri lie in relatively dry regions, where moreover the winter precipitation is mainly in the form of snow. The Ohio, on the other hand, runs through a region of comparatively heavy rainfall, and is much more liable to flooding.

During the last few months of 1936, the rainfall in the valley of the Ohio and the Mississippi above Memphis had been abnormally heavy, the total for the months September–December being nearly one and a half times the normal. Thus at the beginning of January, the ground was waterlogged and there was already minor flooding in some of the tributaries of the Ohio. In January a type of pressure distribution developed which was very favourable to prolonged heavy rain (Fig. 1). Pressure was high off the east coast of the United States, and decreased steadily westwards. This was associated with a current of warm moist air blowing from the Caribbean Sea and the Gulf of Mexico across the eastern half of the United States. Above this warm and very moist south-easterly wind was an upper current from the west, which was relatively cool. The air was therefore highly unstable. Farther north, over the Great Lakes and southern Canada, pressure decreased northward, and the westerly current descended to ground-level. The encounter of the warm moist south-east wind with this great barrier of colder air from the west gave all the conditions necessary for heavy and prolonged rain, which was localized by a series of depressions travelling from south-west to north-east along or near the line of the Ohio Valley.

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* Paper read before the Royal Meteorological Society on February 17.

The rainfall was abnormally heavy, exceeding four times the January normal between Cincinnati and Cairo, the totals for the three weeks January 6–26 reaching 12 inches at Cincinnati and 16 inches at Louisville farther down the Ohio*. The latter river rose steadily along its whole length, the rise being hastened by the abnormally high temperatures, which prevented any accumulation of snow or ice. The main stream of the Ohio was in flood on January 10, and by January 19 the floods were general. From that date conditions rapidly became disastrous. The official "flood stage" at Cincinnati is a level of 52 feet, and the highest level on record was 71·1 feet, which occurred on February 14, 1884. This record was passed on January 23, and on January 26 the level stood at 80 feet. Previous records were exceeded at all stations on the Ohio below Parkersburg, and on the Mississippi from Cairo to at least Memphis.

The crest of the flood reached Cairo, at the junction of the Ohio and Mississippi, early in February, the highest level being about 60 feet. This is nearly four feet higher than the highest crest of the great flood of 1927, which itself constituted a record. The defences of Cairo have, however, been greatly strengthened during the past ten years, and although the city was isolated and abandoned by most of the inhabitants, it did not suffer so severely as in 1927. It lay precariously in a hollow surrounded by water up to the level of the house-tops, and some damage was caused by water forcing its way through an underlying bed of sand and coming up in sudden 'sand-boils'. Farther down the Mississippi, the chief danger areas are along the tributaries entering the main river below the Ohio. These cannot be completely protected by levees, and the water floods back up them, and over the surrounding country. As a measure of precaution, thousands of people were evacuated from their homes along these tributaries in Arkansas, Louisiana and Mississippi.

By about February 5, the cities of the Ohio Valley were able to resume normal activities and the level had begun to fall at Cairo. The flood crest was now making its way slowly down the main Mississippi; but the levees were being strengthened at all danger spots, and the engineers were confident that they would hold. On February 9 the river at Memphis reached a level of 48·7 feet, more than two feet higher than in 1927, without breaking its banks. On February 10 the level at Helena, Arkansas, was about three feet above the previous record. After that date, however, the levels began to fall steadily and no further danger was anticipated.

The flood of 1937 differed from that of 1927 mainly in the area of greatest damage, which was limited to the Ohio valley instead of extending widely over the whole Mississippi below Cairo. In 1927 the Ohio valley was much less affected than in some earlier floods, especially those of 1883 and 1907. The Ohio valley is narrower and steeper than that of the lower Mississippi, and the Ohio floods both set in and pass away comparatively rapidly. This is shown by the speed of the flood crest, which normally exceeds 50 miles a day on the Ohio from Cincinnati to Cairo, compared with about 23 miles a day along the Mississippi from Cairo to Helena. The crest of the 1937 flood appears to have travelled even more rapidly, 80–90 miles a day, and this flood was therefore a relatively sudden affair, lasting less than a month. The floods of 1927 continued for two months at Cincinnati, but four or five months at Memphis and Helena.

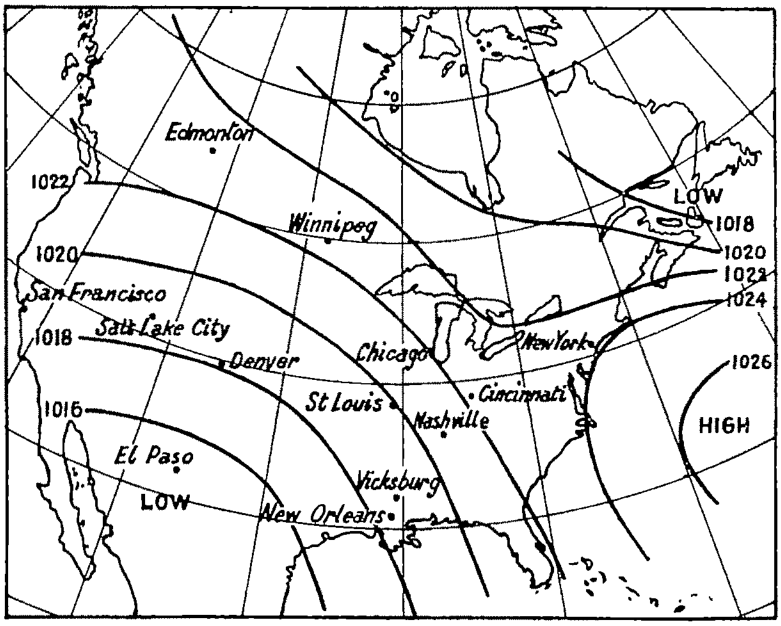

Fig. 1.

DISTRIBUTION OF PRESSURE OVER THE UNITED STATES IN JANUARY.

The great cities of the lower Ohio valley suffered severely during the recent flood. In Cincinnati and Louisville the level of the water reached to the tops of many of the houses. The supply of drinking water broke down and there was grave risk of typhoid, which actually broke out in Louisville. Petrol floating on the water became ignited, and there were several outbreaks of fire. About a million people were homeless, and though the loss of life was probably not more than five hundred, the material damage amounted to hundreds of millions of pounds.

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* See map in NATURE, Feb 6, 1937, p 227

The meteorologists at least have not been found wanting, and it is fitting to conclude this brief account with a reference to the work of the United States Weather Bureau. The forecasts of the times and heights of flood stages were of incalculable assistance throughout to the patrols and rescue organizations. Without these warnings, the loss of property, and still more of life, would have been enormously greater.

News and Views

Prof. J. Stanley Gardiner, F.R.S.

THE retirement of Prof. Stanley Gardiner from the chair of zoology and comparative anatomy in the University of Cambridge next October will bring to an end a remarkably interesting and important period in the history of the Department of Zoology at Cambridge. At the time of his appointment, Prof. Gardiner was a leading authority on marine zoology, with a specialist's knowledge of the systematics of corals. He had gained a wide knowledge of the methods used in the exploration of the sea during the times when he took part in expeditions to the Pacific and Indian Oceans. As a result, he has been able to give most important and valuable advice and assistance to all the British expeditions for scientific oceanography from the time of his appointment to the present day. But Prof. Gardiner is a naturalist, and his extensive interests in animals and plants have given him a wide sympathy for all branches of scientific research in zoology, and therefore when the dream of an adequate zoological institute in the University became true, he saw to it that every aspect of the subject was fully provided for. The very large number of his former pupils will remember with gratitude the personal interest he took in their work, and the kindly advice and help he gave them at the outset of their careers.

Dr. J. Gray, F.R.S.

Prof. Stanley Gardiner will be succeeded by Dr. James Gray, who was one of his pupils when he became professor in 1909. Dr. Gray has had a varied career. He was demonstrator of zoology before the Great War, carrying out research on fertilization of echinoderm eggs. Then he saw war service from August 1914 until the peace, serving in France and Palestine, attaining the rank of captain and being awarded the *M.C.* Returning to Cambridge, he became Balfour student, commencing a long line of research on ciliary movement, in which he and his pupils are still interested. Lecturer and reader in turn, by a natural evolution he passed onwards to a comprehensive study of the physiology of animal locomotion, being especially interested in fish. In 1928, he was visiting professor at Columbia University. His share in the rebuilding of the whole Zoological Department at Cambridge was great, and in particular he was charged with the design of the experimental section, which contains, besides a teaching laboratory, twenty-five separate research rooms and at present overflows into the whole building. Elected to the Royal Society in 1929, he is now a member of the Council. He is also a member of the Advisory Committee on Fisheries of the Development Commission, but perhaps his greatest public service to science is in the editing of the *Journal of Experimental Biology*, which is associated with the Society of the same name.

Inauguration of an Ultra-centrifuge at Oxford

A SVEDBERG ultra-centrifuge, generously lent to the University of Oxford by the Royal Society and erected in the Department of Biochemistry (Prof. R. A. Peters), was formally set going on February 27 in the presence of a large company by the Vice-Chancellor of the University, the president of the Royal Society and Prof. The Svedberg of Uppsala himself. The cost of the complete instrument, defrayed by the Royal Society, was £2,000. The cost of its erection has been met by the University. It is one of five similar instruments, the third outside Sweden—two are at Uppsala, one in London at the Lister Institute of Preventive Medicine, and another in the United States. It is designed for the determination of the rate of sedimentation of particles of very high molecular weights. The rotor, of a nickel-chromium steel found after many trials to stand the great strain put upon it, is supported by bearings of Babbitt's metal and driven by two small oil turbines, one at each end of the shaft, which give a smooth and easily regulated run. The rotor moves in an atmosphere of hydrogen of about 25 mm. pressure. Rotation speeds, determined electrically, up to 65,000 revolutions per minute (equal to about 300,000 times gravity) can be safely attained. The solution to be centrifuged is contained as a thin column in a cell with quartz windows carried, and suitably balanced, on the rotor. The height of the column, which is about 7 cm. from the centre of rotation, does not generally exceed 27 mm. The position of the moving boundary of the particles sedimented during a run of the ultra-centrifuge is determined from photographs obtained at suitable intervals with a camera with a lens of very great focal length, the source of light being a mercury lamp. The ultra-centrifuge, which will be available for any research worker in the University, is, under the direction of Prof. R. A. Peters, in the charge of J. St. L. Philpot, Balliol College. He will employ it in a general investigation of enzymes as proteins, and particularly to see how the alteration by chemical reaction of certain groupings on the enzyme affects the stability of the particle itself.

Scientific Research in New Zealand

THE tenth annual report of the New Zealand Department of Scientific and Industrial Research covers the year 1935–36, and in addition to the Minister's statement and the Secretary's report, includes reports of the various research committees as well as of the Dominion Laboratory, the Geological Survey Branch, Meteorological Branch, and the Dominion, Apia, and Magnetic Observatories (Wellington: Government Printer, 1936. 2*s.* 3*d.*). Of the expenditure of £91,344 during the year, £46,306 was on research investigations, £11,225 of which was for industries and £21,360 in the Consolidated Fund. Plant research plays a large part in the activities of the Department, and has now been organized so that each Division is situated in the part of the Dominion most affected by its activities. General co-ordination of the work on animal health and nutrition has also been effected, and it is hoped that a comprehensive scheme of attack on these problems will be evolved during the year. A systematic soil survey of New Zealand is in progress and a survey of the tung oil industry will shortly be undertaken. Soil surveys form an important part of the investigations which are being made in the development of the citrus industry.

THE first organization to be established under the Department was the Dairy Research Institute, and this has already attacked with success certain major problems in the manufacture of butter and cheese. Strains of starter bacteria which afford the best type of Cheddar cheese have been isolated, and much information on the action of bacteria in the ripening of cheese has been accumulated. Valuable research by the Wheat Research Institute has resulted in the breeding of a new hybrid which avoids the necessity of importing strong wheats for blending purposes. An outstanding feature of the fruit research in the year has been the proving of a successful method of controlling corky-pit disease of apples by the application of boron compounds. Steps are being taken to establish research associations for various industries on the lines of those in Great Britain and also to establish a general bureau of technical information for industry. Recently the Government has taken over the responsibility for the development of industrial standards. The work of the Meteorological Office has been considerably affected by the inauguration of regular air services in New Zealand, and the system of weather observation and reporting is being considerably increased.

League of Nations and Nutrition

AT a meeting of the Expert Committee on Nutrition set up by the Committee of the League of Nations, held on December 8–10, 1936, under the chairmanship of Prof. H. Laugier, methods and results obtained as an outcome of the report on the physiological bases of the subject and a programme of research outlined, were compared and a plan of action established. Agreement was reached as to the technical methods to be applied, and a plan of future studies for co-ordination by the Health Organization was drawn up. Three methods are recommended for assessing the state of nutrition of children of pre-school age and school age and of adolescents. The first method is essentially suitable for practical work, such as the determination of the state of nutrition of large numbers of children, and for this purpose the preparation of record cards giving particulars of age, sex, physical appearance, weight and height is recommended, as well as a clinical examination of each child bearing on the colour of the skin, the state of the teeth, the condition of the subcutaneous fat layer, the state of the muscles and any signs of abnormal fatigue.

THE second type of inquiry is intended for more thorough and more scientific investigation covering smaller groups, and will include an inquiry into the child's food intake and the economic and social status of its family. A thorough medical examination and, so far as possible, special measurements and special tests, for example, on protein content of blood, pre-deficiency tests, etc. The third type of inquiry is intended to study scientifically the disturbances to which all the functions of the body are subjected when the diet is quantitatively or qualitatively deficient. A further meeting of the Expert Committee on Nutrition held on December 11–12, 1936, under the chairmanship of Prof. E. Gorter was concerned with nutritive food requirements during the first years of life. These requirements were defined as regards calories, proteins, vitamins and iron, indicating to what extent milk, cereals, vegetables, eggs, meat and broth should be used to provide a suitable diet for infants, and remarks on the quality and preparation of food were also made.

Science and Social Problems

A RECENT broadsheet issued by Political and Economic Planning (PEP) directs attention to the welcome evidence afforded by the malnutrition controversy of the recognition that science can make important and indispensable contributions to the solution of social problems. The present broadsheet merits attention not merely as presenting a concise summary of experiments and studies bearing on the known facts of nutrition, but also for a helpful discussion of the main points of controversy or misunderstanding. This is particularly true of its efforts to disperse some of the confusion caused by the use of the word 'malnutrition' in several different senses. Available evidence shows that even in the lowest income groups, shortage of calories cannot affect more than a small number of persons. On the other hand, shortage of protective food elements affects many millions, and the effective absorption as well as the actual consumption of essential food elements requires consideration. Since this is affected, for example, by exercise and fresh air, these may also be ancillary factors in nutrition. The most serious and widespread form of malnutrition at the present time in Great Britain is probably the deficiency of calcium among children and adolescents, but there is also insufficient consumption of fresh fruit, vegetables and fats, although in the present state of knowledge the deficiency cannot be measured. The most pressing nutritional needs are, however, clearly indicated, and Government and industry carry a heavy responsibility for taking the necessary steps to meet these needs. Not the least valuable feature of this admirable broadsheet is a list of reports and books on nutrition.

Roman Leicester

LEICESTER has saved her Roman remains. At a meeting of the City Council held on February 23, it was decided that the site of the Roman Forum, recently discovered in the course of the excavations carried out by Miss Kathleen Kenyon (see NATURE, **138**, 356, 432) should be preserved as an open space for all time. As the site is centrally situated and had been chosen for the erection of municipal baths, it will be widely appreciated that the citizens of Leicester by this decision have shown a generous public spirit in their attitude towards the claims of the past and a consciousness of their obligation to the nation at large and to posterity, which is worthy of all praise. Of this monument, unique in Britain, the excavations have now proceeded to a point which reveals two sides of the Forum with one of the flanking streets; while it has been shown that the famous "Jewry Wall", one of the largest pieces of Roman work in England, was part of the west wall of the basilica. In later times this became a place of Christian worship, and in the early medieval period the Jewry Wall itself was utilized as the west end of a church. Tiles and bricks from the Forum were used in the construction of the adjacent late Saxon church of St. Nicholas, itself one of the notable monuments of Leicester. It has been pointed out that in declaring that this area shall remain in perpetuity an open space, the Council preserves in the heart of the city "the veritable birth-place of her commerce, her self-government, and her religion"; but in fact it does even more. For Miss Kenyon in the course of her excavations has discovered traces of pre-Roman settlement, which may well go back to the original British village founded on the banks of the Soar. The City of Leicester is to be congratulated on a decision which will earn the gratitude of all who are interested in the preservation of such relics of the past.

An Experiment in Science Teaching

IN discussing some time ago certain aspects of university science teaching (NATURE, **129**, 773–5; 1932), doubts were expressed of the present-day necessity for, or desirability of, extensive spoon-feeding lecture and laboratory courses in universities. In proposing some changes, a plea was made for incorporating into science teaching some instruction in scientific method. An interesting development on these lines is being carried out by Prof. A. J. Riker in the University of Wisconsin in a laboratory class in plant pathology. Instead of using the same set of exercises repeated by each member of the class, the routine laboratory manipulations are acquired in carrying out simple investigations. Most members of the class work on different subjects, and compare the results freely. When a piece of work has been completed, a time is arranged and the student gives a short account and demonstration, after which the results are discussed by the other members of the class.

To facilitate the supervision, Prof. and Mrs. Riker have published in a limited edition "An Introduction to Research on Plant Diseases" (Madison, Wis.: Prof. A. J. Riker, College of Agriculture, University of Wisconsin, 1936. 2.65 dollars), giving a short account, with references to selected original papers, of the methods usually needed. Some of the chapters serve to guide the student in making his own systematic search of the literature before starting experimental work in the laboratory, in formulating his problem and his proposed plan of work clearly and in preparing an adequate report of the results. The more a method of teaching departs from a formalized routine, the more does its effect depend upon the actual supervisor, who must judge how much and how little help may be given to each individual. Much experience and analysis are then necessary before a supervisor may be able to help others to apply his new methods. Not infrequently in pioneer work the 'right' course of action may be adopted for what others may regard as a 'wrong' reason or rationalization. Since, however, there is little doubt that the methods of scientific workers could help in dealing with some of the major problems troubling present-day civilization, any attempts at developing educational methods so as to foster scientificaction deserve encouragement and close study.

Institute of Chemistry

AT the fifty-ninth annual general meeting of the Institute of Chemistry, held on March 1, the president, Dr. R. H. Pickard, stated that the membership now includes a roll of nearly 6,800 members and 800 registered students. This year, on October 2, the Institute will attain the sixtieth anniversary of its original incorporation. The ideals of its founders have been steadily pursued. Chemistry, Dr. Pickard said, has established its place among the learned professions, and its practitioners are to be found in industry and commerce, in the Government and other public services. Chemists, by the very nature of their calling, have been for the most part of a retiring and modest disposition. Happily, there are also among them not a few who have developed a measure of business acumen. That is a matter of very great significance and importance. Everything possible should be done to encourage in the profession a continuous supply of men of that type. There are, in the profession, young men, many as yet little known, who have courage and initiative to come forward with new work, to read papers, and to make useful and sensible contributions to discussions. To be able to express themselves clearly and with assurance on matters on which they can claim to know something is a valuable asset in itself. He would suggest to the younger members that much could be done to acquire this ability by good reading, by cultivating the habit of mixing with men of other professions, and by taking an active interest, not only in the proceedings of the societies devoted to their science, but also in the world of affairs generally. The supply of men and women for administrative posts is a difficult problem. There is another side of the question, however, namely, that in attaining an administrative post with the responsibility that it entails, there is a danger of the chemist losing touch with his science, so that it becomes more and more difficult for him to encourage the workers in the laboratories. Dr. Pickard was re-elected president of the Institute for the ensuing year.

Smoke Reducing Grates for Domestic Use

IN NATURE of January 23, an article on the prevention of smoke and dust emission referred to the difficulty experienced in burning raw coal smokelessly in the conventional open grate, and stated that investigations are now in progress having as their object the removal of this source of atmospheric pollution. The fundamental cause of smoke production from a domestic fire is the low temperature obtaining in the space above the fuel bed, combined with the cooling of the hot products of combustion by excess air entering the face of the grate. This normally gives rise to partial combustion of the hydrocarbon distillation products and the evolution of materials rich in carbon, but at certain periods, notably on kindling and on refuelling, the tarry matter may pass into the atmosphere unchanged.

To overcome these defects, a number of grate designs have been advanced, and the more important may be divided roughly into four classes. In the first, preheated air is supplied to the space above the fuel, increasing the temperature and promoting the early combustion of the volatile matter. This method can only be partially successful, as both the air supply and its temperature will be lowest just before adding a fresh charge. The second class, which is used in many multiple purpose grates, employs a draught which carries the distillates downwards through the hot fuel, giving conditions more suitable for their combustion. In these two, the smoke from the ignition charge is little altered. Gas is used in the third class as an auxiliary to burn the smoke. A novel example of this type was demonstrated recently by the Coal Utilisation Council, British Industries House, Marble Arch, London, W.1. The final class consists of more complicated devices in which the heat from the fire partially carbonizes raw coal contained in a suitable receptacle, the distillation products passing through the burning fuel where they are consumed. Dr. Arnot's smoke consuming grate (1855) was the forerunner of this type, but more recently a gravity feed from a hopper behind the fireback brings it more into line with modern ideas.

Control of the Grid System in Great Britain

IN a paper, read to the Institution of Electrical Engineers on February 10, Mr. J. D. Peattie describes the control rooms provided by the Central Electricity Board for controlling the generating stations supplying electricity to the grid and for supervising the operation of the transmission lines. The whole of Great Britain with the exception of northern Scotland is now divided into nine schemes. These are grouped into seven systems which are controlled from seven centres, at Glasgow, Newcastle, Leeds, Manchester, Birmingham, Bristol and London respectively. For short distances, continuous metallic circuits are provided, but for longer distances the Post Office channels pass through repeating stations and alternating current signals only are transmitted. The telephones and automatic indicating apparatus are always combined in one equipment suitable for use in conjunction with the channels hired from the Post Office. The vital line of communication is that connecting the control engineer on duty and the operator at the distant station.

IN general, the control engineer has access to, and a prior claim from his desk on, the outgoing channels. By means of automatic indicating apparatus he knows the position of the circuit breakers, the routine instruction signals and the readings of the load. In most cases the transmitting and receiving equipment for the signals are developments of apparatus used in automatic telephony. As a check on the frequency and time control carried out by the operators at the generating stations, meters connected to the local supply are installed in each control room. Differential dials are provided showing the difference between the time given by a high-grade standard clock and the system time given by the synchronous motor clocks. The standard clock is checked daily against the Greenwich radio time signal. Differential dials are also provided showing the difference between the time given by the standard clock and the system time given by a synchronous motor clock.

Recent Acquisitions at the Natural History Museum

AMONG recent acquisitions in the Department of Zoology are the mounted head of a Mexican bighorn sheep presented by Mr. John Lawson, the head of a Newfoundland caribou presented by Mr. W. Lawson, and the head of a woodland caribou presented by Captain D. A. Lawson. The study collection has been enriched by an Argali sheep skin from Samarkand, the gift of Mr. Douglas Carruthers, and a tiger skin and skull from Perak presented by the Zoological Society. Miss Emma Hutchinson of Grantfield, Leominster, Herefordshire, has presented to the Museum the collection, contained in four cabinets, of British Lepidoptera made at Leominster by her mother and other members of the family, mostly between 1860 and 1900, though Miss Hutchinson has added to it odd specimens and notes up to 1936. The specimens number some 10,000, and included with them are Miss Hutchinson's note-books in which all the records are kept. Among donations to the Geological Department is one from Mr. C. T. A. Gaster, who collected the material during many years of intensive study of the chalk of the South Downs. This collection includes 10,000 Polyzoa, 3,200 Echinoderms, 700 Sponges, 360 Annelids, 85 Mollusca, and 450 Brachiopods, and forms a valuable source of information on the succession of faunas in the Chalk. The Mineral Department has acquired by gift from Dame Maria Ogilvie Gordon, a carefully labelled series of rocks and minerals which were collected by her in the Monzoni district, Val di Fassa, Italy. She first visited this region in 1891 when on Baron von Richthofen's geological excursion. Since then she has carefully studied the structure of the western Dolomites and has made a geological map of the whole area. The present gift is a first selection of all the original material studied. Prof. S. J. Shand, of Stellenbosch University, has given a fine series of igneous rocks from localities in South Africa, South-West Africa, and Kenya Colony.

COLONEL R. H. INGHAM CLARK has placed on permanent loan in the Botanical Department of the Museum a large collection of gums. Two enormous pieces of Kauri gum, one the largest ever discovered in New Zealand, are in the collection; and one sample of Demerara Animi is the largest example known. The collection was shown at the Paris Exhibition of 1878. Since then it has been added to mainly by F. W. Fell Clark. Many of the gums are no longer obtainable, the demand having considerably decreased from a commercial point of view, and the 'workings' have reached a point where there is too much water to make the mining of gum a commercial proposition. A collection of about 1,100 Phanerogams and 50 Cryptogams from around Kangersdlugssuck at the southern end of Knud Rasmussens Land, East Greenland, has been received from Dr. H. G. Wager (British East Greenland Expedition). The importance of the collection is that it was made from inland nunataks, which has only once previously been achieved. Dr. Wolfgang von Hagen has presented seventy-three Phanerogams and nine Cryptogams from the Galapagos Islands. The Department has also received the first consignment of 420 plants collected on the Swedish Expedition to South Africa and Southern Rhodesia (1930–31) by Thore C. E. Fries, T. Norlindh and H. Weimarck.

British Science Guild

A BRIEF review of the formation and activities of the British Science Guild, including a list of subjects investigated by its committees, details of the Norman Lockyer and Alexander Pedler Lectures, the Research and Development Lectures and other lectures arranged by the Guild has recently been issued as a final statement to members. Some notes on the Parliamentary Science Committee, which has been constituted a separate body and is not included in the scheme of incorporation with the British Association, are also given. The statement gives a list of the officers and members of Council at the time of incorporation with the British Association, together with the final income and expenditure account and capital account.

An Astronomical Handbook for 1937

IN addition to the standard astronomical ephemerides, such as the "Nautical Almanac", there are published each year a few handbooks which supply, for the non-technical inquirer, astronomical tabular matter and information that is generally wanted concerning the aspects of the heavens. The 1937 edition of Flammarion's "Annuaire Astronomique" (Paris: Ernest Flammarion, 1937. 14 francs) has for some years reached the status of a modest text-book, and is an excellent example of what a non-technical ephemeris should be. An important feature of this compilation, which runs into 450 pages, is the large number of tables and diagrams, many of them conveying at a glance some fact of astronomical or of geophysical interest. This annual handbook, which is carefully revised each year so as to include the latest observations of note, should be of real use to those requiring an elementary guide to the study of the heavens.

Institution of Chemical Engineers: Medal Awards

AT the fifteenth annual corporate meeting of the Institution of Chemical Engineers, held on February 26, the following medal awards were made: Osborne Reynolds Medal to Viscount Leverhulme in recognition of his work in the interests of chemical engineering during the year 1936, especially as president of the Chemical Engineering Congress; Moulton Medal to Dr. D. M. Newitt for the paper on "The Design of Vessels to withstand High Internal Pressures" as the most valuable paper among those read before the Institution during the year (1936); Junior Moulton Medal and prize of books to Mr. Roy F. Hayman for the paper on "Corrosion", read before the Graduates and Students Section in 1936; William Macnab Medal to Mr. G. U. Hopton, for meritorious work in the Associate-Membership Examination, 1936. At this meeting Dr. William Cullen was elected president of the Institution for the year 1937.

Fitzwilliam Museum, Cambridge: New Director

MR. L. C. G. CLARKE, curator of the Museum of Archæology and Ethnology, Cambridge, has been appointed director of the Fitzwilliam Museum, Cambridge, in succession to Sir Sydney Cockerell. Mr. Clarke was appointed curator of the Museum of Archæology and Ethnology in 1922, succeeding Baron Anatole von Hügel. He has travelled extensively in Central and South America, and in Abyssinia and other parts of Africa; and he has conducted archæological excavations in New Mexico and Hungary. In addition to being recognized as an authority on the material cultures and art of the peoples of South America, he is well known as a connoisseur in art.

International Management Congress

PRELIMINARY notice has just been received of the seventh International Management Congress, which will take place in Washington during September 1938. This will be the first of the series to be held in the United States, and it will provide the most favourable opportunity which is likely to occur for many years of seeing examples of the application of American management methods to business undertakings. Two main themes are proposed for the Congress: (*a*) recent developments in scientific management; (*b*) economic and social aspects of scientific management. The papers which are accepted will be classified under one of the following six heads: administration, production, distribution, personnel, agriculture, the home. It is proposed to preface the discussions by an authoritative review of the history of scientific management up to the time of the London Congress, which will be based on reports previously prepared by each of the national committees. The organization of the British participation in the Congress is in the hands of the newly formed British Management Council, the Secretary of which is Mr. U. Baliol Scott, Armour House, E.C.1.

Scholarships in Electrical Engineering

APPLICATIONS, which must be received not later than April 15, are invited for the following scholarships awarded by the Institution of Electrical Engineers. Inquiries for full particulars and nomination forms (specifically mentioning the name of the scholarship) should be addressed to the Secretary of the Institution, Savoy Place, London, W.C.2. *Duddell Scholarship* (value £150 per annum, tenable for three years), open to British subjects under nineteen years of age on July 1, 1937, who wish to take up a whole-time day course in electrical engineering. *Ferranti Scholarship* (value £250 per annum, tenable for two years), open to British subjects under twenty-six years of age on July 1, 1937, who are students or graduates of the Institution of two years standing and desire to carry out whole-time research or post-graduate work of an electrical engineering nature. *Swan Memorial Scholarship* (value £120, for one year), open to British subjects under twenty-seven years of age on July 1, 1937, who desire to carry out whole-time research or post-graduate work of an electrical engineering nature. *Silvanus Thompson Scholarship* (value £100 per annum and tuition fees, tenable for two years), and *William Beedie Esson Scholarship* (value £120 per annum, tenable for two years, renewable in approved cases for a third year), for works employees, open to British subjects less than twenty-two years of age on July 1, 1937, for wholetime instruction in electrical engineering at an approved university or technical college.

New Fellows of the Royal Society of Edinburgh

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 1, the following ordinary fellows were elected: Dr. A. J. G. Barnett, lecturer in chemistry, Education Department, Nigeria; Mr. Biswas Kalipada, curator of the Herbarium, Royal Botanic Garden, Calcutta; Dr. J. J. Black, manufacturing chemist, Edinburgh; Prof. Max Born, Tait professor of natural philosophy, University of Edinburgh; Mr. G. B. Brook, chief chemist, British Aluminium Co., Ltd., London; Mr. A. G. R. Brown, manager and actuary, Life Association of Scotland, Edinburgh; Mr. C. J. Cousland, Edinburgh; Dr. W. S. McR. Craig, Medical Officer, Ministry of Health, Whitehall, London; Dr. S. C. Dhar, head of Mathematics Department, College of Science, Nagpur, C.P., India; Dr. H. P. Donald, research assistant, Institute of Animal Genetics, University of Edinburgh; Prof. D. M. Dunlop, Christison professor of therapeutics, University of Edinburgh; Prof. R. C. Garry, Department of Physiology, University College (University of St. Andrews), Dundee; Dr. A. R. Gilchrist, assistant physician, Royal Infirmary, Edinburgh, and lecturer in therapeutics, University of Edinburgh; Dr. G. Green, lecturer in applied physics, University of Glasgow; Mr. W. A. F. Hepburn, director of education, Ayrshire Education Authority; Prof. P. R. Kirby, professor of music and musical history, University of the Witwatersrand, Johannesburg, South Africa; Dr. P. C. Koller, cytologist, Institute of Animal Genetics, University of Edinburgh; Mr. W. O. Leitch, civil engineer, Edinburgh; Dr. H. W. Melville, fellow of Trinity College, Cambridge; Mr. James Miller, Stirling; Lieut.-Colonel J. Morison; Mr. Roy Nasmith, United States Consul in Edinburgh; Mr. T. T. Paterson, fellow of Trinity College, Cambridge; Dr. J. D. Pollock, Edinburgh; Dr. B. N. Prasad, lecturer in pharmacology, P. W. Medical College, Bankipore, P.O., Bihar, India; Mr. F. I. G. Rawlins, scientific adviser to the Trustees of the National Gallery, London; Dr. M. Ritchie, assistant lecturer in chemistry, University of Sheffield; Mr. J. W. Robertson, headmaster, Central School, Aberdeen; The Hon. Lord Robertson, a senator of the College of Justice, Edinburgh; Dr. W. R. Russell, assistant physician to the Royal Infirmary and to the Deaconess Hospital, Edinburgh; Dr. J. K. Slater, assistant physician, Royal Infirmary and physician to the Deaconess Hospital, Edinburgh; Dr. A. M. Smith, lecturer in agricultural chemistry, University of Edinburgh; Mr. H. G. Smith, assistant, Department of Natural History, University of Aberdeen; Dr. H. M. Steven, divisional officer, Forestry Commission, Aberdeen; The Right Hon. the Earl of Suffolk and Berkshire, Eskbank, Midlothian; Mr. J. G. Tait, scholar of Peterhouse College, Cambridge and formerly principal, Central College, Bangalore, India; Dr. H. Tod, biochemist, West House, Edinburgh; Mr. M. McK. Turnbull, lecturer in banking, University of Edinburgh; Prof. E. M. Wright, Department of Mathematics, University of Aberdeen; Mr. A. W. Young, Writer to the Signet, Edinburgh.

Announcements

WE regret to announce the death, which occurred on February 27, at the age of seventy-one years, of Mr. W. Taylor, O.B.E., F.R.S., past president of the Institution of Mechanical Engineers, director of Messrs. Taylor, Taylor and Hobson, Ltd., optical instrument manufacturers, Leicester.

MR. R. H. BECKETT, director of public instruction, Bombay Presidency, in 1930–34, has been appointed registrar of the Indian Institute of Science, Bangalore. The appointment follows on the publication of the report of the second quinquennial reviewing committee of the Institute under the chairmanship of Sir James Irvine (see NATURE, Dec. 5, 1936). Mr. Beckett was a student of the Imperial College of Science, and entered the Indian Educational Service in 1906. He was appointed principal of the College of Science, Nagpur, in 1908, and became officiating director of public instruction and secretary for education to the Government of the Central Provinces in 1924. Mr. Beckett was made C.I.E. in 1928 and C.S.I. in 1934.

ACCORDING to *Science and Culture* (2, No. 8; Feb. 1937), Rao Bahadur K. N. Dikshit has been appointed director general of archæology in India in succession to Mr. J. F. Blakiston. Rao Bahadur Dikshit was appointed superintendent of the eastern circle in 1920; in 1930 he was appointed deputy director general for exploration and in 1935 deputy director general of archæology. He has successfully carried out archæological excavations at Mohenjo-daro, Paharpur, Mahasthan, Rangamati and a number of other places.

THE Grant Fellows in Planning at the Edinburgh School of Art recently displayed the results of two years' research in an exhibition under the aegis of the Royal Scottish Societies of Artists in Water Colour. The exhibition has now been brought to London and is to be opened at the Housing Centre, 13 Suffolk Street, Pall Mall, S.W.1, at 4 p.m. on March 10 by the Right. Hon. Arthur Greenwood.

THE Rudolf Virchow Medal has been awarded to Prof. Hans F. K. Gunther by the Berlin Society of Ethnology, Anthropology and Primeval History.

DR. HUGH S. CUMMING, surgeon-general, United States Public Health Service, has been awarded the Marcellus Hartley Gold Medal for eminence in the application of science to public welfare.

PROF. P. UHLENHUTH has been awarded the Cothenius Medal of the German Academy of Natural Philosophers for his researches on immunity and infectious diseases.

DR. FRANK G. BOUDREAU, chief of the League of Nation's service of epidemiological intelligence and public health statistics, has been appointed executive director of the Milbank Memorial Fund in succession to the late Edgar Sydenstricker.

THE American Congress of Therapeutics has awarded the "Gold Key of Merit" and the title of honorary member to Dr. Stefan Jellinek, professor at the University of Vienna, for his work in electropathology and his important contributions to the scientific development of physical therapeutics.

A MINISTRY OF HEALTH has recently been established in Paraguay by a presidential decree, under the direction of Dr. Pedro Duarli Ortellado.

THE General Education Board of the Rockefeller Foundation has given the University of Chicago three million dollars for the development of the Medical School and the improvement of the University generally.

THE Hungarian Society of Public Health, one of the oldest public health associations in the world, recently celebrated the fiftieth anniversary of its foundation, when the Archduke Josef Franz delivered the opening speech under the presidency of Dr. Daranyi.

IN spite of the vigorous campaign carried on throughout the country, the birth-rate in Italy fell from 23·1 per 1,000 in 1935 to 22·2 per 1,000 in 1936. The excess of births over deaths in 1936 was 372,577 (8·7 per 1,000) as compared with 401,833 (9·4 per 1,000) in 1935.

THE International Homœopathic League will hold a congress in Berlin on August 8–15. Further information can be obtained from the Office of the Congress, Tauentzienstrasse 7, Berlin, W.50.

THE third International Congress of Radiology will be held in Palmer House, Chicago, on September 13–17. The official languages will be English, French and German. The subscription is 20 dollars. Information regarding communications can be obtained from the president, Dr. Arthur M. Christie, 1835 Eye Street, Washington, D.C., and all other information from the General Secretary, 2561 North Clark Street, Chicago.

THE Child Guidance Council has arranged a vacation course on child psychology to be held on March 31–April 9 at Berridge House, Fortune Green Road, London, N.W. The programme will include lectures on normal emotional growth and its bearing on good mental health (Dr. J. R. Rees, Dr. Henry Wilson, Dr. Grace Calver), clinical experience in dealing with behaviour difficulties (Dr. William Moodie, Dr. R. MacCalman, Dr. Hamilton Pearson), and intellectual development and its relation to problems of learning (Miss L. G. Fildes, Mrs. Susan Isaacs, Miss M. MacTaggart and Miss C. Simmons). Further information can be obtained from the Secretary, Woburn House, Upper Woburn Place, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

The Constant of Gravitation

WITH regard to Prof. P. A. M. Dirac's recent letter to NATURE[1], I have shown, in various contexts[2] that the relation between γ, the 'constant' of gravitation, and t, the epoch, is given by

$$\gamma = c^3t/M_0, \tag{1}$$

where M_0 is the *apparent* mass of the fictitious homogeneous universe. (The *actual* mass must be infinite.) With $t = 2 \times 10^9$ years, this gave $M_0 = 2{\cdot}4 \times 10^{55}$ grams = mass of $1{\cdot}5 \times 10^{79}$ protons. Two points of interest (amongst others) emerge from the treatments I have given. First, (1) is a purely macroscopic formula, having no connexion with atomicity. It is derived from purely kinematic considerations, involving no appeal to any empirical dynamical laws, still less to atomic laws. In papers already communicated for publication, I have extended the application of (1) to all local gravitational situations and derived the inverse square law of gravitation in relativistic form in flat space, again without recourse to empirical appeals, by kinematic methods.

Secondly, the actual meaning of M_0 is that it is the mass which would occupy the sphere of radius ct with matter of density ρ_0, the density at the observer, and so

$$M_0 = \frac{4}{3}\pi(ct)^3\rho_0 = \frac{4}{3}\pi m_0 B, \tag{2}$$

where B is a constant depending on the mode of counting of fundamental particles (for example, as spiral nebulæ or smaller particles) and m_0 is the mass-number assigned to a fundamental particle. It has been shown[3] that the mass-number assigned to *any* particle may be regarded as a constant of integration. M_0 is therefore a constant. Thus there is no inference as to the creation of matter, inside stars or anywhere else. It is clear in fact that the considerations leading to (1) could never lead to any such inference, for the complete inverse square law of local gravitation (of which (1) is an intrinsic part) emerges from arguments depending on the use of Boltzmann's equation, which is a kinematic consequence of the conservation of particle numbers for any given system. We have thus $\gamma \propto t$.

When we transform the scale of time-measurement from kinematic time t to the dynamical time τ corresponding to the present epoch t_0 by the formula

$$\tau = t_0 \log (t/t_0) + t_0, \tag{3}$$

and adjust the measures of all derived quantities accordingly[4], γ reduces to a constant γ_0, and is given by $\gamma = \gamma_0 (t/t_0)$. The usually adopted constancy of γ_0 is thus connected with our habitual use of a dynamical scale of time.

Relation (3) is not, of course, a transformation of co-ordinates but a re-graduation of the fundamental observers' clocks. The associated transformation of co-ordinates is readily found. It then appears[5] that this transformation leads to the relation $ds = e^{(\tau-t_0)/t_0}\, d\sigma$, where $d\sigma^2 = d\tau^2 - c^{-2}d\varepsilon^2$ and $d\varepsilon^2$ is the metric of the static, infinitely extending hyperbolic space into which the interior of $r = ct$ transforms. The epoch co-ordinate τ of *any* event is an invariant, the same by whatever fundamental observer it is measured, and it enjoys all the properties of a world-wide Newtonian time; and $d\sigma$ may be taken as the interval between two events with the same justification as ds. These results confirm Dirac's remarks at the end of his letter.

Note added in proof, Feb. 26. Complete agreement between Dirac's results and kinematic cosmology can be obtained, and his proportionalities $M \propto t^2$, $\gamma \propto t^{-1}$, replaced by $M = \text{const.} = M_0$, $\gamma \propto t$, if we take the 'electrostatic' constant γ' in the inverse square law to be proportional to t; γ' is, of course, usually taken as unity. This is formally the same as taking $e^2 \propto t$. The t-dynamics then gives the radius of the Bohr atom as proportional to t, and a material rod is 'rigid' on the τ-scale. Electrostatic forces then become to some extent analogous to gravitational forces, and might be discussed kinematically by examining the properties of an expanding sphere of mingled positive and negative particles.

E. A. MILNE.

Oxford.
Feb. 23.

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[1] NATURE, 139, 323 (Feb. 20, 1937).

[2] "Relativity, Gravitation and World-Structure' (1935), pp. 103–4. See also pp. 130, 145, 187 These results depended on $G(1) = -1$, but the deeper result $G(\xi) \equiv -1$ has since been obtained. See also *Proc. Roy. Soc.*, A, 154, 43; 153, 75 (1936).

[3] *Proc. Roy. Soc.*, A, 154, 31 (1936).

[4] *Proc. Roy. Soc.*, A, 158, 333, 340 (1937).

[5] *Proc. Roy Soc.*, in press. (The invariance of τ was obtained independently by Leontowski)

Scotopic Luminosity Curve and the Absorption Spectrum of Visual Purple

ALTHOUGH it is generally accepted that visual purple plays an essential part in the process of scotopic vision, attempts[1] at relating the *human* scotopic luminosity curve (for equal energy spectrum) with the extinction (absorption) coefficient curve of *amphibian* or *mammalian* visual purple have shown a difference in the wave-length position of the maxima. Hecht and Williams[2], using a 'constant stimulus' method, found that the maximum of this luminosity curve was at 510 mμ. This was a mean value for forty-eight young observers, and there was little variation. Abney and Watson[3], using a threshold intensity method, found that the maximum of the luminosity was at 505 mμ for three monochromats.

Most experimenters have found maxima for the extinction coefficient of visual purple solutions between 500 mμ and 504 mμ. König[4] found a maximum at 500 mμ for human visual purple. Recently, Lythgoe[5], using an improved technique[6] and carefully purified specimens, has found the maximum for *Rana esculenta* to lie at 502 mμ. His measurements were made against a blank of the solvent, a solution of digitonin (colourless).

Hecht and Williams explain the difference in the position of the maximum of luminosity and of extinction by supposing that in the eye the visual purple is dissolved in a substance of high refractive index, when according to Kundt's rule, the absorption spectrum would be displaced towards the red with respect to an aqueous solution of visual purple. Kundt's rule is untrustworthy, and in any event, before a comparison can be made, it is essential to consider the physical (dimensional) relation between the two factors, luminosity and light absorption.

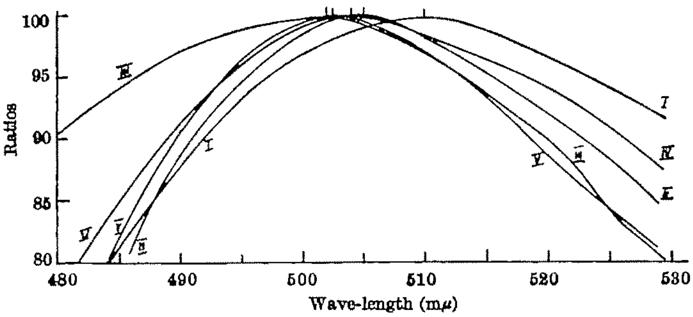

Fig. 1.

Scotopic luminosity curves. Energy basis, I, Hecht and Williams, and II, Abney and Watson; Quantum basis, IV, Hecht and Williams, and V, Abney and Watson. Curve III shows the extinction coefficient of visual purple, Lythgoe.

Evidence continues to accumulate indicating that the primary part of the physico-physiological process in scotopic vision is photochemical[7]. Thus the relative luminosity, R_λ, should be represented not on the basis of an equal *energy* spectrum but on that of an equal *quantum intensity* spectrum. This may be effected by multiplying the figures for the relative scotopic luminosity (energy basis) by the value of the quantum at the wave-length in question. This has the effect of shifting the maxima from 510 mμ and 505 mμ to 504 mμ and 502 mμ respectively, as shown on a large scale in Fig. 1. Thus reduction to the quantum basis discloses that the curve of the extinction coefficient of visual purple and the curve of relative scotopic luminosity have effectively coincident maxima. This supports the contention that the primary process in scotopic vision is the absorption of light *quanta* by visual purple.

In order to extend the relation between the two curves it is necessary to consider the following points. According to the above definition of the relative luminosity, equality of the stimuli produced by light of two different wave-lengths implies equality of the values of $R_\lambda I_\lambda$, where I_λ is the intensity of light in quanta per second at the wave-length λ, given by the instrument used. If almost any simple photo-chemical mechanism were assumed, the stimulus would be a function of the intensity of light *absorbed*, I_a, at each wave-length, that is, equality of stimulus arises from an equality of I_a. The value of R_λ would, therefore, be proportional to I_a/I_λ, which in turn is given by

$$I_a/I_\lambda = 1 - e^{\alpha c} \quad . \quad . \quad . \quad (1)$$

where c is the areal concentration in chromophore groups[7] per sq. cm. and α the extinction coefficient per chromophoric group. αc is simply 2·3 times the usual optical density ($\log_{10} I_0/I_T$). If, therefore, we know the optical density of visual purple in the dark-adapted eye for wave-length 502 mμ, we can calculate the relative intensities of the light absorbed at the other wave-lengths.

Unfortunately, there are no trustworthy measurements of this density. Konig[4] extracted visual purple from a human eye in an amount sufficient to cover the retina to an optical density of 0·018 (λ = 500 mμ). This value is probably much too low owing to decomposition before extraction and incomplete recovery of the visual purple. In the course of our experiments with visual purple solutions carried out in conjunction with Dr. R. J. Lythgoe, we have calculated that at complete dark adaptation the optical density in a frog's eye (*Rana esculenta*) at the maximum is not less than 0·1. For the purposes of argument a value of 0·1 will be assumed for the dark-adapted human eye, but should this value be incorrect by as much as a factor of two, the argument below is not appreciably affected.

The densities for other wave-lengths have been obtained by combining the relative extinction coefficient curve with the above value for the density at 502 mμ (that is, solving for c equation (1); in arbitrary units). The fraction of the incident light which is absorbed, I_a/I_λ, has been calculated relative to the value at 502 mμ (where it has been taken as 100 units), and the results plotted as shown in Fig. 2.

It will be seen that on the red side of the maximum the 'light absorbed' curve agrees well with the luminosity curve of Abney and Watson and in part with that of Hecht. If the value for the density of the visual purple in the eye is an acceptable one, the contention that the primary process in scotopic vision is photochemical is strengthened by this agreement.

On the blue side, the luminosity curve lies well below the 'light absorbed' curve. This would be expected for a number of reasons, only a few of which need be mentioned here. It is well known that yellow substances are present to a considerable extent in the retina. These are probably visually insensitive, but will affect the luminosity curve by absorbing the light below a wave-length of about 500 mμ, thus reducing the amount absorbed by the visual purple in this region. This probably accounts for most of the difference in the curves. Yellow substances in the eye lens may sometimes have an important effect.

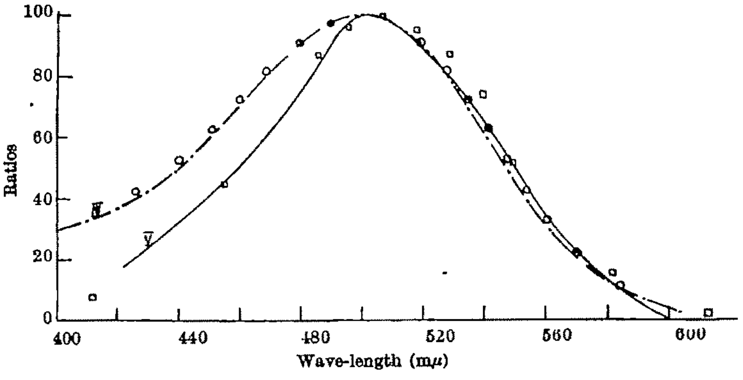

Fig. 2.

Curves III and V as in Fig. 1. Squares, as Curve IV, Fig. 1. Circles, light absorbed by visual purple (calculated).

If in place of the absorption curve as shown, one uses the curve from which has been subtracted the absorption of the bleached solution (as is usually done), the difference in the blue is much reduced. Such a 'correction' is, however, meaningless, as visual purple bleaches to a yellow substance, and the resultant curve depends largely on the yield and stability of this substance. The yellow products of visual purple may themselves be partly responsible for the low luminosity in the blue. The curve obtained by Dr. Lythgoe may include absorption due to a small amount of residual impurities, but is much more trustworthy than the 'corrected' curves.

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[1] See for example Houstoun's "Vision and Colour Vision", p. 89 (Longmans Green and Co, London, 1932).

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[4] Konig, A, *Sitz. Berlin Akad.*, **2**, 577 (1894)

[5] Lythgoe, R. J., private communication.

[6] Bayliss, L. E., Lythgoe, R. J., and Tansley, K., *Proc Roy. Soc.*, B, **120**, 95 (1936).

[7] See, for example, Dartnall, H. J. A, Goodeve, C. F., and Lythgoe, R. J, *Proc. Roy. Soc.*, A, **156**, 158 (1936); Goodeve, C. F., *Proc. Roy. Soc*, A, **155**, 664 (1936)

Sharpness of the Magnetic Curie Point

EXPERIMENTS carried out in recent years on nickel and iron have led to the view that the spontaneous magnetization does not disappear suddenly at the Curie point, but that there is a definite 'tail' to the magnetization-temperature curve. The specific heat measurements of Ahrens[1], and more particularly the work on very pure nickel by Grew[2], establish beyond doubt that the energy (E) associated with the ferromagnetic state does not vanish suddenly at the Curie point, although there is probably a sharp discontinuity in the $(d^2E/dT^2, T)$ curve at this temperature. The measurement of the energy, either through the specific heat or the magneto-caloric effect, appears to us to be the only sound method of estimating the degree of spontaneous magnetization.

Recently, Svensson[3] has measured the resistance of nickel near its Curie temperature and finds a discontinuity in the temperature coefficient taking place within a temperature range so small as 0·1° C. One of us (H. H. P.) has recently repeated and verified this result, and has also shown that from the Curie point (357° C.) up to a temperature of 1,000° C., the resistance-temperature curve is concave to the temperature axis with a very marked curvature for some 30° or more above the Curie point. We wish here to suggest a means of reconciling the results of the experiments on the change of magnetic energy with those on the change of resistance.

The magnetic state is determined by the degree of order among the electron spins, the disappearance of the ferromagnetism being associated with the break-up of the Weiss domains. Now the magnetic energy must depend on the interactions between spins at close range or, in other words, on short-distance order. On the other hand, since the mean free path of an electron in nickel at its Curie point is of the order of 20 times the interatomic distance, the resistance will depend on long-range order. If at a definite temperature (Curie point), order suddenly ceases to extend over domains of more than about 8,000 atoms, a kink in the resistance-temperature curve will be obtained; but owing to the presence of smaller ordered domains the magnetic energy will not have vanished completely.

The effect of the subsequent break-up of these smaller domains is to produce the 'tail' of the magnetization-temperature curve, and a marked curvature in the resistance-temperature curve in the region immediately above the Curie point.

The continued concavity of the resistance curve towards the temperature axis up to 1,000° C. is due to quite another cause; it occurs also for paramagnetic metals, and has already been explained by one of us[4].

It may be noted that Stoner[5] has used a similar idea of small ordered domains persisting above the Curie temperature to explain certain apparent anomalies in the magneto-caloric effect.

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[2] Grew, *Proc. Roy. Soc.*, A, **145**, 509 (1934).

[3] Svensson, *Ann. Phys.*, (5), **28**, 97 (1935).

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Constitution of the Keratin Molecule

FROM a study of the elastic properties of wool fibres in solutions of varying hydrogen ion concentration, Speakman[1] has argued that the long peptide chains of wool are bridged by salt linkages formed from the acid side chains of aspartic and glutamic acids, and the basic side chains of arginine, lysine and histidine. In addition, chemical equivalence between the *free* acid and basic side chains was deduced from the form of the curve relating the ease of fibre extension to the pH of the medium. Such is the salt linkage theory, for which support was later found in the titration curves of wool[2] and feather keratins[3], as well as in deductions concerning the influence of the salt linkages on the reactivity of the disulphide bond in strained animal fibres[4]. Unfortunately, however, the amounts of aspartic and glutamic acids isolated from wool and goose feather by Abderhalden[5] are insufficient to account for the basic side chains as well as amide nitrogen. The difficulties of protein analysis are so great that the salt linkage theory is not called into question by Abderhalden's results, but it was felt desirable to augment the supporting evidence already available by direct proof based on new determinations of the dicarboxylic acids in wool and seagull quill, which may be regarded as typical keratins.

Using modifications of Foreman's[6] and Jones and Moeller's[7] procedures, which will be described elsewhere, the following data, corrected for nitrogen loss at different stages of the investigation, were obtained for Cotswold wool.

Acid	Amount isolated expressed as: per cent on weight of wool	mgm.N/gm. of wool
Glutamic acid	15·27	14·54
Aspartic acid	7·27	7·65
	Total N =	22·19

When uncorrected for loss of nitrogen, the total dicarboxylic acid nitrogen was 20·75 mgm./gm., so that correction, being small, is justified. The amide nitrogen content of the wool was found to be 13·7 mgm./gm., leaving dicarboxylic acid equivalent to 8·49 mgm./gm. available for combination with the basic side chains. Taking Vickery and Block's[8] determinations of the basic amino acids in wool, the excess dicarboxylic acid required for combination according to the salt linkage theory is 8·55 mgm.N/gm. Vickery and Block's results are probably low, but even if the maximum combining capacity of wool for hydrochloric acid is taken as a measure of the basic amino acid content, the amount of dicarboxylic acid needed for combination is only 11·2 mgm.N/gm. In other words, we have succeeded in isolating 22·19 out of the maximum possible requirement of 13·7 + 11·2 = 24·9 mgm./gm. of dicarboxylic acid nitrogen.

The methods employed in the preceding investigation were evolved during a preliminary attempt to determine the dicarboxylic acid content of seagull quill. According to the salt linkage theory, the quill should contain 20·6 mgm./gm. of dicarboxylic acid nitrogen, comprising 14·9 mgm./gm. for amide nitrogen and 5·7 mgm/gm. for basic side chains as deduced from the acid combining capacity. In the case of goose feather, however, Abderhalden[5] succeeded in isolating only 2·3 per cent of glutamic acid and 1·1 per cent of aspartic acid, together equivalent to 3·4 mgm.N/gm. When corrected for nitrogen loss as before, the quantities isolated in the present investigation were as follows:

Acid	Amount isolated expressed as:	
	per cent on weight of feather	mgm N/gm. of feather
Glutamic acid	9 72	9·26
Aspartic acid	6·57	6·92
Not identified	—	0·96
		17·14

The amounts of aspartic and glutamic acids are an improvement on Abderhalden's values, and the agreement between the nitrogen content of the isolated dicarboxylic acids and the requirement of the salt linkage theory is sufficient to establish its validity for feather, as well as for wool, if due account is taken of the preliminary character of the feather investigation.

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Feb. 10.

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[3] Speakman and Townend, *Trans. Faraday Soc.*, 32, 897 (1936)

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Chromatin Arrangements in Spore-forming Bacilli

WE have recently made a cytological study of several species of spore-forming bacilli, using the vital staining method of Nakanishi as modified by Stoughton[1]. This has resulted in two observations which help to explain (1) the confusion of ideas as to the changes in cell structure accompanying spore-formation, and (2) the role of the spore in the cycle of development of the bacillus.

(1) In young cultures (purified by plating, followed by single cell isolation), prior to the appearance of spores, many cells show a sharp lateral division into two sections depending upon a difference in affinity for the stain (for example, neutral red chloride). One section (usually rather less than half the cell) is deeply stained, the other section very lightly and in many cases apparently not at all. This appearance (shown by the top cell in the photomicrograph reproduced as Fig. 1, *a*) has been found to be typical in the case of six spore-formers—two isolated from silage, one from soil, one found as a contaminant in a medium and two stock cultures (*B. subtilis* and *B. megatherium*)—otherwise easily distinguishable on physiological grounds.

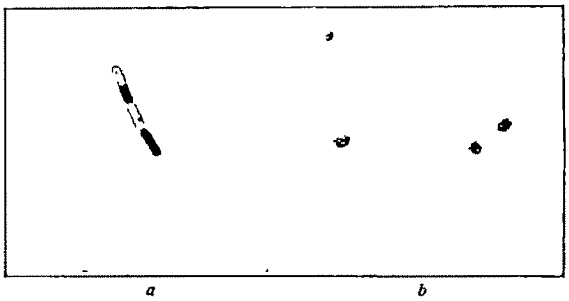

Fig. 1.

Observations on cultures of a slightly more advanced age indicate that the cell containing the two sections undergoes fission in the usual way, giving rise to one cell capable of staining deeply and one which has little or no affinity for stain (as shown by the two lower cells in Fig. 1). Further observations in the case of three of the above cultures have led us to the conclusion that the two kinds of cells thus produced differ in their subsequent cytological development, resulting in each case in a cell containing an endospore but with a different structure extraneous to the spore. These alternative methods of forming endospores shown by the same species of organism may possibly explain to some extent the divergence in descriptions of the process of spore-formation by different authors.

(2) As is well known, the fully formed bacterial spore, examined by ordinary methods, appears as a refractile body resistant to the entry of stains, and it has been generally assumed that it is in fact homogeneous and represents a resistant resting stage in the life of the bacillus. So far as we are aware, there is no record of experimental evidence to refute this view, and the only suggestion found in the literature is one by Mellon (quoted by Hadley[2]) that the bacterial spore may be a 'cover' for nuclear reorganizations.

In the case of two of the above species of spore-formers, both isolated from silage, structures visible by vital staining methods have been followed at frequent intervals until the cultures were several weeks old. This has disclosed the fact that endospores, though certainly refractile for some time after formation and subsequent release from the enclosing cells, may later take up the stain and reveal a deeply staining granular structure. This shows rearrangement into several definite forms over a considerable period of time. In some spores showing an internal structure the stain is absorbed quickly, in others the structure appears more slowly after leaving the spores in contact with the stain. One such appearance is shown in the photomicrograph reproduced as Fig. 1, *b*.

These appearances suggest that, in some instances at least, the bacterial spore certainly has a function other than that of a resistant resting stage, namely, that it provides an opportunity for rearrangement of chromatin material.

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Development *in vitro* of the Mammalian Gonad

IN recent experiments the entire mammalian gonad has been successfully cultivated *in vitro* and the explants continued to differentiate during cultivation.

The ovary and testis from young and embryonic rats and mice were grown by the watch-glass method on the surface of a clot composed of equal parts of fowl plasma and fowl embryo extract. For each culture, one gonad was fixed as a control.

A typical maturation division figure was observed in an explanted ovary from a four-day (post-embryonic) rat after 9 days' cultivation (Fig. 1). The appearance of the figure was preceded by an actual growth of the ovum.

Small, normal Graafian follicles differentiated *in vitro* in the ovaries of two 19-day rat embryos and of three new-born mice, although the controls showed that at the time of explantation the germinal tissue was in the form of sex cords and contained no Graafian follicles. Some of these follicles remained healthy after twenty-two days *in vitro*. Many residual ova survived *in vitro* for an equally long time. After a month *in vitro*, the organ degenerated.

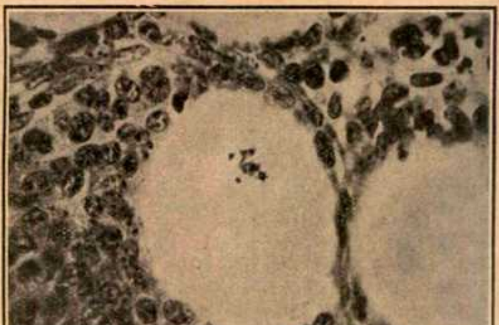

Fig. 1.

OVARY FROM A FOUR-DAY (POST-EMBRYONIC) RAT AFTER 9 DAYS' CULTIVATION *in vitro*. (ALLEN'S MODIFICATION OF BOUIN'S FLUID; MAYER'S HAEMATOXYLIN. × 640.)

The testis also grew and differentiated *in vitro*. In the explanted testis of a new-born mouse, spermatocytes in the typical pachytene phase of the meiotic prophase had developed *in vitro* after 11 days' cultivation (Fig. 2), although only spermatogonia were present at the time of explantation. Similar spermatocytes were also observed in the explanted testis of a 17-day mouse embryo after 16 days *in vitro*.

So far, spermatogenesis *in vitro* has always stopped at the pachytene stage of meiosis, although female germ cells growing under the same conditions seem to pass through this phase without difficulty. This point requires further investigation.

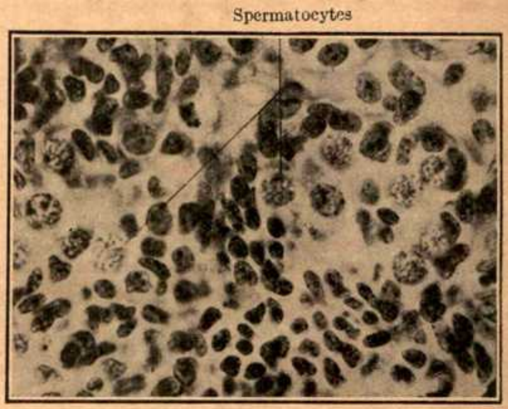

Fig. 2.

TESTIS OF A NEW-BORN MOUSE AFTER 11 DAYS' CULTIVATION *in vitro*. TYPICAL SPERMATOCYTES SHOWING CHROMATIN FIGURES OF THE EARLY MEIOTIC PROPHASE HAVE DIFFERENTIATED *in vitro*. (ALLEN'S MODIFCATION OF BOUIN'S FLUID; MAYER'S HAEMATOXYLIN. × 640.)

Many seminiferous tubules maintained their original form for as long as 17 days' cultivation, but the germ cells mostly degenerated by the twentieth day *in vitro*.

The results so far obtained have provided a new experimental approach to several problems of sex physiology.

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Metamorphosis of the Larva of *Ostrea edulis*

ALTHOUGH we now have a complete description of the fully-developed larva[1] of the European oyster (*Ostrea edulis*), we have as yet no account of the metamorphosis which takes place when the larva attaches itself and becomes the settled spat. The smallest spat yet described is that figured by Yonge[2]. The shell of this individual measured 1·2 mm., whereas the shells of fully-developed larvæ before settlement average only 0·30 mm. There is therefore a considerable gap which requires to be bridged by the description of smaller spat.

I have been able to obtain a number of such early stages attached to glass slides, and, with the addition of further material during the coming season, it may be possible to prepare a complete description of the metamorphosis. The material already collected shows the evolution of the posterior adductor as the one shell muscle, and the development of the gills. The fully-developed oyster larva, as described by Erdmann[1], possesses anterior and posterior adductor muscles about equal in size and symmetrically placed with regard to the hinge. At this stage the rudiments of six gill filaments on the left side are shown by Erdmann. The earliest settled spat that I have yet examined, which possesses the larval shell (prodissoconch) only, without any fringing growth (dissoconch), has seven gill filaments on this side. In this spat the anterior adductor already shows reduction and, with the increase in size of the posterior adductor, the ratio between the two is already 3 : 2 in favour of the latter.

During the first eighteen hours after settlement, the spat retains the 'eyespots' which are so characteristic of the fully-developed larva, and such 'eyed' spat usually have eight gill filaments on the left side with a suggestion of the ninth. The 'eyespots' disappear within twenty-four hours of settlement, and at forty-eight hours a fringe (dissoconch) has been added to the larval shell. The spat at about forty-eight hours after settlement measures about 0·35 mm. and possesses ten gill filaments on the left side, while still showing distinct vestiges of the foot and velum. The fate of these larval organs in the American oyster (*Ostrea virginica*) has been described by Stafford[3], but we have no information concerning their fate in *Ostrea edulis*. The eleventh, twelfth and thirteenth gill filaments appear on the left side before the spat is ninety hours old, and such spat usually show the anterior adductor reduced to a few fibres at the edge of the shell, or absent altogether. The posterior adductor has increased in size and its point of attachment has moved ventrally until it lies almost outside the prodissoconch attached to the dissoconch, the definitive shell of the adult. Such ninety hours old spat may be 0·6 mm. in diameter, that is, with a shell twice the diameter of that of the larva. The foot and velum are completely absorbed and there are 13 gill filaments on the left and 7 on the right. The smallest spat described by Yonge[2] had 20 filaments on the left and 13 on the right and its shell measured 1·2 mm. It is probable that it had been attached for five or six days.

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[2] Yonge, *J. Mar. Biol. Assoc.* (n.s.), **14** (1926).

[3] Stafford, "The Canadian Oyster" (1913).

Light and Breeding Seasons

IT has recently been shown by Marshall and Bowden[1] that not only duration but also intensity of illumination can affect the onset of a breeding season, and that ultra-violet as well as visible light is effective. These discoveries have an important bearing on seasonal phenomena in the tropics.

On the equator itself the length of day is always the same, and in the equatorial regions the seasonal change is small. (As my brother, Mr. S. J. Baker, points out, the difference in minutes between the longest and shortest day in the tropics may be found by multiplying the latitude in degrees by 7·2. The result is always correct within two minutes between 20° N. and 20° S.) Despite a constant or almost constant length of day, not very many equatorial birds are known to breed all the year round. One may suppose that the control is by intensity of illumination (visible and ultra-violet).

It is an interesting fact that, of those species of birds in Ceylon the breeding seasons of which are known, no fewer than eleven definitely have two breeding seasons annually, and at least sixteen other species probably behave in the same way. The length of day, of course, only rises to a maximum and sinks to a minimum once annually, but the intensity of illumination probably has two maxima in the year, at about the times when the sun passes overhead. Although these are often times of heavy rainfall, yet the mornings and early afternoons tend to be sunny. In South America in nearly the same latitude as Ceylon, it has been shown that there are two periods of maximum intensity of ultra-violet light in the year, in May and October (Chavarria and Gomezvega[2]). Similarly, Harrisson and I[3] have shown that in the tropics of the southern hemisphere the amount of ultra-violet light sinks to a low figure when the sun is near the Tropic of Cancer.

Those birds of Ceylon which have two breeding seasons commonly breed at about the times when one must suppose that the intensity of illumination is near its maxima. To take only one example, the Ceylon blackbird, *Turdus merula kinnisii*, breeds in March–April and again in September[4].

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[1] Marshall, F. H. A., and Bowden, F. P., *J. Exp. Biol.*, **13**, 383 (1936).

[2] Chavarria, A. P., and Gomezvega, P., *Amer. J. Hyg.*, **20**, 508 (1934).

[3] Baker, J. R., and Harrisson, T. H., *J. Linn. Soc.* (*Zool.*), **39**, 433 (1936).

[4] Wait, W. E., "Manual of the Birds of Ceylon" (London : Dulau, 1931).

Extent of the Ranikot Sea

WITH reference to my preliminary note[1] on the results of work by Mr. Pinfold and myself on the Eocene beds of the Punjab Salt Range, we have now determined the fact that, of the six sections of the local Eocene, the lower three (Dhak Pass Beds, Khairabad Limestone and Patala Shales) are all of Upper Ranikot age ; the Patala Shales representing later Ranikot elements than have yet been found elsewhere. The three upper sections (Nammal Shales, Sakesar Limestone and Bhadrar Beds) are of Lower to Middle Laki age, the unconformity between Ranikot and Laki being rather less on the Salt Range than elsewhere. Our paper on this subject, giving full palæontological details, will appear in due course as the first part of vol. 24 (N.S.) of the *Palaeontologia Indica*.

We have meanwhile studied the Eocene rocks of Waziristan, and the Kohat and Attock Districts, in order to determine the further extensions of these beds to the north and north-west. I also examined the late Sir Henry Hayden's collections from the Cretaceous and Eocene beds of Kampa Dzong in Tibet, due north of Calcutta. Certain of these beds were referred to the Danian by Prof. H. Douvillé in 1916 ; but Dr. G. de P. Cotter, of the Geological Survey of India, afterwards argued that they more probably belong to the Laki. I found that they are really of Upper Ranikot age, their foraminiferal fauna agreeing in closest detail with that of the Khairabad Limestone of the Punjab Salt Range.

It has thus become obvious that the Ranikot Sea, once thought to have been limited to a small area in western Sind, not only reached northwards as far as the Tirah, but also extended thence to the east over the whole length of the Himalayas, as far, at least, as the longitude of Calcutta. The peculiarly rich and characteristic Ranikot foraminiferal fauna has not, however, yet been traced far to the west; and its distinction from the contemporary faunas of Europe indicates that Indian waters formed a separate zoological province in Palæocene times. Many European species appear in the succeeding Laki, however, and the foraminiferal fauna of the Khirthar is very similar to that of the Lutetian. Thus the isolation of Indian waters during the early Tertiary appears to have been limited to the Palæocene.

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[1] NATURE, **135**, 188 (Feb. 2, 1935).

Racial Theory and Cross-breeding

CROSSES have been the great stumbling block in the path of physical anthropology. Different races can and do breed together, therefore there can be no such thing as a race of men, if by race we mean the human equivalent of a breed of dogs or horses. Anthropologists allow an exception where deserts or other obstacles isolate one lineage from another.

They overlook the possibility that man may be isolated by his own action, by his language, his custom, even by his own decision. In practice, lineages do isolate themselves for breeding purposes where there is no external necessity, just because they like to do so. Not being a physical anthropologist, I have not pursued the facts systematically from the point of view of breeding, but such facts as have come my way in the pursuit of other aims seem to raise two questions which have not been given proper consideration:

1. Is cross-breeding really common?
2. Does such cross-breeding as takes place leave much trace in the long run?

1. In a commune near Alexandria, 'Ali Ahmed 'Isa Eff. counted 53 marriages in two years, of which 23 were within the village or hamlet; 7 were outside the village or hamlet, but within the commune; 13 were outside the commune, but into neighbouring communes; 10 were into towns round about. It is common knowledge that English peasants used until recently to view with disfavour marriages with 'foreigners', that is, strangers to the village.

I can only record the impression left by a Guernsey pedigree now unfortunately lost. Marriages went on mostly within a small group of families. First cousin marriage between two of those families never failed for several generations. Of three marriages I remember outside the circle, all encountered opposition.

Writings on exogamy have encouraged the idea that it means compulsory breeding out. As a matter of fact, it is generally not a system of enforcing marriage outside the family, but of restricting it to another branch than one's own, exactly as happened between the two Guernsey families above (cf. *Genesis*, xxiv and xxviii, and my "Progress of Man", 239 ff.). The exclusiveness of Indian lineages is notorious and extreme, and they constantly split up into lineages exclusive of one another.

These are only a few of the facts.

2. Anthropologists get their impressions from middle-class practice. This class is addicted to promiscuous breeding; in fact, it may be said to be characteristic. The middle classes, however, appear to be dying out, not for the first time in history (see notably S. Dill, "Roman Society in the Last Century of the Roman Empire"). It seems doubtful whether townsfolk generally last many generations. We know that towns are constantly recruited from the country. This is particularly so in Paris. Eventually, towns dwindle and sometimes disappear altogether.

To take a concrete case. The North Central Province of Ceylon was once thickly populated all around an extensive capital. It is now reduced to a miserable remnant of peasants living in small hamlets. From whom are they descended? From the ancient city population? But we have no evidence that city populations ever return to the soil in any numbers, if at all. They can only be descended from the peasants. That is only one of countless cases.

This brings us face to face with a phenomenon which is seldom faced because it is not pleasant. Communities flare up and die down. Therefore only a small fraction carries on the breed. Who? There is every appearance that it is the peasantry, which is most given to self-imposed isolation.

We can no longer be content to note that cross-breeding occurs; we must *observe* its consequences for generations, instead of *assuming* them.

Perhaps if we do so we shall find out a great deal more than by the study of animals, which is experimental, and so works under the unnatural conditions of the laboratory. In observing man, we observe what happens in Nature. When we watch human lineages isolating themselves, we may get the clue to the segregation of species in Nature.

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Negative Protons in Cosmic Radiations

AT Asmara, magnetic lat. 11° 30′, Rossi[1] and Benedetti[2] have counted the number of coincidences between two counters mounted with their axes parallel in such a way that the plane containing them could be rotated about a parallel axis so as to make any given angle with the vertical at the point. They have measured the diminution in the number of coincidences caused by introducing lead between the counters, and also by rotating the plane of the counters so as to make various angles θ with the meridian plane. Certain conclusions follow from these experiments which we shall now deduce.

Benedetti has measured the number of coincidences in the following three cases:

Arrangement.	Thickness of lead between the counters.	Angle θ to the west.	Rate/minute.
(1)	4 cm.	0°	$0{\cdot}625 \pm 0{\cdot}010$
(2)	16 cm.	0°	$0{\cdot}575 \pm 0{\cdot}009$
(3)	4 cm.	30°	$0{\cdot}516 \pm 0{\cdot}009$

The decrease between (1) and (3) is about twice the decrease between (1) and (2). Since at the height of Asmara 12 cm. of lead corresponds in mass to the extra thickness of atmosphere in going from the vertical to $\theta = 30°$, the difference between (1) and (3) might be ascribed to the greater absorption due to the same mass of air. This possibility can, however, be excluded by the experiments of Street, Woodward and Stevenson[3], who have measured the absorption in lead, iron and marble, and of Clay and his co-workers[4], who have measured it in various substances including water. These investigators find that, to within a few per cent, all these substances absorb the hard radiation proportionately to their mass. It is impossible that air[5] should absorb essentially differently, so that we are led to the conclusion that the larger difference between (1) and (3) is due to the fact that, *before entering the atmosphere*, the number of particles arriving in a direction 30° to the west of the meridian is appreciably less than the number arriving vertically. This can only be due to the magnetic field of the earth, if there are *negatively* charged particles present.

These negative particles may be electrons or *negative* protons. The possibility that the smaller number of coincidences in (3) may be due to the intensity at the top of the atmosphere of electrons in a direction 30° west being smaller than the vertical intensity can be excluded at once, *provided these electrons behave in accordance with the theory*. For in order that this should be the case, at least the difference between (2) and (3), that is, more than 10 per cent of the number of coincidences in (2) with 16 cm. of lead between the counters, must be attributed directly or indirectly to them. It now follows from a recent paper[6] where successive processes of emission of radiation and pair-creation by γ-quanta have been treated according to quantum mechanics, that the absorption in 12 cm. of lead is so great that the number of coincidences with 4 cm. of lead, namely in case (1), should be at least a thousand-fold this difference, which is in flat contradiction to the actual observation. The results of Benedetti then force us to one of the two following conclusions.

(1) Extremely high energy electrons do not behave in accordance with the theory, and in particular, the radiation formulæ of quantum mechanics break down for these high energies.

(2) There are negative protons in cosmic radiation in considerable numbers, or alternatively, some other negatively charged particles hitherto unknown to physics.

I believe that sufficient experimental evidence,[7] direct and indirect, has accumulated by now to exclude the first possibility, particularly when taken in conjunction with the fact that the theoretical arguments showing that the theory should hold for all energies are sounder than any against the validity of the theory. It seems, then, that we are compelled to admit the existence of negative protons or new negative particles in appreciable numbers in cosmic radiation.

That we are forced to choose between the conclusions (1) or (2) is indeed not new, and follows also from a number of other observations, for example, the power some negatively charged particles have of apparently penetrating great thicknesses of lead[7]. The interest in the above considerations, however, lies in the conclusion that *negative primaries* entering the top of the atmosphere are responsible in part for the *penetrating* component of cosmic radiation.

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[1] *Phys. Rev.*, **45**, 212 (1934).

[2] *Phys. Rev.*, **45**, 214 (1934).

[3] *Phys. Rev.*, **47**, 891 (1935).

[4] *Physica*, **2**, 645 (1935); **3**, 332 (1936).

[5] Prof. Clay has kindly informed me that experiments on substances containing nitrogen show the same absorption as for other elements.

[6] Bhabha and Heitler, NATURE, **138**, 401 (1936); *Proc. Roy. Soc.*, in the press.

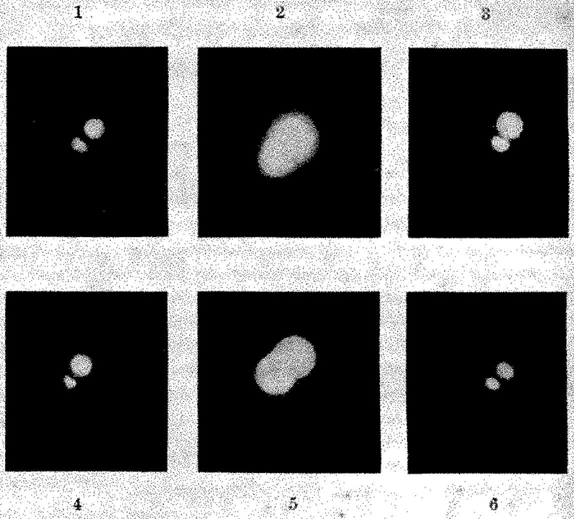
[7] Leprince-Ringuet and Crussard, *J. Phys.*, **204**, 112 (1937). Anderson and Neddermeyer, *Phys. Rev.*, **50**, 263 (1936).

Diffraction Experiments on the Resolving Power of Telescopes and Microscopes

THE diffraction of light on a circular aperture in a thin opaque screen has been studied by G. B. Airy[1], E. Lommel[2] and many others after them. The experiment is of fundamental importance for the theory of the image formation in optical instruments. The formula given by Airy has been but little modified, and in its present form (Preston[3]) is:

$$X = 0{\cdot}5F\frac{\lambda}{d},$$

where X is the minimum separable distance between two neighbouring disks, representing points of the object, λ the wave-length of the light, F the focal length and d the diameter of the lens.



DRAWINGS BY W. TH. SHEILLS AFTER PHOTOGRAPHS ENLARGED 4 TIMES.

Experiments with virus bodies, the size of which was below the limit of resolution given in the above formula, led to investigations of the experimental basis of that formula. It had been observed that reduction of intensity shows details that should not be visible in some cases and not resolvable in other cases if the formula was strictly right.

Compared with Airy's and Lommel's arrangements, one alteration was introduced, namely, instead of one hole in the opaque screen two holes were used. These two holes were observed in a telescope with an aperture variable by means of an iris diaphragm. A carbon arc served as a light source. White light as well as that of different wave-lengths was employed for the experiments. Photographs of the image were obtained by fitting a camera on top of the eyepiece of the telescope.

Fig. 1 shows the two holes in the screen as they appear with a large aperture of the telescope. The shape of the holes is well defined.

Fig. 2. The same holes illuminated with white light of higher intensity: the shape of the holes is not distinguishable.

Fig. 3. The intensity of the light is reduced again to that of Fig. 1, and the aperture of the telescope is reduced so far that the shape of the holes just cannot be discriminated.

Fig. 4. By the introduction of two polarizing prisms (Polaroid screens) into the path of the rays,

the intensity of the light was reduced until the threshold of the eye was reached for the minimum visible light intensity: the shape of the holes could be recognized and recorded photographically to a certain extent.

These experiments show that structure in the object can be resolved with an aperture of the optical instrument smaller than that postulated by the formula. Therefore it was desirable to test whether two points could be separated if their distance is too small to be separated otherwise than by this new principle.

Fig. 5. Shows the two holes imaged through a small aperture which does not enable them to be separated.

Fig. 6. Shows the effect of reduced intensity: discrimination of two points (the holes are not resolved) is achieved.

The effect has been reproduced on microscopic objects as well and the experiments are being published elsewhere.

Arising from the experiments described above, it is suggested that a factor *I* for the intensity of the light should be included in the formula of resolution. The value of *I* cannot be given as a constant as it necessarily varies with the light source employed. In my experiments it had the rough value of 0·1, judging by the respective times of exposure necessary to record the effect.

My thanks are due to the Council of the Middlesex Hospital Medical School and to the Trustees of the Sir Halley Stewart Trust Fund for facilities which enabled this work to be carried out.

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Feb. 1.

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[1] Airy, G. B., *Trans. Camb. Phil.*, 5, 238 (1834).

[2] Lommel, E., Beugungserscheinungen an einer Kalsionschen Öffnung, Munchen, 1884.

[3] Preston, T., "The Theory of Light", 327 (London, Macmillan & Co., Ltd., 5th Edition, 1928).

The Modern Centrifugal Pump as a Plankton Collector

THE elimination of the many sources of error encountered in some form or another when collecting plankton for quantitative work with silk nets is a problem that has been attacked many times. During the last fifty years, a number of workers, many of them with some measure of success, have from time to time used a pump and filter as a means of collecting a small, but quantitatively accurate sample, of plankton.

Encouraged by the obvious possibilities and advantages of this method, we have recently conducted experiments with a modern centrifugal pump. The experiments were made from the Research Ship *Explorer*, Fishery Board for Scotland, and the results have proved to be of great value and interest. We are preparing a paper on the subject in which the whole aspect of the problem of sampling is discussed, and the historical position of the plankton pump reviewed.

The experiments were conducted with a water meter included on the delivery side of the pump, and show how a comparatively large volume of water (two and a half cubic metres) was filtered in ten minutes with a two-inch pump. A three-inch machine would deal with almost double the volume (five cubic metres) in the same time, and it is a pump of this calibre that we suggest for general use.

Filtering can be done either by suspending the net in a tank of water to take up the force of heavy delivery, or direct on to the ship's deck. This latter method was used in our work and the results show that the plankton so collected is little, if at all, damaged in passing the impeller at 2,000 revolutions per minute. Even complicated chains of diatoms and delicate forms such as *Aglantha* remained whole, while some of the zooplankton forms were seen swimming actively in the filtered sample. The suction action is more than ample to take all forms of life, so that the collections are in no sense selective, and the results obtained indicate clearly the greater quantity of small forms, both of phyto- and zooplankton, as compared with the larger forms.

The suction hose, which is made in jointed lengths of 25 feet (8 metres), can be readily attached to a steel warp weighted with lead, and though in the experiments only two such lengths were used, they presented no difficulty in handling. As the pump was designed to overcome the frictional resistance in ten or more such sections, there would presumably be no more difficulty with 100 metres of pipe than with 12–15 metres. The joints are made with a quickly meshed screw thread, and are water-tight; and it was found that sections of much greater length than those used could be employed without difficulty.

This modern method of plankton pumping overcomes many obstacles familiar to the quantitative worker, and should be of widespread interest.

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Symmetry of Symbols

THE application of the theory of symmetry to decorative designs is well known to students of crystallography and to mathematicians interested in the theory of groups. Text-books on design do not discuss these simple rules for the construction and classification of patterns, most likely because the subject up to the present has been treated only in the technical language of mathematics.

In preparing some articles which have as their purpose to explain the subject in a simpler form, I came across the following example which may be of more general interest. If we classify the letters of the alphabet according to their symmetry characteristics, we find the following five groups (in mathematical language they are the sub-groups of the symmetry group of the rectangle):

(I) F G J K L P Q R
(II) A M T U V W Y
(III) B C D E
(IV) N S Z
(V) H I O X

I. Those letters which have no real symmetry properties.

II. Those of which the left half is the mirror image of the right half.

III. Those of which the upper half is the mirror image of the lower half.

IV. Letters which can be rotated over half a circle without changing; they remain the same when the page is turned upside down.

V. Letters which have all the above characteristics combined.

What stands out in this classification is that the letters *N*, *S* and *Z* are together in one group. They are just the characters which are always written incorrectly by uneducated people It seems, therefore, that their type of rotation symmetry is slightly more difficult to grasp than the more common reflection symmetry. In this connexion it may be noted that many of the magic symbols used by ancient people possess such rotation symmetry over a half, a third or a quarter of a circle. This may perhaps help to understand why various primitive tribes independently have come to worship symbols like the swastika.

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Points from Foregoing Letters

PROF. E. A. MILNE relates considerations recently advanced by Dirac with his own results, but concludes that there is no inference as to the creation of matter. The form of the differential relation connecting intervals for the $t \rightarrow \tau$ transformation is stated.

Under very feeble illumination the eye sees the visible spectrum in a uniformly grey colour (scotopic vision). It had been found that the maximum luminosity for *equal energy* is at 5000–5040 A., while the maximum absorption of the visual purple pigment in the eye is at 5100 A. Dr. H. J. A. Dartnall and C. F. Goodeve point out that if instead of comparing energies one compares equal *quantum intensities*, then the two maxima coincide. They consider this, and also further approximate calculations of the relative intensities of the light absorbed at different wave-lengths, to give support to the hypothesis that the primary process in scotopic vision is the absorption of light quanta by visual purple.

Recent experiments on the resistance of ferromagnetics show a sharper Curie point than the specific heat measurements. Prof. N. F. Mott and Dr. H. H. Potter state that this is to be expected, because the resistance depends on long-range order (domain of more than about 8,000 atoms) and the magnetic energy depends on the interaction of electronic spins at close range.

The percentage of glutamic and aspartic acids in Cotswold wool and in seagull quill has been determined by Dr. J. B. Speakman and F. Townend. They conclude that the results support the 'salt-linkage' theory developed by Speakman to account for the elastic properties of wool-fibres in solutions of varying acidity. According to that theory, the long peptide chains of the keratin molecule are bridged by linkages arising from the combination of the acid side-chains of aspartic and glutamic acids, with the basic side-chains of arginine, lysine and histidine.

A study of spore-forming bacilli by a vital staining technique leads Dr. L. A. Allen, Miss J. C. Appleby and J. Wolf to the conclusions: (1) that a single species of bacillus may show alternative methods of forming endospores, resulting in two different cell structures extraneous to the spore; (2) that the spores, after being released from the cells, are at first refractile, but may later (in old cultures) take up stain, revealing an internal structure which undergoes rearrangement during a considerable period of time.

The ovary and testis of young and embryonic rats and mice have been grown *in vitro* by P. N. Martinovitch. The ova developed and survived for three weeks, but at the end of a month the whole organ degenerated. Spermatogenesis was less successful, stopping at the pachytene phase during the chromosome reduction stage during meiosis.

Some of the changes taking place when the larvæ of the oyster settle and become 'spat' are described by H. A. Cole. Within ninety hours a considerable metamorphosis occurs while the diameter of the shell increases from 0·3 mm. to 0·6 mm. There is still a gap in the life-history of the oyster, since the next stage described is one in which the diameter of the shell has reached 1·2 mm.

It is suggested by Dr. J. R. Baker that the breeding seasons of equatorial birds may be controlled by changes in the intensity of visible and ultra-violet illumination.

Lieut.-Colonel L. M. Davies finds evidence that the Ranikot (Palæocene) Sea of India extended from Sind to the Tirah, and from the Tirah to Tibet. It was apparently isolated from the contemporary marine waters of Europe.

A. M. Hocart adduces a few examples and impressions of lineages which voluntarily isolate themselves for breeding purposes. These he considers give a clue to the segregation of species in Nature.

From recent observations by Rossi and Benedetti, H. J. Bhabha infers that the number of cosmic particles arising from a direction 30° west of the meridian is appreciably less than the number arriving vertically. These, he reasons, must be negatively charged, and if the radiation formulæ of quantum mechanics hold for the high energies involved, then either negative protons or some other negatively charged particles hitherto unknown must be assumed to be present in appreciable numbers in cosmic radiation.

An effect of increased resolving power of telescopes and microscopes produced by means of reduced light intensity in some diffraction experiments is described by Dr. K. B. Merling-Eisenberg.

S. G. Gibbons and J. H. Fraser have experimented with a modern high-speed centrifugal pump for collecting plankton, and find that even delicate organisms are undamaged. They claim that accuracy is obtained by this quantitative method of sampling.

Research Items

Milk-Drinking Habits of School Children

SPECIAL efforts have been made in Great Britain during the last few years to popularize milk consumption. The most important measure designed for this purpose was the so-called milk-in-schools scheme, by which milk is supplied free or at a reduced cost to children attending grant-aided schools. The object of this scheme was to encourage the milk-drinking habit in the younger generation, but little information exists regarding the habits of the children prior to its commencement. To remedy this defect, an inquiry was undertaken by the Hannah Dairy Research Institute, Kirkhill, Ayr, under the director, Dr. Norman Wright, the results of which have now been published by that Institute (Bulletin No. 7, 1936). The inquiry covered nearly 14,000 school children, about two thirds of whom were resident in Glasgow and one third in rural and urban districts of Ayrshire. The outstanding fact revealed by the inquiry is the small extent to which milk is normally drunk by children of school age. Of the 13,317 children investigated, more than one half did not drink milk at all and one third only took it once daily. Tea drinking, on the other hand, was almost universal, only five per cent of the children failed to take tea once, while fifty per cent took it three or more times in the day. Only twenty-five per cent of the children took porridge at breakfast. Of other drinks, coffee was rarely taken, and cocoa only by about seven per cent. Only seven per cent took water at dinner, but nearly half the children took it between meals or at supper.

Return of Swallows to their Nesting Sites

UP to the end of 1935, the number of swallows marked with numbered rings under the *British Birds* scheme was 34,243, the great majority being nestlings. The number recovered up to the middle of 1936 was 285, of which 24 were found abroad. A. W. Boyd and Dr. A. Landsborough Thomson (*British Birds*, 30, 278, Feb. 1937) have analysed the British returns, and find that adult swallows which have nested almost invariably return to the same place in subsequent summers, and often to the same nest. There is no record of an adult being recovered elsewhere in the breeding season, and there are records of pairs returning to a nest in more than one season. But young swallows very seldom return to the exact place where they were hatched, although many are found in the neighbourhood and within a few miles. A few were recovered so far away as 75–160 miles. A new feature which the analysis brings out is that soon after they are fledged, swallows tend to disperse from the nesting centre, previous to the setting in of true migration. This movement seems to take place in any direction, but since the observations are based upon the recovery of only 15 birds, confirmation is desirable.

Spawning of Black-headed Minnow

THE small North American cyprinoid, *Pimephales promelas*, known as the black-headed minnow, frequents areas where the bottom is covered with silt, and this leads to a peculiar spawning habit, described by L. R. Richardson (*Canadian Field-Naturalist*, 51, 1, Jan. 1937). To avoid the smothering of the eggs in mud, they are adhesive and are attached to the under surface of some substantial object lying clear of the river bed. The site is selected by the male minnow, which thereafter shepherds a female to the place, after having cut her out from a group of various species. Invariably the male swims below the female during the shepherding operation, chivvying, pushing and even snapping at her if she shows any sign of an attempt to escape. On the arrival of the pair beneath the nesting site, the male by steady pushing causes the female to rotate with gradually increasing speed in an anti-clockwise direction. At the same time he presses her into a sideways position, in which her belly comes in close contact with the under surface of the log, to which during or after a few seconds of extreme commotion the eggs are attached and fertilized. The female is then driven away by the male, who repeats the performance with another and perhaps a third female. No special attention is given to creating a protective structure about the eggs, but the male guards the egg-mass assiduously from the attacks of other individuals who would devour them.

The Brown Bat in Western North America

IN Canada, the United States and Lower California, and Mexico, five races of *Eptesicus fuscus* are recognizable. These conform to Bergmann's law, showing a progressive decrease in size from north to south, the greatest difference being 19 per cent in total length and 8–9 per cent in skull length (William L. Engels, *Amer. Midland Naturalist*, 17, 653; 1936). From the author's descriptions, it would also appear that richer coloration is more frequent in the moist coastal regions and that the inland race (*E. f. pallidus*) is distinguished by a much larger number of pale individuals.

Reactions of Nauplii to Light

THE nauplii of *Balanus amphitrite* and *Tetraclita squamosa* show remarkable reactions to light. Shuzo Ishida (*Sci. Papers Inst. Phys. and Chem. Res., Tokyo*, 30, No. 659) describes how in the same culture some move to the side of the beaker that is illuminated, and others, fewer in number, move to the opposite side; he terms these movements skotophobic and photophobic. By using a beam of light passing through a slit, the concentration becomes more marked since the illuminated area is limited, and by altering the direction of the beam it can be shown that the phenomenon is independent of geotropism. If the light is directed horizontally and half the beaker is screened vertically, the two types show an interesting circulation in opposite directions in the darkened half of the beaker.

Physiological Effects of Polyploidy in Tomatoes

DR. A. C. FABERGÉ has made a statistical investigation of the effects of tetraploidy in the tomato in two recent papers (*J. Genetics*, 33, No. 3) in which the effects on growth and size and variability are carefully analysed. It is well known that auto-tetraploids generally differ from their diploid parent in being larger and stouter in many of their parts and in having larger cells and nuclei, although the fruits appear to be always smaller. Dr. Fabergé finds, however, that tetraploid tomato plants contain no more substance and no more water than diploids, although $4n$ embryos are 30 per cent heavier than $2n$. This advantage is lost during germination. It is concluded that heterosis in the F_2 generation is due only to the greater initial weight, and is of the same magnitude in $2n$ and $4n$ plants. As regards variability, the results agree with those of Lindstrom in showing less variation in fruit-weight of $4n$ than of $2n$ plants. The same is true of the weight of whole plants, where the decreased variation is found to be due entirely to diminution in variability of the embryos. Possible causes of this surprising decrease in variation of tetraploids are discussed. In the fruits, the reduction of variability occurs not between different plants but between the fruits of the same plant. This appears to mean greater stability in the plants. It cannot be accounted for as a direct genetic effect of segregation, and the author suggests that doubling of the genes results in an increased probability of the action of quantitative factors, which is reflected in the greater physiological stability of the early meristems. In the terms of Timoféeff-Ressovsky, the penetrance and expressivity of quantitative genes may both be increased by an increase in their absolute number.

Vernalization of Garden Crops

THE process known as vernalization, in which the time of flowering can be controlled by treatment of the seed and seedling, seems to promise such beneficial results, that any practical contribution to the subject is of great interest. A short paper by Miss D. M. Turner and Mr. S. Burr (*Gard. Chron.*, Jan. 2, 1937) shows that tomato plants respond to vernalization. The most successful treatment seemed to be a chilling of the seed for twenty-four days previous to sowing, and the application of twelve days' continuous light to the young seedlings. Experimental results are on rather a small scale, but show that the yield of vernalized plants is both heavier and earlier than normal. *Calendulas* and peas apparently did not respond to the treatment.

Migmatites of Central Sweden

IN a recent memoir of the Sveriges Geologiska Undersökning (*Årsbok*, 30, No. 8, 88; 1936), Nils H. Magnusson describes his investigations of the veined gneisses of the iron-ore district of Kantorp in Sodermanland. The ores belong to the leptite formation, which consists largely of volcanic rocks and sediments and their metamorphosed equivalents. Transformation of these rocks to veined gneisses was brought about, during regional subsidence, by emanations and solutions which arose from deeper levels where palingenetic processes were active. The change begins with the appearance of pegmatitic spots and strings, and these gradually increase in proportion until pegmatitic veins dominate the rocks. It is noted that slates everywhere appear to be most readily pegmatized. Comparative studies of nineteen chemical analyses indicate that granitic emanations 'soaked' through the leptite complex with its iron-ores and limestones. The emanations were followed up by intrusive pegmatites and these, in turn, by granites. The latter are regarded as concentrated segregation products, the material of which came partly from below, and partly from the rocks now accessible at the surface. Reasons are given for rejecting the earlier view that the gneisses are products of magmatic differentiation during conditions of high tectonic pressure.

Earthquakes in New Zealand

DR. J. HENDERSON and Mr. R. C. Hayes have recently issued the report on New Zealand earthquakes for the year 1935 (Wellington, N.Z.,: *Dom. Obs. Bull.*, No. 116), a report prefaced by some general considerations on the earthquakes of the islands. During the century 1835–1934, sixty-nine destructive earthquakes were felt, of which forty-nine were of intensity 8 (Rossi-Forel scale) or semi-destructive, fourteen of intensity 9 and six of intensity 10. The regions visited most frequently by such earthquakes were the eastern and southern parts of the North Island and the northern part of the South Island. In the fiord region of the latter, sealers are said to have felt violent earthquakes in 1792, 1810 and 1826–27. Thus, although some parts of New Zealand have experienced no severe shocks during the last century, it does not follow that their immunity will continue. The year 1935 was a comparatively quiet one; there were no destructive earthquakes, and only one of intensity 7, the total number reported as felt being 150.

A New Mass-Spectrograph

IN part 7 of vol. 145, Section 2*A* of the *Sitzungsberichte* of the mathematical sciences division of the Vienna Academy of Sciences, Dr. Josef Mattauch, of the Physical Institute of the University, gives an account of the behaviour of the mass-spectrograph constructed by the Institute with financial help from the Academy and the Rockefeller Foundation on the lines laid down by himself and Dr. Herzog in the *Zeitschrift für Physik* (89; 1934). It depends on the power of a radial electrical field of mean radius a to render parallel a beam of positive rays diverging from a point $a/\sqrt{2}$ from the entrance plane of the field, whatever their velocities. If the parallel beam then enters a magnetic field at right angles, each mass component of it when bent through a right angle is focused on a plane through the point of entrance at 45° to the line of entry, and the distance of a line from the point of entry is proportional to the square root of the mass of each constituent. This system of double focusing has been generally adopted recently and gives excellent results. Dr. Mattauch finds a new isotope of strontium ^{84}Sr, new bands due to the dissociation of hydrocarbons, separates ^{14}N and ^{16}O from CH_2 and OH_2 and can resolve triplets.

Excitation of Phosphors in a Neon Discharge Tube

IN connexion with a note appearing in these columns under the above heading (NATURE, 139, 160; 1937), we are informed by Mr. C. C. Paterson, director of the Research Laboratories of the General Electric Company, Ltd., that a neon discharge tube in which a zinc silicate phosphor is excited by the discharge was patented by the G.E.C., Ltd. and H. G. Jenkins in May 1935, the patent becoming available to the public in November 1936. Such discharge tubes are at present being used commercially, while mercury discharge tubes with phosphors have been on the market in England for at least three years.

Science and Building Exhibition

THE Building Centre at 158 Bond Street, London, W.1, is an organization formed by architects and others associated with the industry, and supported by official bodies for the benefit of all engaged or interested in building. Its most prominent function is the formation and maintenance of a permanent but continually changing exhibition of building materials and equipment, where a technical staff is available to give unbiased information regarding these. Its range of usefulness to the industry and to the general public is extended by special temporary exhibitions held from time to time and by lectures on cognate subjects. In another direction, a very important contribution to the progress of building technique is being made by the work of the several research stations engaged on one or other aspect of this many sided subject and the Department of Scientific and Industrial Research has arranged at the Centre a special Science and Building Exhibition to remain open until March 25.

In relation to timber, the Forest Products Research Laboratory has been engaged on several lines of investigation. The attack of insects is under constant inquiry involving the study of their food supplies and digestive processes. Here, emphasis is given to the fact that the lyctus beetle is the most serious cause of loss in Great Britain. In relation to fungus attack, models of properly and improperly ventilated buildings show how the progressive destruction occasioned by dry-rot can be avoided, while in another section the quantitative relation of moisture content to shrinkage of timber is demonstrated. Two other lines of inquiry relate to the wearing qualities of wood and to the best cutting angles of woodworking tools. In the former, a comparative test has been devised whereby the relative value of each sample of wood can be stated, while the improvements obtained in economy and finish resulting from the latter investigation can only be adequately appreciated by inspection of the results.

Geological data regarding sites and resources of building stones, clay pits, limestones, etc., come within the province of the Geological Survey and Museum which, manifestly, can exhibit here only a few items from the store of maps, publications and other accumulated information available at its headquarters.

The pivot of this Exhibition may be said to be work of the Building Research Station, wholly directed as it is to the interests of the industry. Its exhibits are of a varied nature. Here are on view examples of tests on concretes, plasters, bituminous preparations, etc., and of the machinery devised for the testing and correct manipulation of the materials in use. Photographs are shown of the full-size tests conducted under fire conditions at the Elstree Fire Research Station.

The insistent problem of noise and its mitigation is dealt with at the National Physical Laboratory, and several models are exhibited to show how the use of suitable materials and methods of construction can eradicate its worst effects The conditions under which double walls and windows can be made effective, the right use of floating flooring to reduce impact noises, the elastic support of machinery and the application to walls of sound absorbent linings are demonstrated by means of models fitted with stethoscopes. On analogous lines, the work being done in connexion with illumination, wind pressures on structures and vibrations in roads and buildings is illustrated by means of diagrams and models.

In a series of photographic sequences, some aspects of the work of the Paint Research Station can be studied. A good paint requires to possess certain definite and distinct properties at different stages in its life—flow and 'brushability' during application, drying properties in the next stage, and elasticity, durability and appearance in its finished state. The photographs illustrate the tests applied at each stage and those also to which the raw materials are subjected. Of especial interest are those illustrating the electron diffraction camera used for ascertaining surface properties of pigments, the pattern obtained on a photographic negative and finally the actual atomic structure which can be deduced therefrom.

The Water Pollution Research Board and Chemical Research Laboratory have exhibits of fuller's earth in various conditions and of base-exchange and acid-exchange resins. These have been found to possess water-softening properties and the samples illustrate several stages in the processes of preparation. Apparatus used in determining the average concentration of lead in water for cooking and drinking is shown together with specimens illustrating the rate of the action of water on lead. Another activity represented is the purification of effluents from dairies and milk-products factories.

Domestic heating comes within the programme of the Fuel Research Station, the staff of which are showing samples of several fuels and are prepared to advise on this point with due respect to the national prejudice in favour of the open fire. The measurement of conditions in the domestic chimney is shown, and it is explained that so easily are these upset that special precautions are necessary as, for example, in ascertaining the amount of air passing up the chimney it is necessary to seal the room and admit air by one aperture in which the anemometer is placed.

A steel structure model illustrating the stages in the construction of multi-story flats is exhibited by the Iron and Steel Industrial Research Council and shows a number of alternative exterior treatments. Other exhibits and models illustrate the preparation and uses of 'foamed slag' for light-weight concrete. The British Non-Ferrous Metals Research Association is represented by tests on the behaviour of galvanizing and zinc coatings in domestic hot-water systems. The glass apparatus shown is used to test materials either in replacement of the corresponding glass part or by suspending a sample in the apparatus. The B.N.F. jet test, also exhibited, is designed to determine simply and rapidly the thickness of a metal coating, and an outline is given of the more important points emanating from the Association's research on the frost-bursting of water pipes.

Further opportunities of learning of these activities will be given in a number of lectures by members of research stations during the period of the exhibition.

Royal Botanical Gardens and Empire Botanists

By Sir Arthur Hill, K.C.M.G, F.R.S.

THE leading article in NATURE of January 9, on "National Museums of Natural History", discusses the relationship, "beyond the ordinary courtesies of friendship, which exists between these institutions". In the final paragraph, it is said: "We know of no such ties, and we wonder whether the interests of science in our Commonwealth of Nations would not be best served by attempting to develop such links. A free interchange of co-types could do much", and concludes, "But more is wanted, for the taxonomists in all [institutions] must have the same methods and ideas as to species in their work, and this can be secured by the periodical interchange of their staffs".

With regard to the Royal Botanic Gardens, Kew, which were specifically included with the "Museums" in the terms of reference of the Royal Commission on National Museums and Galleries appointed in July 1927, it seems desirable to direct attention to the fact that arrangements have been in operation for many years with other institutions and Governments, which are far more than "the ordinary courtesies of friendship" which, also, are of a very intimate nature with all other kindred institutions.

The Royal Botanic Gardens, Kew, being the headquarters of botanical work for the Empire, has built up in its herbarium and museums a vast collection of type specimens from all parts of the Empire, and the "Floras" of British India, Australia, South and Tropical Africa, etc., have been written at Kew. Kew, therefore, is the Mecca for our botanists from overseas, who must also pursue their studies among the historic specimens, especially from Australia, preserved in the British Museum (Natural History).

Sir Joseph Hooker, so long ago as 1882, realized the importance of establishing a close liaison between botanists working in India and those at the Royal Botanic Gardens, Kew, and on his proposal the Government of India appointed an Assistant for India to work in the Herbarium, and this post, paid by the Government of India, has been maintained since the year 1883. Several of the holders of the assistantship have formerly held Government botanical posts in India.

The Government of the Union of South Africa similarly maintains an Assistant for South Africa at Kew, but in this case a botanist on the staff of the Union Government is sent to work at Kew on the historical South African collections in the Kew Herbarium and returns to his duties in South Africa at the end of two or three years' service in the national herbarium. The salary of the Assistant for South Africa is paid by the Government of the Union of South Africa. This valuable arrangement came about as a result of a meeting of botanists of the Division of Botany held at Pretoria in 1918, in connexion with the establishment of the Botanical Survey of South Africa. At the moment, the South African Government has two officers working at Kew.

An Assistant for West Tropical Africa was appointed to Kew by the Governments of the West African Colonies in connexion with the preparation of "The Flora of West Tropical Africa". The assistant was appointed in 1909, but the post has now lapsed on the completion of the "Flora".

The proposal for the establishment of liaison officers between the Commonwealth of Australia and the Dominion of New Zealand and the Royal Botanic Gardens, Kew, was put forward by the Director of Kew in his report to the Governments of the Commonwealth and the Dominion after his visits to Australia and New Zealand in 1927–28, and received their approval. Nothing, however, resulted, for various reasons, and when the Third Imperial Botanical Conference was held in London in August 1935 the following resolution was passed:

"*Liaison Officers.*

"(1) This Conference commends to the Government of the Commonwealth of Australia the importance of maintaining close liaison in botanical matters with the Royal Botanic Gardens, Kew, and urges the Government to consider favourably the appointment of one of the younger Australian Systematic Botanists to work at Kew for a period of at least two years in making a critical examination of the historic Australian type-specimens at Kew and the British Museum and determining current collections made in the Commonwealth and sent over to Kew for critical examination.

"(2) It is further suggested that, at the expiry of his term of service, the officer appointed as Assistant for Australia should be replaced by another of the younger Australian Systematic Botanists."

Similar resolutions, appropriately worded, were passed with regard to New Zealand and Canada.

It is most gratifying to be able to record that the Commonwealth of Australia has now arranged to send over the Botanist from Perth, Western Australia, as its liaison officer to work for two years at Kew, who will be replaced at the end of the period by another botanist from the Commonwealth.

The resolution is also being considered favourably by the Dominion of Canada and by the Dominion of New Zealand. The Government of New Zealand hopes it may be able to send over in the near future a botanist to work at Kew, and it is expected that the Canadian authorities may eventually be able to send over an officer.

An interchange of officers has also been effected at Kew. A few years ago, one of the botanists on the staff of the Herbarium at Brisbane was sent over to Kew by the Queensland Government and a Kew Herbarium assistant was sent to Queensland to take his place, the two institutions paying the salaries of their officers. This exchange proved of the greatest possible value not only to the two institutions but also to the individuals themselves. The Australian botanist was able to study the historic types at Kew and the British Museum, while the Kew botanist had the opportunity of studying the flora of Queensland both in the field and in the Brisbane Herbarium, and also of getting into personal touch with all the botanists in the Commonwealth. Botanists from Kew have also been sent out to South Africa, Rhodesia and Malaya to study the flora, and botanists from all parts of the Empire are constant and welcome visitors at Kew.

It may be of interest to record that on the Gardens side the principle of exchange has for some time been in active operation, as we now exchange student gardeners with Germany, France, Italy, Sweden, Switzerland, Belgium, Canada, the United States of America and New Zealand, and other parts of the Empire when opportunity offers. The Kew student is sent out in exchange for one or two years, his place being taken by a student gardener from the botanic garden or other centre to which he has been sent. At the present time, twelve exchanges are in operation, much to the advantage of the men concerned and certainly to the advantage of Kew.

Wetting and Detergent Action

THE symposium on the "Scientific and Technical Aspects of Wetting and Detergency", held at the Imperial College of Science on February 19–20 under the auspices of the British Section of the International Society of Leather Trades Chemists, brought together a large company of scientific and technical workers for the discussion of nearly twenty interesting papers, which dealt with many of the known important points in these two problems, and suggested new points of view likely to prove important in future research.

The fundamental quantities determining whether a solid is, or is not, completely wetted by a liquid, are the surface tensions of the solid, and the liquid, and the amount of adhesion between the solid and the liquid. The impossibility, at present, of measuring the surface tension of solids is not such a serious difficulty in the scientific study of wetting as might be supposed, since the contact angle, which can be measured, is simply related to the surface tension of the liquid and the adhesion between solid and liquid, and is itself the immediately relevant quantity in most problems of wetting; and probably also in detergency.

C. G. Sumner described modifications in the 'plate' method for determining contact angles; N. K. Adam showed how contact angles can be determined on single textile fibres or thin wires visible under low powers of the microscope; and J. O. Cutter and C. W. Price reported a careful study of the method (originally due to Bartell and Osterhof) of measuring the adhesion tension and contact angles of liquids against solid powders, by determination of the pressure required to prevent the liquid penetrating into solid plugs of the powder, kept compact under high compression. This method, the only one available for the quantitative study of the wetting of fine powders, is not easy; it depends on careful attention to details of the apparatus and on the maintenance of a high pressure on the powder.

Probably the most important single industry dependent on the wetting properties of solid surfaces is that of mineral flotation; H. Freundlich dealt, in a short paper with a valuable bibliography, with the principal features of this process, including a discussion of the importance of contact angle, and of the surface films formed by the selective adsorption of the 'collectors' on the surface of the valuable minerals, which decrease their ease of wetting by the water and consequently cause them to stick to the air bubbles rising in the froth, and thus become collected at the surface. H. Martin described the very important applications of wetting agents in assisting the spread of insecticide solutions over the surface of leaves and fruit. He has taken particular account of the difference between the advancing and the receding contact angles, directing attention to which of the two is relevant for each practical problem; and he deserves gratitude for his timely protest against the pernicious and short-sighted practice of some manufacturers, in placing on the market, and expecting intelligent and chemically minded customers to use, or advisory officers to recommend, mixtures of unspecified and possibly inconstant composition bearing names suggestive of 'nostrums' rather than of scientifically manufactured and reliable products.

A paper by E. J. Daniels and D. J. Macnaughtan directed attention to some effects of surface impurities and inclusions in metals, on their ease of wetting by solders or by tin; this is a very important subject to which but little quantitative study appears to have been given. A. de Waele discussed the importance of wetting in the deflocculation and the plasticity of solid suspensions; and W. E. Wornum and G. A. Campbell dealt with the wetting problems of the paint industry, including the fundamental problem of the wetting of pigments by the liquid medium, and that of the surfaces to be painted by the finished paint or varnish. Wetting, it must be remembered, is not identical with deflocculation or dispersion; it is but one of the two main factors concerned. The other is the adhesion of the solid particles for each other, which must be overcome by the wetting liquid for the dispersion to be effective.

Detergency, which formed the subject of the second day's discussion, is a more complicated and perhaps more interesting problem. C. Robinson, in his introductory paper, discussed a theory due to N. K. Adam which places the emphasis in detergent action on the displacement of the grease from the solid surface, as comparatively large globules; the contact angle formed by the surface of separation between grease and aqueous detergent solutions, and the solid being cleaned, being the important measurable quantity determining the efficiency of detergent action. If this is correct, detergent action is essentially a preferential wetting of the solid surface by the detergent, instead of by the grease, and not, as has been occasionally held in the past, simply a wetting of the grease by the detergent, with consequent emulsification of the grease or other dirt. Surface and interfacial tensions, of course, enter into the problem, but neither alone is necessarily of predominating importance. Robinson considered also the problem of the removal of detached globules of grease from entanglement with the cloth; and described his measurements of the interfacial tension between oils and detergent solutions, which show some very remarkable effects of traces of polyvalent salts. G. S. Hartley discussed the power that solutions of soaps and paraffin chain colloidal electrolytes ('soap-like' substances) possess, of actually dissolving organic compounds which are insoluble in water. These substances, even in quite dilute solutions, have their long paraffin chain ions aggregated into 'ionic micelles', and Hartley suggests that the solvent power is due to the interior of these micelles closely resembling liquid paraffin, and having similar solvent properties; so that when such a substance as azobenzene, or cetyl alcohol, is caused to dissolve in a soap solution, it is not distributed evenly over the whole solution, but is all to be found in the interior of the ionic micelles. A discussion of the changes in vapour pressure, as the ionic micelles increase in size through taking up other organic substances, leads to the conclusion that they can increase only to a certain size before becoming unstable; hence the solvent power of a soap solution for organic substances insoluble in water is definite and limited, and there is an unstable region of sizes between the largest micelles which can exist, containing dissolved organic material, and the droplets of an emulsion stabilized by a monolayer of the soap-like material: these emulsions simulate stability, though they are not strictly stable in a thermodynamic sense. Whether such solvent action has any practical bearing on the problem of detergent action is not certain; but it is a most interesting and novel theory of solvent action in unusual circumstances. E. K. Rideal directed attention to the possibility that the molecules of detergent substances may penetrate and displace films of other substances adhering to a solid surface; that such penetration often occurs in monolayers at an air-water surface has been shown by J. H. Schulman and A. H. Hughes. An extension of v. Búzagh's work on the adhesion of solid particles to solid faces was also described, with particular reference to detergent solutions.

Space scarcely permits of an adequate notice of the important points in the chemical constitution of detergent and wetting agents, but papers by H. K. Dean, and by E. T. Williams, C. B. Brown and H. B. Oakley gave a general account of them. As a rule, the successful detergents have a long hydrocarbon chain attached to an ionizable, strongly acidic, end group; compounds of similar constitution but basic, yielding paraffin chain cations, may be good detergents but suffer from the practical difficulty that, being mutually precipitated by soaps, they cannot be utilized in conjunction with soaps. One case was mentioned, however, of a new detergent in which there is no ionized end group, but instead a polymerized glycerol derivative, partially esterified with fatty acids.

That wetting and detergent agents operate by forming surface films on the surface both of the solid and of the grease or other dirt to be removed is clear. Part of the discussion turned on the orientation of the molecules in these films. Though the proof is not complete, it appears probable that when the wetting of a greasy surface, that is, one externally composed mainly of paraffin groups, is assisted by a wetting agent, the hydrocarbon part of the molecule of the wetting agent lies flat on the surface; the observed increase in hydrophilic character can probably be accounted for by the presence of only one water-attracting group in the space on the surface occupied by a molecule of the wetting agent lying flat. Such observations as are available on the amount of adsorption of detergents by paraffin wax surfaces show it to be much less than that required to cover the surface with a monolayer oriented perpendicular to the surface, but of the right order for a complete layer of molecules lying flat. In cases where a soluble agent is required to diminish the ease of wetting of a solid surface, as with the collectors used in flotation, the molecules may be oriented perpendicular to the surface, but with the hydrophilic groups towards the solid; this is not yet, however, certain, as a considerable diminution of wetting could probably be attained even with the molecules lying flat. A rather interesting case of the deposition of a layer difficult to wet on glass was mentioned; substances such as cetyl trimethyl ammonium salts, with a long paraffin chain cation, cause (in dilute solution) clean glass to become greasy in appearance, probably through their hydrophilic ends being attracted to the glass, which thus acquires a paraffin-like exterior.

The papers presented will be published in a separate volume, shortly; and they constitute a valuable focusing of ideas on many very important, and not yet fully understood, industrial questions.

N. K. A.

Maiden Castle, Dorchester

A REPORT by Dr. Mortimer R. E. Wheeler on the results of three years' work on the hill-top site of Maiden Castle, Dorchester, on behalf of the Society of Antiquaries and the Dorset Archæological Society, was presented at a meeting of the former Society on February 25.

As originally planned, the excavation was intended to occupy three seasons. The third and last of these in the autumn of 1936 was prolonged until December 24. As, however, the site has proved of even more intense interest than was anticipated, providing evidence of signal importance in its bearing on the development of civilization in the south and south-west of Great Britain, it has been decided to extend the investigation for another season to enable supplementary excavations to be carried out next year.

Maiden Castle has always been impressive by its size alone; and its vast dimensions have borne witness to a capacity for economic and political organization, which it seemed difficult to credit to a population so primitive as the early inhabitants of Britain. Dr. Wheeler's excavations have shown that not only was the construction of a far more complex and imposing character than surface indication showed, but also that it embodies a complete picture of all known phases of urban life in Britain before the days of the building of Roman towns in the latter part of the first century; while the presumedly primitive character of early British culture is shown to be anything but in accord with the facts now revealed.

Dr. Wheeler distinguishes at least four major phases in the occupation of Maiden Castle. The first, belonging to the early neolithic, was a settlement at the eastern end of the mound which had long been covered over, and became known only by this excavation. It had been enclosed by at least three rings of entrenchment excavated in the chalk by deer-horn picks. A large section of this was uncovered in the excavations of the last season. From the contents it was evident that the settlers had been farmers, pasturing sheep and long-horned cattle, as well as practising agriculture. Their pottery showed that here in Wessex was a meeting place of the two strains of the neolithic in Britain, the western deriving from Brittany and the eastern from the Baltic. After a brief occupation by beaker folk from the Rhine, there followed a period extending over fifteen hundred years in which the site was abandoned.

Resettlement began in the eighth or seventh centuries; and by the fifth century B.C. settlers landing from north-east France had begun to raise the downland population to crowding point, necessitating organized defence behind the ramparts and entrenchments of the first Maiden Castle, concerning which recent excavation has revealed so much that is new in the elaborate limestone faced walls, the impressive double entrance, and the great ditch, 50 ft wide and 25 ft. deep. Then comes the great enclosed city, covering forty-five acres, with a population of upward of four thousand—a city, however, primarily of farmers and industrially self-supporting, with few imports. Finally, in the first century B.C., there was the last and most ambitious enlargement, a monument of civic dignity, when spreading ramparts and ditches and high stone walls were added, with a provision of twenty thousand sling stones at the gates to ward off attack—walls which were to be laid low and finally abandoned save for a brief period, when Roman Dorchester was built.

Science News a Century Ago

Lyell and his Views on Geology

ON March 7, 1837, Lyell wrote a long letter to Whewell regarding the criticism with which some of his views had met. "As we had some conversation the other day," he said, "touching the extent to which I carried my doctrine of 'Uniformity' in the 'Principles of Geology' I wish to refer you to the first edition of that work . . . in order to show you that certain passages were somewhat unfairly seized upon by the critic, and not duly considered with and interpreted by others and by the context generally of the first volume. . . .

"It was impossible, I think, for anyone to read my work, and not to perceive that my notion of uniformity in the existing causes of change always implied that they must for ever produce an endless variety of effects, both in the animate and inanimate world. . . .

"In the review in the *British Critic* . . . you stated three formidable theses which I had undertaken to defend, in order to hear out my theoretical views. . . . I am sure that none of the propositions can now seem to you extravagant and visionary. . . . I allude to, first the adequacy of known causes as parts of one continuous progression to produce mechanical effects resembling in kind and magnitude those which we have to account for; secondly, to changes of climate; thirdly, the changes from one set of animal and vegetable species to another. . . .

"I was taught by Buckland the catastrophical or paroxysmal theory, but before I wrote my first volume, I had come round, after considerable observation and reading, to the belief that a bias towards the opposite system was more philosophical."

Geology of Suffolk

AT a meeting of the Geological Society held on March 8, 1837, the Rev. W. B. Clarke concluded the reading of his paper on Suffolk. The substratum of the whole of Suffolk, Norfolk and Essex, he said, is chalk overlaid with clay, sand and crag. While the crag still lay beneath the sea a violent catastrophe broke up many of the secondary strata from the chalk to the lias inclusive, and the debris thus caused, together with numerous masses of ancient rocks, was spread by a rush of water, over the surface of the tertiary formations and the chalk, in some places to a depth of 400 feet, constituting the beds of drift, clay, etc., which occupy so great an area in Suffolk. Afterwards a series of shocks elevated the whole district until the crag attained the height of nearly 100 feet above sea-level.

Shillibeer's Voltaic Battery

WRITING from the Grammar School, Oundle, on March 9, 1837, to William Sturgeon, the Rev. John Shillibeer gave a "Description of a new arrangement of the Voltaic Battery and Pole Director". "In the course of the last winter," he said, "when I was preparing a few lectures on experimental philosophy for the amusement of my scholars, I was struck with the complicated arrangement of the voltaic battery, and the difficulty which frequently occurred from the number of connexions, to get all the wires into so perfect a contact as to ensure success to the experiment." To get over the difficulty he experienced, Mr. Shillibeer had devised a battery consisting of a copper trough divided into five compartments by copper partitions, the trough being filled with a solution of copper sulphate. Into the compartments dipped five plates of zinc the tops of which were soldered to a copper bar which was fixed to a wooden cover to the trough. In a groove in the wooden cover were two sliding terminals by which contact could be made with the copper or the zinc. By means of these terminals the direction of the current in a wire could be easily reversed. In concluding his description, Mr. Shillibeer said, "I cannot but feel gratified at the success which has hitherto attended the career of my little instrument; and very glad shall I be if it may lead to other and more important improvements in aid of a science which, let us hope, may be ultimately applied to purposes of solid benefit to all mankind." (*Sturgeon's Annals*, 1, 224.)

Airy's Observations at Cambridge Observatory

ON March 10, 1837, Airy communicated to the Royal Astronomical Society the "Results of the Observations of the Sun, Moon and Planets, made at Cambridge Observatory in the Years 1833, 1834 and 1835" During those three years, he said, the sun, moon and planets were observed on the meridian at Cambridge Observatory with the transit and mural circle, with as much regularity as the limited personal establishment of the institution permitted. The instruments with which the observations were made were not, he thought, surpassed by any in the world. The immediate results of observation were systematically compared with the places given by tables, and the apparent error of the tabular place in right ascension and north polar distance was given in the *Cambridge Observations*. The series of apparent errors thus found was, he believed, one of the most complete that had been formed from observations over the same period.

University Events

CAMBRIDGE.—D. H. Barron has been appointed University lecturer in the Department of Anatomy.

In a report of the Buildings Syndicate, it is recommended that the plans for a new School of Anatomy prepared by Mr. J. Murray Easton be approved, and that the Financial Board be authorized to accept a tender.

The degree of M.A. has been conferred on J. S. Baxter, D. V. Davies, M. T. Greig and W. R. M. Morton, University demonstrators in anatomy.

W. T. Astbury, lecturer in textile physics in the University of Leeds, has been approved for the degree of Sc.D.

The Sedgwick Prize offered every third year for the best essay on some subject in geology or kindred sciences and valued at about £90 has been divided equally between Dr. E. C. Bullard of Clare College and Dr. F. C. Phillips of Corpus Christi College.

Dr. J. Gray, University reader in experimental zoology, fellow of King's College, has been elected, as from October 1, 1937, to the professorship of zoology vacant owing to the retirement of Prof. J. Stanley Gardiner.

OXFORD.—Sir Arthur Salter (Independent) has been elected an M.P. for the University in succession to Lord Hugh Cecil, who resigned on his appointment as Provost of Eton. Sir Arthur, who is professor of political theory and institutions in the University, has been a member of the Economic Advisory Council since 1932.

In Convocation on February 27, the honorary degree of D.Sc. was conferred upon Prof. The Svedberg, director of the Physical Chemical Institute at Uppsala.

H. W. Thompson, St. John's College, has been appointed University demonstrator in chemistry for two years as from October 1, 1937.

Prof. N. V. Sidgwick has been re-appointed University reader in chemistry.

The following have been reappointed for four or five years as from October 1, 1937, as University demonstrators in their subjects: Dr. R. S. Creed and Dr. C. G. Douglas (physiology), T. C. Keeley (physics), Dr. R. L. Vollum (pathology), E. Whitley (biochemistry) and J. Z. Young (zoology).

Societies and Academies

London

Royal Society, February 25.

JULIA BELL and J. B. S. HALDANE: The linkage between the genes for colour-blindness and hæmophilia in man. Colour-blindness and hæmophilia are known to be sex-linked. The genes responsible for them should therefore be carried in the same chromosome, and exhibit partial linkage with one another. Six pedigrees are described in which both conditions are found. In three of these, the genes are located in the same chromosome, and are associated throughout the pedigree, all hæmophilics investigated being also colour-blind, and none of their non-hæmophilic brothers being colour-blind. In two pedigrees, the opposite condition holds, whilst one is doubtful, including two colour-blind brothers only one of whom is hæmophilic. This fact is attributed to crossing-over. A function $P\ (x, p)$ of the frequency x of crossing-over, and the frequency p of colour-blindness in the male population, is calculated, which represents the probability of the observed association. The probability that the association attributed to linkage is due to sampling is less than 4×10^{-6}. The frequency of crossing-over is as likely to be above as below 5 per cent. Further confirmation has been obtained for the view that hæmophilia originates by mutation.

D. E. LEA, R. B. HAINES and C. A. COULSON: The action of gamma rays on growing and on non-proliferating bacteria. Experiments are described on the lethal action of gamma radiations upon aqueous suspensions of *B. coli* and spores of *B. mesentericus*. Exponential survival curves are obtained, the mean lethal ionization dosages being approximately equal to those previously obtained for beta rays under conditions in which the rate of death was very much greater. Experiments upon *B. coli* in nutrient media are also described which suggest that the lethal action of the radiation proceeds independently of growth in the medium. Under certain conditions, abnormal *B. coli* in the form of long filaments have been obtained. A quantitative analysis of the results of viable counts, total counts, and length distribution measurements leads to the conclusion that the production of long forms is due to division being inhibited, while growth, in the sense of increase of volume, is unaffected.

Dublin

Royal Irish Academy, February 8.

L. B. SMYTH: Some observations on *Lophophyllum cyathophylliodes* Vaughan. This carboniferous coral was described by Vaughan under the generic name *Lithostrotion*. It is here transferred to *Lophophyllum*, and shown to be very variable. A young stage is described. The type is in Dublin.

J. SELWYN TURNER: The faunal succession in the carboniferous limestone near Cork. Lower Carboniferous zones from Z to D_1, inclusive, are identified in the limestone facies east of Cork city, and their fauna discussed, as a preliminary to a study of the Culm facies immediately to the west. At Little Island, the succession is best exposed, but observations were also made at Blackrock and Midleton.

Paris

Academy of Sciences, February 1 (*C.R.*, 204, 305–383).

EMILE BOREL: An elementary problem of strategy.

MAURICE GIGNOUX and FRANCK BOURDIER: The history of the ancient Rhone glacier at its exit from the Geneva basin.

CHARLES PISOT: The modulo 1 distribution of successive powers of the same number.

ROBERT FORTET: Probabilities in chains.

DANIEL DUGUÉ: An extension of the law of large numbers.

PAUL DELENS: Studies on the tetrahedron.

SERGE FINIKOFF: Series of Laplace for which the index surfaces of the same parity have their asymtotics in correspondence.

ANTOINE APPERT: The relations between Linfield spaces and complexes.

GEORGES KUREPA: The problem of Souslin and abstract spaces.

I. Privaloff: The general theory of polyharmonic functions.

Léopold Escande and Georges Sabathé: Researches on hydrometric velocity meters. Study of the errors introduced by the usual method of calibration.

Kentaro Yano: The unitary theory of fields proposed by M. Vranceanu.

Emile Sevin: Novæ and white dwarfs.

Raymond Grandmontagne: The photo-electric study of the colour of the night sky. Application of a recording photo-electric photometer, fitted with colour screens, to the study of the variations of brightness of the night sky. The distribution of energy differs from that of a black body, and shows a high proportion of red.

Mme. Irène Mihul and Constantin Mihul: The propagation of radio-electric signals between two points at a distance from each other.

Augustin Boutaric, Louis Ferré and Mme. Madeleine Roy: Spectro-photometric researches on the dilution and mixture of wines.

Salomon Rosenblum and Marcel Guillot: The possibility of the existence of equidistant energy levels in the nuclei of radioactive bodies.

P. Carré and H. Passedouet: The influence of the terminal group on the melting point of normal chain fatty compounds.

Jules Brüll: The influence of electrolytes on the hydration of some complex cobaltic compounds.

Maurice Curie: Phosphorescent glasses. The influence of crystallization. Experiments are described proving clearly the influence of crystallization on the duration of phosphorescence. Ordinary glass and zinc borate were used, the latter with additions of small proportions of manganese, lead, bismuth, samarium and uranium.

Jean Savard, Marc de Hemptinne and Paul Capron: The ionization potential of carbon monoxide. The number of critical points was so numerous that doubts arose as to the apparatus used; but a repetition of the work, with tantalum replacing copper, proved the correctness of the first experiments. The ionization potential of the molecule CO is given as 13·5 eV.

Arakel Tchakirian: The germanioxalates and zirconioxalates of quinine and strychnine.

Joseph Hoch: The action of organomagnesium compounds on the trialkylacetophenone oxims.

Paul Chovin: Researches on the Pechmann colouring matters. A method of synthesis allowing the preparation of colouring matters with unequal substituents.

Raymond Paul: The action of Raney nickel on some aldoxims.

Georges Dantlo: The esterification of Congo copal in the oil varnish industry.

Jean Cuvillier: Discovery of the nummulitic in the island of Shadwan (Red Sea).

René Perrin: Metamorphism and folding.

Lucien Plantefol: The respiratory oxidations: intrinsic and extrinsic oxidations.

Maurice Langeron: Statistical and mycological observations on human scald-head in Morocco.

J. Risbec: The crystal sac of *Nerita*.

Louis Fage: The apneumonic spiders.

Constantin Dawydoff: Some observations on the embryonic development of the madrepores.

Arthur Brunel: A new enzyme, allantoicase. Its presence in the animal kingdom. This enzyme is capable of splitting allantoic acid into two molecules of urea and one molecule of glyoxylic acid. Originally isolated in *Sterigmatocystis*, it is now shown to be present in the liver of *Raja punctata* and in the liver of frogs.

Maurice Doladilhe: The relations between alexine and the viscous protein of serum.

Moscow

Academy of Sciences (*C.R.*, 4, No. 6; 1936).

S. Soboleff: The algorithm of Schwarz in the theory of elasticity.

N. Košliakoff: Some infinite integrals.

B. Segal: Generalized Waring's problem in connexion with the estimation of trigonometrical sums.

G. Fichtenholz: Contribution to the theory of linear functions.

M. P. Želdak: Influence of cutting on the distribution of the first order strains in a cylinder.

P. M. Murzajev: Sericitization of pegmatites of the Gdov district, Leningrad region, and its genesis.

A. G. Eberzin: Miocene of south-east Transcaucasia.

G. G. Martinson: Distribution of sponge spiculæ in a bore hole of deep borings near the village Possolsk on the Baikal Sea.

G. Laemmlein: Twisted quartz.

A. E. Kriss: Anthocyanin in Actinomycetes.

V. Vasnecov: The caudal keels of fishes.

Vienna

Academy of Sciences, November 12.

Ernst Chwalla: A new type of solution in the theory of stability. The case of a symmetrically loaded rectangular framework having two joints is considered.

Otto Benndorf: Anthracene-1, 2-dicarboxylic acid anhydride.

November 19.

Jovan Jurišić: (1) Germination and morphology of the seeds of *Bryophyllum*. (2) Physiology of germination of Gesneriaceæ. Some species of Gesneriaceæ will germinate in the dark, provided the temperature lies within a certain range, while others will not germinate in any circumstances in the dark.

Rudolf Wagner: Existence of typical non-bracteolate blossoms of Rubiaceæ.

Herbert Schober and Heinrich Angenetter: Spark spectrum of radium emanation.

Lothar Koschmieder: Operational calculus with two variables, and the bilinear form of the Laguerre polynomial.

Franz E. Suess: Periplutonic and enorogenic regional metamorphosis. Regional metamorphs are divided into two classes according to whether the diffusion of material is brought about by temperature gradients or by tectonic displacements.

Julius Pia: Principal data from a stratigraphical study of the Prague Dolomites (south Tyrol).

Karl Strubecker: Circular quadratic complexes.

M. Pestemer and G. Schmidt: A new polarization photometer for the visual determination of differences of blackness, and its application to photographic spectrophotometry.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, March 8

Royal Geographical Society, at 8.30.—Prof. George Barbour: "The Tennessee Valley Project".

Tuesday, March 9

Royal Horticultural Society, at 3.30.—Prof. E. J. Salisbury, F.R.S.: "The Plant and its Water Supply" (Masters Memorial Lectures. Succeeding lecture on March 23).

Quekett Microscopical Club, at 7.45—(at 11 Chandos Street, Cavendish Square, W.1).—H. S. Sarson: "The Microscope and Distillation of Vinegar".*

Pharmaceutical Society, at 8.30.—Dr. W. H. Hatfield, F.R.S.: "The Uses of Stainless Steel for Pharmaceutical Apparatus".

Wednesday, March 10

Geological Society, at 5.30.—Dr. G. M. Lees and P. T. Cox: "The Geological Basis of the Present Search for Oil in Great Britain".

Institute of Welding, at 6.30—(at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Dr. V. E. Pullin: "The X-ray Examination of Welds".

Royal Society of Arts, at 8 15.—Dr. C. S. Myers, F.R.S.: "Industrial Psychology and the Modern World".

Friday, March 12

Royal Society of Arts, at 4.30.—Dr. E. J. H. Mackay: "Excavations at Chanhu-daro".

Physical Society, at 5—(at the Imperial College of Science and Technology, South Kensington, London, S.W.7).—Annual General Meeting.

Royal Institution, at 9.—Sir Gerald P. Lenox-Conyngham, F.R.S.: "Monteserrat and the West Indian Volcanoes".

Institute of Metals, March 10 and 11, at 10 a.m.—Twenty-ninth Annual General Meeting to be held in the Hall of the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Lecturer in Electrical Engineering and Hydraulics in University College, Swansea—The Registrar (March 10).

Science Lecturer (chemistry, physics and mathematics) in the County Technical College, Worksop—The Principal (March 12)

Senior Physicist in the Wool Industries Research Association—The Secretary, Torridon, Headingley, Leeds, 6 (March 12).

Veterinary Bacteriologist in the Imperial Veterinary Research Institute, Muktesar, India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (March 13).

Senior Scientific Officer in the Explosives Directorate, Research Department, Woolwich, S E 18—The Chief Superintendent (March 13).

Assistant (Grade III) (physics or engineering) in a War Department Establishment—The Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, N.W.1 (March 13).

General Inspector of Agriculture in the Ministry of Agriculture for Northern Ireland—The Secretary, Civil Service Commission, Stormont, Belfast (March 15).

Principal of the Bihar Veterinary College, Patna—The Director, Veterinary Services, Bihar, Patna, India (March 31)

Lecturer in Mathematics in the West Ham Municipal College, Romford Road, Stratford, E 15—The Principal (April 3).

Cartographer in the Hydrographic Department of the Admiralty—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (April 8)

Assistant Lecturer in Metallurgy in the University of Manchester—The Registrar (April 17)

Regius Professor of Chemistry in the University of Glasgow—The Private Secretary, Scottish Office, Whitehall, London, S W.1 (April 30).

Official Publications Received

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1936–1937. Vol. 57, Part 1, No 1: Some Philosophical Aspects of Modern Physics (Inaugural Lecture as Tait Professor of Natural Philosophy, University of Edinburgh). By Dr. Max Born Pp. 18. 1*s*. 6*d* Vol. 57, Part 1, No. 2: Some Formulæ for the Associated Legendre Functions of the Second Kind; with Corresponding Formulæ for the Bessel Functions. By Prof. T M. MacRobert. Pp. 19–25. 6*d*. Vol. 57, Part 1, No. 3: Quantitative Evolution in Compositæ. By Prof. James Small and Miss I. K Johnston. Pp. 26–54. 2*s*. 6*d*. Vol 57, Part 1, No. 4: Studies in Clocks and Time-keeping, No. 6: The Arc Equation. By Prof. R. A. Sampson. Pp. 55–68. 9*d* (Edinburgh Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [22

The British Electrical and Allied Industries Research Association. Sixteenth Annual Report, October 1, 1935, to September 30, 1936. Pp 136. (London: British Electrical and Allied Industries Research Association.) [32

Ministry of Agriculture and Fisheries and Department of Agriculture for Scotland. Soils Surveyors' Conference: Executive Committee ("Soils Correlation"). Third Report, England. Pp. 68. (London. Ministry of Agriculture and Fisheries.) [52

Other Countries

The Science Reports of the Tôhoku Imperial University. Second Series (Geology). Special Volume No. 1: Recent Reef-Building Corals from Japan and the South Sea Islands under the Japanese Mandate. By Hisakatsu Yabe, Toshio Sugiyama and Motoki Eguchi. Pp. 66+59 plates. (Tôkyô: Maruzen Co, Ltd.) [22

Bulletin of the American Museum of Natural History. Vol. 73, Art. 1: Results of the Archbold Expeditions, 14: Birds of the 1933–1934 Papuan Expedition. By Ernst Mayr and A. L Rand. Pp. 248. (New York: American Museum of Natural History.) [42

South Australia. Annual Report of the Director of Mines and Government Geologist for 1935 Pp 8. (Adelaide: Government Printer) [52

Association de Géodésie de l'Union Géodésique et Géophysique Internationale. Bibliographie géodésique internationale. Tome 1: Introduction; années 1928, 1929, 1930. Par Georges Perrier et Pierre Tardi. Pp 221 (Paris: Association de Géodésie de l'Union Géodésique et Géophysique Internationale.) 70 francs. [62

Lucknow University Studies. Faculty of Science, Session 1934–35. No. 111: Parasitic Worms and Disease, Lectures on Certain Aspects of Helminthology. By Dr Gobind Singh Thapar. Pp. iv+46 (Lucknow: Lucknow University) [82

A Memorandum on the Spirit and Pharmaceutical Industry of India, with a Discussion of its Difficulties, Needs and Requirements. By Raj Mitra B D. Amin. Pp iii+52. (Baroda and Bombay: The Alembic Chemical Works Co, Ltd) [82

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 35: Technological Reports on Trade Varieties of Indian Cottons, 1936. By Dr. Nazir Ahmad. Pp. v+144. (Bombay: Indian Central Cotton Committee.) 1 8 rupees. [82

Imperial Council of Agricultural Research. Scientific Monograph No 10 The Spotted Boll-Worms of Cotton (*Earias fabia* Stoll. and *Earias insulana* Boisd) in South Gujarat, Bombay Presidency. (Final Report on Investigations financed by the Indian Central Cotton Committee, 1923 to 1931.) By B P. Deshpande and N. T. Nadkarny. Pp v+208+25 plates. (Delhi: Manager of Publications) 5.14 rupees, 9*s* 6*d*. [82

New Zealand State Forest Service Leaflet No 28: Terminal Hypertrophy in *Pinus radiata* in relation to Frost Damage. By T. T. C. Birch. Pp. 11. (Wellington: Government Printer.) [92

Sveriges Geologiska Undersokning. Ser. Ca, No. 25: A General Earth Magnetic Investigation of Sweden carried out during the Period 1928–1934 by the Geological Survey of Sweden. Part 1. Declination. By Kurt Molin. Pp. 98+4 plates. (Stockholm: Sveriges Geologiska Undersokning.) 10.00 kr [92

Statens Meteorologisk-Hydrografiska Ânstalt. Arsbok, 16, 1934, iii: Vattenstânden vid rikets kuster. Pp. 28. 2.00 kr Ârsbok, 17, 1935, v: Hydrografiska mâtningar i Sverige. Pp. 12. 3 00 kr. Meddelanden, Serien Uppsatser. No. 10: A Contribution to the Knowledge of the Influence of the Gulf Stream on the Winter Temperature of Northern Europe. By Folke Bergsten. Pp. 298–307. 1 00 kr. No. 11: A Coefficient of Humidity of General Applicability. By Anders Angstrom. Pp. 245–254. 1 00 kr. No. 12: Radiation Measurements on Isachsen's Plateau. By Hilding Olsson Pp. 225–244. 1.50 kr. No. 13: Physik der Troposphärischen Fronten und ihrer Storungen. Von Tor Bergeron. Pp. 381–395. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [92

U.S. Department of Agriculture. Farmers' Bulletin, No. 1624: The Mexican Bean Beetle in the East and its Control. By Neale F. Howard, Loyd W. Brannon and Horatio C. Mason. Pp. ii+21. (Washington, D.C.: Government Printing Office.) 5 cents. [125

Catalogues

Old Science and Medicine. (Catalogue 43.) Pp 64 (London E. P. Goldschmidt and Co, Ltd)

The Colorimetric Determination of Oxidation-Reduction Balance. Second edition, revised. Pp. 20. (London: The British Drug Houses, Ltd.)

A Catalogue of Books, including Bibliography and Palæography, European History and Literature, Genealogy, Heraldry and Topography, Occult Sciences, Periodicals and Publications of Learned Societies, Political Economy, Sports and Pastimes, followed by a Selection of Books on Botany (No. 529.) Pp. 124 (London: Bernard Quaritch, Ltd)

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Librarianship in Relation to Scientific Research

HUMAN nature being what it is, the continued existence of a collection of books presupposes the existence of a custodian whose primary instinct and duty is defence. So, no doubt, in the fifth or sixth century were the first librarians regarded; and so, of course, have the members of that profession to-day heavy responsibilities for the safety of priceless literary collections.

Not that all books are to be prized as storehouses of the mind; some indeed are "no good for reading", whilst others tell us "little that one need know, very much which it would be a positive mistake to believe". There are old libraries that resemble museums of antiquities, where the shelves are so many substitutes for glass cases; the bindings still a delight to the appreciative eye, and the leaves beckoning us to a near-by arm-chair for the pleasure of a dream in the remoter past. In tune with the atmosphere, we would call the venerable student in whose charge we enjoy these treasures by the name of 'library keeper', feeling the usual designation to be a little too businesslike and efficient for our mood. But there are also new libraries which repel or attract us, as may be, with the kaleidoscopic dust-covers of ephemeral fiction purporting to echo the delirium of a feverish modernity; where the keeper of the books cares nothing for their message (perhaps his sense of values is not so false after all) but counts his task well done when he replenishes his stock for fewer pence than his customers are willing to pay for their entertainment. He, too, is a 'librarian', if the title may still be held by a dealer in books, as it once was also by those who copied manuscripts and by their errors planted the seeds of so much perplexity and polemic in later generations. But to-day, if we exclude popular fiction, fewer books are read for pleasure—such is the pace of life and such the competition of other forms of enjoyment—and more for profit, so that our conception of librarianship has undergone a significant change; the custodian of books has come to be recognized for what he really is—a custodian of information. Perhaps the scientific library offers to him at once the most difficult task and the most fruitful opportunity of service in the nation's daily work.

Research, whether it be conceived in an academic spirit or planned to achieve some specific utilitarian purpose, needs for its development a basis of existing knowledge as wide and as deep as can be secured. Study of what is already known is the first step in discovering the unknown; and in that study the research worker needs help in increasing measure as the sources of his information become ever more numerous and heterogeneous. There was a time when the chemist, for example, was both expected and able to read most of the significant original papers in his subject; now he is fortunate if it is possible for him to keep abreast of part of it with the aid both of a voluminous special literature designed expressly for that purpose and of the extensive facilities provided by special libraries.

Yet a collection of books, journals, and pamphlets, while indeed the foundation, is not the only constituent of a scientific library as it is understood to-day. The service which such a library renders to students, investigators, and teachers alike depends for its efficiency on a human factor, the personality and the competence of the library staff; and for that reason, matters relating to their training are of some moment both to research workers and to students, particularly to those who may be fitted to serve their science better in a library than at a bench. Librarianship has already a valid claim to be ranked as a learned profession, the preparation for which is appropriately a concern of the universities. For example, the School of Librarianship at University College, London, is now in its eighteenth session, having been established by the Senate of the University of London on the basis of suggestions received from the Council of the Library Association, and opened in October, 1919. The School is "organised so as to give a systematic training on a broad basis to students who are already employed in libraries, record offices, or documentation centres, or who propose to adopt work of this kind as their profession."

The full-time course leading to the University of London diploma in librarianship occupies two years in the case of undergraduates (whose matriculation certificate must attest proficiency in Latin), or one year in the case of approved post-graduate students, whilst part-time students are required to devote from three to five years or two years, respectively, to the diploma studies, due account being taken also of practical experience in library administration. So much importance is attached to such experience that the diploma course includes a period of practical work to be carried out in selected libraries, a new arrangement which has already proved its value, and it is a condition of the award of the diploma that a substantial period of service in a library shall have been performed.

The University of London diploma is not, however, the only hall-mark which members of the profession may acquire. Fellowship of the Library Association is already recognized as indicating a very high degree of competence and experience, and the courses provided by the University of London School of Librarianship are equally available to persons desiring to take the intermediate and final examinations conducted by the Library Association. Here, therefore, are two avenues by which aspirants and those who have already commenced the journey may seek to demonstrate that they have reached that degree of competence which, combined with opportunity, will put them in possession, not of fame, but of the knowledge that they contribute significantly in advancing the world's work and culture. Perhaps when fuller recognition is accorded to the position which trained and experienced librarians occupy as 'key' men and women in unlocking the stores of accumulated knowledge for our instruction and delight; when both library authorities and senior members of the profession make greater use of such an institution as the School of Librarianship for the recruitment of their assistants, then an enhanced status will be associated with greater material rewards.

To this end, however, there must needs be co-operation between employers and teachers; and if the truth must be told—as indeed it should—there is here room for considerable improvement The director of the University of London School of Librarianship, Mr. J. D. Cowley, has recently made a substantial contribution. It is his responsibility to see that his students attain such a degree of familiarity with the principles of librarianship as will equip them to accept service under progressive authorities, and such practice in the application of those principles as will commend them to busy librarians who are thus spared much of the burden of instruction. He has therefore reorganized the syllabus in a manner which experience has led him to regard as desirable, and has devoted special attention to the practical aspects of the work. The new course, which is already in operation, provides lectures and examinations in languages, in English literary history, in cataloguing and classification, in administration (including local government organization and the administration of public, university, and special libraries), in bibliography and in palæography. It includes the period of supervised library experience to which reference has already been made, and makes provision for individual studies or research.

The hope may now be expressed that library authorities will, on their part, make a generous contribution to the further success of this scheme of professional training, helping it to serve more effectively not only the needs of the libraries but also the requirements of the reading public. They can do so, for example, by facilitating participation by junior members of their staffs, by regarding it as a principal source of supply of library officers, and by offering such salaries as will both attract the trained candidate and encourage the University of London to permit the School to expand, both in activities and in numbers, parallel with the demands which the profession of librarianship may make upon it in the interests of a community seeking culture, of a nation demanding progress, and of a world sorely needing that sympathy and understanding which fails where knowledge is lacking.

The Imperial Agricultural Research Institute, New Delhi

By Dr. W. Burns, Imperial Council of Agricultural Research

SINCE the time when Voelcker wrote his report "The Improvement of Indian Agriculture" in 1893, it has been recognized that agricultural progress in India must be based firmly on research. Accordingly, when Mr. Henry Phipps, an American philanthropist, came forward in 1901 with a splendid donation of £30,000 to be devoted to some project of public utility, if possible in the direction of scientific research, Lord Curzon, who was then Viceroy, decided to use the greater part of this donation for the construction of an agricultural research laboratory at Pusa. Pusa is in a rather out-of-the-way part of the province of Bihar, and the choice of site was not perhaps the happiest. The earthquake of January 1934, which did great damage to the Institute, brought up the question of rebuilding or shifting it. The second alternative won the day, and the result is the new Institute of Agricultural Research at New Delhi. But the old name Pusa has become very familiar, and those coiners of local place-names, the taxi and tonga drivers of Delhi, have already christened the new Institute the "Pusa College", while many scientific workers in India often refer to it as the "New Pusa".

The early days of Pusa saw the pioneer work of Leather in soil chemistry, of Butler in the realm of fungal diseases of plants, of the Howards in the production of new races of crops, especially wheat, and of Maxwell-Lefroy (whose name is written in the Book of Martyrs of science) in the cataloguing and combating of insect pests.

The Howards' wheats, particularly Pusa 4, Pusa 12 and Pusa 52, are now grown over six million acres in India, and some of the Pusa wheats have a vogue in Australia. Plant breeding for strictly economic ends and also the study of pure genetics have always figured largely on the programme of the Institute. Some useful hybrids between American and Indian tobaccos, wilt-resistant pigeon-pea strains, and better linseed types are some of the economic results, while the inheritance of characters in several important crops including linseed and chillies (*Capsicum*) has been the subject of important memoirs. It should be mentioned that the now world-famous Sugar Cane Research Station at Coimbatore in the Madras Presidency is a sub-station of the old Pusa and of the new Institute.

The site of the new Institute is within the limits of Imperial Delhi, and contains 476 acres of good agricultural land, plus 300 acres, of which part is pasture and part occupied by roads and buildings. About seventy miles from Delhi on the Grand Trunk Road (and also on the railway) is Karnal, where there is a farm that is now a sub-station of the Imperial Institute. Progress with the construction of the Institute was rapid. Lord Willingdon laid the foundation stone of the library on February 19, 1935. The library and laboratories were, in April 1936, ready for internal fittings and equipment. Work in these laboratories actually began in August 15, and the formal opening took place at the hands of His Excellency the Viceroy, the Marquis of Linlithgow, on November 7, as soon as possible after the Government of India came back to Delhi from Simla. Special references were made on that occasion to the late Sir Fazl-i-Husain (who had as Member for Education, Health and Lands been of the greatest help to the Institute) and the late Dr. F. J. F. Shaw, who was director of the Institute during the period of transfer and reconstruction. The total cost of the transfer, including the building of the new Institute and the acquisition and layout of the land, was Rs. 36 lakhs. The climate and soil of Delhi are suitable for growing a much greater range of crops than at Pusa. Part of the land will be cultivated under rainfall and the rest under irrigation water from the Jumna pumped through 12,000 feet of pipe line and open channels.

The New Delhi Institute naturally differs from that of Pusa in its buildings and layout. The Pusa laboratories were located in a central two-story building, divided up into sections for the various sciences and the library. At Delhi each science has its own separate single-story block, giving ample room for the present and opportunity for expansion in the future. The library is housed in a spacious central building with a clock tower. The Institute now possesses 80,000 volumes and is considered to have the biggest agricultural library in the East. It also receives every important periodical dealing with agriculture and its underlying sciences

The Botanical Section is housed in two blocks. The main one consists of a number of rooms equipped for advanced scientific work. The outbuildings are situated in an area of 50 acres laid out for plant breeding. New developments of this section are to be in the directions of plant physiology and cytology, while the plant breeding activities of the section will be maintained and intensified.

The Chemical Block, housing activities in soil science and agricultural chemistry, contains forty rooms fitted up for work in general analytical chemistry, micro-analysis, microbiology, soil physics, physical chemistry and plant chemistry. In addition, there are underground rooms where even temperatures can be maintained, laboratory workshops, a pot-culture house and lysimeters. A new feature of the Chemical Block is a laboratory for carrying out small investigations on the utility of agricultural products and to devise ways and means for the making of intermediate products. The need for this was recognized in 1921 by the Board of Agriculture in India.

In the Entomological Block are a main laboratory, a parasite laboratory and underground constant-temperature rooms. The rooms containing the collections have about 10,000 species represented by hundreds of thousands of specimens both pinned and in alcohol.

The Mycological Block has similarly rooms for use as laboratories, as constant-temperature rooms, as culture rooms and as herbaria, the last named containing a very valuable collection of fungi.

There is a group of buildings consisting of a dairy cattle byre with modern fittings, a veterinary dispensary, bull runs, sheds for sick animals and for segregation, and sheds for implements.

No mention of the Institute would be complete without a mention of what is a great attraction to visitors, namely, the famous Pusa pedigree Sahiwal herd. This is one of the finest herds of milch cattle in India. It has been in existence since 1904, when fourteen cows and one bull were purchased from the Punjab. It has gradually been selected from homebred stock with occasional fresh blood from outside. The average milk yield per cow per day has risen from 5 lb. in 1914 to 22 lb. in 1934. The bringing of this herd, numbering 172, from Pusa to Delhi was an achievement in itself, a special train being required, taking four days on the journey. There was no break in the recording of milk yields or of the routine of the herd during the transit, and the animals arrived at Delhi in first-class condition.

In addition to the research work of the Institute, there is also its educational activity. This takes the form of two-year postgraduate courses in which the student specializes in one or other of the subjects botany, chemistry, entomology or mycology, and in which the current research work of the Institute is the background of the teaching. Since the inception of this course in 1923, fifty-six students have passed out from the Institute, of which number forty-six have obtained employment either in provincial or State departments of agriculture or under schemes financed in whole or in part by the Imperial Council of Agricultural Research. There is also given a one-year course in farm management, and as occasion or need arises, short courses in special subjects such as the flue-curing of tobacco are arranged.

Lord Curzon, when laying the foundation stone of the original Pusa Institute, remarked that he would like to visit the place in fifty years time and see what it had grown into. He said, "Should I find Pusa the centre of a great organization, with ramifications extending to all parts of the Indian Continent, training a series of students who will devote their acquired knowledge to the practical pursuit of agriculture and able to point to the tangible results of successful scientific experiment, both in the quality of seeds and plants, in the destruction of pests, and in improvement of breeds of cattle ? That is the prospect that I should like to look forward to, and if it be at all realized then we may be assisting at a rather momentous childbirth to-day."

The now twice-born Institute faces the future with the means and the will to carry on to still completer realization this prophetic vision.

Chronological Problems in the Prehistory of North Africa

IMPORTANT questions relating to the antiquity of 'fossil' man in North Africa and to the dating and cultural affinities of the later stone age civilization of North Africa and the Sahara are debated by M. R. Vaufrey, of the Institut de Paléontologie humaine, Paris, in two recently published papers*.

In the first of these, M. Vaufrey has assembled and examined critically the evidence bearing on the age of the skeletal remains and artefacts found in the "escargotières" of Mechta el-Arbi, Tunisia. This midden site was discovered in 1907 ; but knowledge of its content is imperfect. Owing to the dispersal of the collections both of human remains and artefacts made by M. A. Débruge, to whom the exploration of the site was entrusted in 1913 and again in 1923, only one of the four skulls then found is now available, housed in the Institut de Paléontologie humaine. The remaining three, with an additional specimen, are represented by casts. There are also casts of a maxilla and a mandible, while there are two mandibles at Constantine, of which one probably belongs to the Mechta el-Arbi type. The Mechta el-Arbi type has also been recognized in the skeletons from the Ibero-Maurusian cave of Afalou bou Rhummel.

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* Vaufrey, R , "L'Age des Hommes Fossiles de Mechta el-Arbi" *Bull Soc Historique et Géographique de la Région de Sétif* (1935) Vaufrey, R., "L'Age de l'Art rupestre nord-africain". *Bull Soc. Préhistorique Française*, **33**, No. 11.

The archæological material obtained from M. Débruge's investigations is also only imperfectly represented in collections, while the material obtained by the archæological mission of the Logan Museum (Beloit, Wis.) in 1926–27, though on a more extended scale, does not include a fully representative series of characteristic microliths owing to defects in the technique of excavation.

Nevertheless, the industry revealed by these investigations—an entirely microlithic industry—is not Capsian; and when the geometric microliths and the microburins, previously overlooked, are added, it conforms with the industries of Aïn Rhilane, Relilaï and a number of other sites of the same culture in the region of Sétif. These all belong to the upper Capsian—the middle Capsian being a purely hypothetical culture, which has never been described anywhere—or to a neolithic with Capsian tradition.

It follows that no greater antiquity than that of this culture can be ascribed to man of Mechta el-Arbi. In other words, Mechta el-Arbi man belongs to the Mesolithic age. Further, it also follows that Capsian man is still unknown. Other skeletal remains, such as those from Djebel Rocknia and Djebel Fartas, and the skeletons secured in 1890 by M. Pallary from caves in the neighbourhood of Oran, do not go back beyond the neolithic of Capsian tradition.

This neolithic of Capsian tradition marks the point when a neolithic culture with pottery, polished axes, querns for corn-grinding, and bifacial arrow-heads, broke in on an upper Capsian culture at the moment when the local industry was on the way to developing the arrow-head with transverse cutting edge. One result of the impact was the magnificent efflorescence of naturalistic rupestral art. This impact came from Egypt across Libya with the time-lag natural in all colonial development.

The age and affiliations of this culture, as found in association with the rupestral art in North Africa, are discussed further by M. Vaufrey in the second of the papers to which reference is made above. It opens with the critical examination of a statement made by M. M. Reygasse, which claimed a relatively high antiquity for certain rock engravings of the Sahara on the evidence of the discovery here for the first time of the spiral with figures of a fauna now extinct, or no longer found locally, such as, for example, the hippopotamus. M. Reygasse had argued further that this evidence showed that the spiral in the Sahara was independent of the Mediterranean, and that in the Hoggar and Tassili des Adjers it was older than the classical spiral of the eastern Mediterranean; while in addition it indicated that these engravings were much more ancient than the paintings showing the Garamantian vehicles.

M. Vaufrey compares the engravings of the Hoggar and Tassili des Adjers with those from Oued Chreaa in southern Oran, suggesting that these may well be the work of the same artists and belong to the same epoch. He maintains, however, that the extinction of the fauna, which is made the basis of the argument, may not have taken place at so remote a date as stated. It is frequently advanced on the evidence, *inter alia*, of the occurrence of a neolithic industry rich in green stone necklace beads in a cave in the central Sahara, that the desiccation of this region is of relatively recent date; while faunal evidence has been adduced in support of a neolithic pluvial phase in the Sahara extending from the middle of the sixth to the middle of the second millennium B.C.

It has been established by an investigation of a number of stations in Oran, some thirty in all, that the culture associated with the rock engravings is the neolithic with Capsian tradition. By the action of time and weather, this culture is not always represented in its entirety; the pottery, in particular, has usually disappeared. It is, however, better represented in more sheltered conditions, such as are found in the caves of El Arouia, north-north-east of Brézina, where a microlithic industry is associated with a class of pottery, in which the fundamental element is a type with pointed base, richly ornamented with incised decoration and frequently provided with lugs. There is also an abundance of polished axes of various kinds of stone, cylindrical or lenticular in section, as well as querns and mullers for grinding corn. In one of these caves was a naturalistic representation of one of the Equidæ and of a member of the ox family engraved on a stone. This industry was found in the north on the very borders of Oran, and from the evidence of the skeletons found by M. Pallary in 1890, its authors are known to have been of the type of the men of Mechta el-Arbi.

The pointed vases afford a new chronological element. They belong to the type found in the Gerzean culture of Negadeh in Upper Egypt of the predynastic epoch. In the same culture are found the earliest spirals, which appear on the painted ware with rounded base and with lugs, dating approximately from 4,000 B.C. Among a number of other indications of affiliation is the Libyan sheath, shown on figures at Fedjet el Khaïl and Kharrouba, which links with the Amratians, the predecessors of the Gerzeans, dating from 5,000–4,000 B.C., while an individual at Kharrouba holds a boomerang, which appears also among the Badarians of predynastic Egypt. Finally, the polished axes, the biface arrow-heads, and the harpoons and the fish-hooks of bone, which in North Africa extend as far as Mauretania, also appear in the earliest neolithic civilization of Egypt, the Tasian of the Fayum and Merimde, while the arrow-heads with transverse cutting-edge are found in the Amratian culture.

The neolithic with Capsian tradition of Oran is thus seen to comprise a number of features which derive from Egypt, but are found there as elements in cultures which succeed one another in a period extending from 6,000 to 4,000 B.C. In the Sahara these features appear more or less contemporaneously, as is shown not only by surface finds, but also on stratified sites. Hence the impression left by this neolithic culture of Capsian tradition is that it has been built up on a Capsian foundation by a succession of borrowings from the neolithic cultures of Egypt. It is a colonial culture, and like all such, is affected by a time-lag. Thus, for example, the head of a ruminant surmounted by a disk first appears in Egypt in the Amratian culture. The same figure, accompanied by bovides and ovides, appears in North Africa, but probably dating from the Middle Kingdom. Another example of the same kind is the painted representations of vehicles, which have been attributed variously to the Garamantes and other sources. The simplest explanation is that these paintings are the work of natives who had been in contact with Egypt under the New Empire, but certainly after the introduction of the horse and chariot into Egypt by the Hyksos. This would give a dating for the culture associated with these paintings, or of those representing the horse alone, such as that at Oued Chreaa, of 1,500–1,000 B.C.

While 3,500–4,000 B.C. would thus represent the extreme upward limit of dating for the neolithic culture of Capsian tradition, the gap which exists between this culture and the Mousterian or Aterian in southern Oran and probably throughout the whole of the Sahara, leads to the conclusion that no naturalistic engraving in the whole of this region is older than the neolithico-Capsian culture which is found in association with this North African school of art.

Natural Colour Eclipse Photography

THE first natural colour photograph of a total eclipse of the sun ever reproduced appears in the February issue of the *National Geographic Magazine*. The original photographs were taken on June 19, 1936, at Ak Bulak in Siberia, by Irvine C. Gardner, leader of the National Geographic Society and U.S. National Bureau of Standards Joint Eclipse Expedition

Dr. Gardner, in his very interesting article describing the general circumstances of the observations, states that six exposures on Dufay colour plates (of 1, 2, 4, 8, 16 and 8 seconds respectively) were made with a specially designed lens of 9 inches aperture and 19-feet focal length. The camera was fixed, being pointed directly at the eclipsed sun, and the plate holder moved to compensate for the solar motion. The solar image had a diameter of almost two inches. One of the photographs is reproduced in colour among the illustrations to the article.

It is perhaps scarcely fair to judge the original photographs by the reproduction, though there is no mention in the text of any differences between the original and the reproduction. The detail shown is, as one would expect, less than in the usual 'black and white' pictures, but all the main structure of the corona is visible, and the image extends to about a solar radius from the limb of the sun. The sky background is reproduced as a brownish-grey, rather than indigo, and the corona itself is distinctly pink, though it is pearly white to bluish to the eye The prominences show whitish to blue, and this seems to be nearer the truth than the common idea of a vivid scarlet.

The precise object of these photographs is not stated in the article, which is a popular account, but despite these defects as pictures corresponding to direct eye observation, these pioneer attempts at colour photography of eclipses are of enormous interest, for to the astronomers it matters little whether the photograph looks like the original. The important thing is whether there exists a one to one correspondence between the spectral composition of the radiation reaching us from the corona and prominences and the radiation transmitted by the photograph ; or, to be more exact, can the spectral intensity curve of the source be deduced from the spectral absorption curve of the photograph ?

Of course, such 'mosaic' processes as the Dufay colour, and nearly all natural colour processes, do not seek such a correspondence between source and image, but only that the image should closely resemble the source to the eye. As a given hue to the eye may be produced by more than one combination of homogeneous radiation, it does not follow that a colour photograph satisfactory to the eye would be equally satisfactory to the spectroscope, and so far no commercial process satisfies this latter test. But at least a 'mosaic' colour photograph can have the same sort of value that a set of ordinary photographs taken through filters has, and represents a coarse spectro-photometric survey. Dr. Gardner in his article does not state explicitly whether any steps were taken to make photometric measurements, but by implication something of the sort was contemplated. If it should prove practicable—and these first results of Dr. Gardner's hold high promise—to conduct even rather rough eclipse spectrophotometry in this fashion, then a new technique of great value will be at our disposal. It is too early to express any opinion on the possibilities of this method, but Dr Gardner is to be congratulated not only on his luck in obtaining clear skies at Ak Bulak, but also on his enterprise and his technical skill in securing these photographs.

Obituary Notices

Dr. W. Maldwyn Davies

BY the sudden and tragic death on February 17 of Dr. W. Maldwyn Davies of Bangor at the age of thirty-four years, entomology, and notably economic entomology, has suffered a grievous loss. Dr. Davies graduated with first-class honours at the University College of North Wales, Bangor, in 1925, and after two years at the Rothamsted Experimental Station he returned to the College in 1927 as adviser in agricultural zoology for North Wales, an appointment which comprised not only duties of a purely advisory character but also to no small extent investigation and research. For this post Davies, with his intimate knowledge of Welsh farmers and Welsh farming, was exceptionally well qualified, as evidenced by his work in connexion with the warble fly, in which science and practice were so happily combined.

Even more outstanding, however, was the research work that Davies was able to carry out in the brief period of ten years. Most notable perhaps was his contribution to our knowledge of the ecology of the aphis *Myzus persicæ* and its relationship to the spread of the virus diseases (mainly leaf-roll) of the potato. Starting from the discovery made by his colleagues, especially Dr. T. Whitehead, that in certain parts of North Wales potatoes could be grown from year to year without the introduction of fresh seed and without appreciable increase in the incidence of virus disease, Davies began a study of the aphis vectors of these diseases. By investigating the population of the aphides in the field, he was able to show that there is a significant difference in the numbers of aphides on farms where healthy seed potatoes could be grown and on those where they could not, a difference which in itself explained the varying incidence of virus disease. At the same time, the important discovery was made that the source of infestation each year was not overwintered eggs on various species of Rosaceæ, but aphides in the apterous stage overwintering on Brassicas, particularly Savoys, and it was concluded that winter Crucifers provide the main source of *M. persicæ* in spring.

The next step was to discover the factors that control the aphis population, and by a combination of laboratory and field work, Davies was able to show that the numbers of aphides in any district depend in part on the proximity of winter host plants but even more on the climatic conditions during the periods of migration. It was found that the aphides are unable to fly when the atmospheric humidity exceeds a certain maximum, owing to the effect of moisture on the wing membranes. It was also found that strong winds, instead of favouring migration, cause the insects to remain *in situ* on the host-plant. The potato-growing areas of North Wales could thus be differentiated on purely meteorological grounds into districts in which the transmission of virus disease would be facilitated by the presence of abundant vectors and those where it would not.

The last stage of the investigation, to establish whether the facts that held good in North Wales were also true of Great Britain as a whole, was already under way, and a visit to Scotland last year was to have been followed this year by a trip to Devon and Cornwall. This conclusion of the work must now be left to others, but Davies's contribution will remain a model of what such an investigation should be, and it is likely to rank as classic in its particular sphere.

Davies was not concerned only with the insects that attack plants, and his work upon the pests of farm animals, notably upon the sheep maggot flies, was of little less importance. At the instance of the Agricultural Research Council, he had recently had the co-operation of a biochemist (Dr. R. P. Hobson) in an investigation of these latter pests—a collaboration that had already produced valuable results and held out great promise of further success.

Davies's official work was thus primarily concerned with agricultural entomology, for which he had a special flair, but his interests nevertheless were not confined to this aspect of his subject. His earliest publications dealt with certain species of Collembola as pests of agricultural crops, and he was so attracted by these insects that he also found time to establish for himself a wide reputation as an authority upon them; many of the collections made by recent expeditions overseas passed through his hands for identification. He had in course of preparation a systematic key to the identification of the British species, which it is hoped is sufficiently advanced to render publication possible.

As a man, Davies was beloved by all who knew him, and he will be greatly missed by entomologists everywhere, and notably by his colleagues and friends in the agricultural services. J. C. F. F.

We regret to announce the following deaths:

Joseph Auclair, *correspondant* of the Section of Mechanics of the Paris Academy of Sciences.

Prof. Cyrus R. Crosby, professor of entomology in Cornell University, on January 11, aged fifty-eight years.

Prof. J. H. F. Douvillé, formerly professor of palæontology in the National School of Mines, Paris.

Sir Albert Kitson, C.M.G., C.B.E., director of the Geological Survey of the Gold Coast in 1913–30, on March 8, aged sixty-nine years.

Prof. C. J. Lewis, emeritus professor of public health in the University of Birmingham, on February 6.

Prof. F. P. F. Ransom, formerly professor of pharmacology in the University of London, on February 22, aged eighty-seven years.

News and Views

Sir Joseph Barcroft, C.B.E., F.R.S.

Sir Joseph Barcroft retires this year from the chair of physiology in Cambridge to which he succeeded on the death of Langley in 1925. Throughout an active life, Sir Joseph has played a prominent part in maintaining the high tradition of the Cambridge school of physiology. He has made many important contributions to knowledge, and has taught others to do the same, but his greatest contribution to physiology has been through his indirect influence on younger men. His enthusiasm, his good humour, his attractive style of writing and speaking, and his unusual gift for putting the results of profound thought into simple language, have inspired many with a love of physiology which has influenced them throughout their lives. As head of a large laboratory, he has found time to take a friendly interest in many different investigations without actively interfering with the natural development of the ideas of his colleagues.

Though he is not a medical man, much of Sir Joseph's work has been with human subjects, and much of it has had a dramatic quality that has made him widely famous. His early investigations were concerned mainly with the carriage of oxygen by blood, and with the chemical changes in organs such as the salivary glands and the kidneys which were found to use more oxygen during activity than during rest, and to liberate metabolites which controlled their blood supply. In order to study the gases in small samples of blood, or other tissues, he invented a differential manometer which is widely known as the Barcroft apparatus. For many years, he represented Cambridge against Oxford in favour of the view that the passage of gases through the epithelium of the alveoli of the lungs was a simple physical process and that, even under adverse conditions, the lungs could not take up oxygen unless the oxygen pressure in the air was greater than that in the blood. In support of this conclusion he led expeditions up high mountains, and exposed himself to low oxygen pressures for many days in a glass box in Cambridge. In more recent years he has shown, by striking experiments, that the spleen plays an important part in the circulation as a reservoir of blood, which is released in emergencies, and he has added much to our knowledge of the oxygen supply to the fœtus *in utero*, and other allied subjects.

Prof. E. D. Adrian, F.R.S.

Prof. E. D. Adrian, who succeeds Sir Joseph Barcroft to the Cambridge chair, has also spent all his scientific life in Cambridge, where he is now a Foulerton research professor of the Royal Society. Before the Great War he worked with Keith Lucas on the problems presented by the impulses in motor nerves. He then left Cambridge, obtained a medical qualification, and quickly showed that he could have been a very successful clinician. He was R.M.O. at the National Hospital, Queen Square, and during the War he had experience of the treatment of shell-shock. In 1919, he returned to Cambridge and started his well-known work on the physical basis of sensation. All knowledge depends on the brain's analysis of impulses arriving in sensory nerves. Adrian took advantage of the new methods for amplifying small electric currents and tapped the messages in the nerves. He has thus analysed the activity of sense organs in a way that was not previously possible. In recognition of this work he received, with Sir Charles Sherrington, a share of the Nobel prize for medicine in 1932. He is now called upon to spread his interests more widely than in the past, and to devote his clear brain and ready understanding to helping investigations in many branches of physiology.

Prof. M. N. Saha, F.R.S.

Prof. Meghnad Saha, who, as is recorded elsewhere in this issue, has been elected president for the current year of the National Institute of Sciences of India, is among the foremost of Indian physicists. He is chiefly known for his theory of stellar spectra, which he put forward in 1920 during a period of research with Prof. A. Fowler at the Imperial College of Science, London. In that theory, which began with a consideration of the solar spectrum and was afterwards extended to the spectra of the stars in general, Saha brought together the thermodynamical theory of ionization of atoms, at that time little known in England, and the observational indications of various degrees of ionization in stellar atmospheres found by Prof. Fowler and others. This formed the starting-point of a vigorous attack on the problems of stellar atmospheres, in which Profs. R. H. Fowler and E. A. Milne in England, and H. N Russell in America, have taken a prominent part. The result of this work has been not only a partial solution and the establishment of a definite viewpoint for the further examination of stellar atmospheric problems, but also the creation of a closer relationship between laboratory and astronomical physics, for in the light of Saha's theory certain atomic properties, for example, the duration of the excited state of an atom, can be determined from astronomical observation as well as, if not better than, from terrestrial experiments. Prof. Saha has also made other useful contributions to theoretical physics, and is the author of an imposing text-book on the subject.

British Chemical Industry and European Affairs

European affairs in relation to the chemical industry, and particularly to the British chemical industry, recently formed the subject of an address by Dr. H. Levinstein to the Institution of Chemical Engineers. If and when war comes it would, he said, be sudden and overwhelming, whilst industries unprepared for war could not be switched on to the requirements of war without great delay and immense cost. In 1914, war was not expected by the British chemical industry. Dr. Levinstein outlined some of the urgent requirements which the industry then had to face, and referred to some of the great deficiences, delays, and difficulties with which it had to contend. That it eventually surmounted these difficulties and removed these deficiencies is attested by military history, but, said Dr. Levinstein, "I have said enough to show the terrible delay, prolonging suffering and death, inevitable to going to war with our chemical industries as they were in 1914". On the other hand, "the German Government had the nucleus of a strongly centralised and organised industry for the chemical side of the production of munitions of war". The formation of Imperial Chemical Industries, Ltd., and the establishment of the Institution of Chemical Engineers are two developments of importance in the present organization of British chemical industry. "We may be thankful," he said, "for it is of great national importance, that the chemical industry is to-day more closely knit. . . . We are not so unprepared in all matters as may sometimes be thought. At least in the chemical industry we are stronger in every branch; more compact in structure, more complete in scope, with large units ably directed." The chemist has his responsibility, as a citizen, to help in removing the causes of war; but likewise his responsibility for ensuring an adequate defence against aggression is great. Dr. Levinstein has assured us that in Great Britain the chemical industry is not asleep.

Royal Commission for the Exhibition of 1851

In consequence of the Government's decision in 1935 to forgo any further contributions from the capital resources of the Royal Commission for the Exhibition of 1851 towards the cost of new buildings for the Science Museum, and owing to other factors that have lately tended to stabilize the Commissioners' income for some years to come, the Board of Management of the Commission has been able to set aside sufficient to provide for an additional annual scholarship of two or three years' duration. This will be used to extend to India the scheme of science research scholarships for overseas universities, each of which is of the annual value of £250–£280. To those who have watched the growth of post-graduate studies in India this decision has naturally given great satisfaction, and the allotment of even a single scholarship has been warmly appreciated by the Indian universities. Indian students have, of course, always been eligible for the coveted senior studentships, of which five are awarded each year by the Commissioners to advanced students of science nominated by universities in Great Britain. But until now they have had no chance to participate in the benefits of the overseas scholarships, which have been the means of training in the methods and technique of research and thus equipping for responsible positions in the scientific service of the Empire so much first-rate talent from the universities of Canada, Australia, New Zealand, South Africa and the Irish Free State. Moreover, these awards, of which eight have been made each year, provide a valuable link between research scholars of this country and the Dominions. From this point of view also the inclusion of India in the scheme is of considerable importance.

The Commissioners' research scholarships scheme, since it was first established in 1891, has, through its beneficiaries, achieved a noteworthy reputation. Of some six hundred past scholars, the majority now occupy positions of the highest rank in almost every branch of scientific activity. University life in Great Britain and the Dominions has been greatly enriched by the men and women trained under the auspices of the Commission. If rather more than half the scholars have distinguished themselves as principals, professors or lecturers in the academic world, the heads of many industrial laboratories and of Government technical establishments at home and abroad have also been recruited from the same source. No less than forty-one scholars have been elected to fellowship of the Royal Society and four of them have received Nobel prizes. This side of the Commissioners' work—and it is by no means the only side—is perhaps the most notable of their achievements since under the inspiring lead of the Prince Consort they set themselves their first task of developing as a great educational centre the property purchased at South Kensington with the proceeds of the Great Exhibition.

The Institute of Metals

Two important announcements were made by the president of the Institute of Metals, Mr. W. R. Barclay, at the annual general meeting on Wednesday, March 10. The first dealt with co-operation with two sister institutes. As a first step in a scheme of co-operation with the Iron and Steel Institute, members of each Institute can become members of the other without formality other than written application. Combined annual subscriptions and entrance fees have also been arranged. The present scheme of co-operation follows one recently completed by the two Institutes with the American Institute of Mining and Metallurgical Engineers whereby members, associates and student members of the British Institutes may, if under the age of thirty-three years, become junior foreign affiliates of the American Institute of Mining and Metallurgical Engineers on specially favourable terms, the arrangement being reciprocal in the case of members of the American Society. The president also announced that the Council had decided to issue an appeal for the creation of an Endowment Fund, to be invested for the support and extension of the work of the Institute. For the last few years the margin between income and expenditure in the annual accounts had been very narrow, and had afforded little or no opportunity to strengthen the Institute's financial reserves. Economies had been effected wherever possible, but these could not be extended without seriously curtailing the service the Institute renders to its members and to the industry in general. In the judgment of the Council the time had arrived when, on the basis of the record and achievements of the Institute, an appeal could and should be made to the non-ferrous metals industry for a substantial capital sum which it was hoped would appreciably lessen the anxiety constantly felt by the Council and its committees as to the financial future. He was glad to be able to announce that promises or actual contributions amounting to about £14,000 had already been received.

Prehistoric Cultures and Chronology in North Africa

THE most recent contribution of M. R. Vaufrey to discussion of a group of chronological and cultural problems in the archæology of North Africa, of which an account appears in another column of this issue of NATURE (see p. 432), is of more than local interest in its bearing on questions of wide import in the study of prehistoric civilizations. M. Vaufrey, the distinguished anthropologist who occupies a chair in the Institut de Paléontologie humaine in Paris, has explored extensively over a number of years among the prehistoric sites of North Africa, and his studies in the classification of the cultures and in the prehistory of that region are accorded the authority due no less to his meticulous precision as an investigator in the field than to his ability in the analysis of archæological evidence recorded by others. In his latest contributions to a subject upon which no one is thus better qualified than himself to speak, M. Vaufrey has two main objectives.

IN the first place, M. Vaufrey's aim is to determine with such precision as the case warrants the cultural association and dating thereby of the 'fossil' man of Mechta el-Arbi, a problem of no little moment in the history of the development of early types of 'modern' man in the Mediterranean area; and secondly, to determine the age which should be assigned to the characteristic art form of prehistoric North Africa, the rock engravings of varied forms of animal life in naturalistic style, a question long a matter of controversy among archæologists, of which the suggested solutions have ranged from the palæolithic to the Iron age or later. By his conclusions that this type of early man belongs to the Mesolithic age and even later, the early Neolithic, while the cultures with which he is associated, by correlation with the early civilizations of the Nile valley, can be fixed in terms of years at a period extending from the beginning of the fourth millennium, down to the middle or even the end of the second millennium B.C., M. Vaufrey arrives at a result which will be of the first importance when brought into relation with the study of mesolithic and early neolithic cultures throughout the whole range of cultural distributions in the ancient world.

Prehistoric Caves in Kent

A RECENT subsidence of earth at St. Mary Cray, Kent, has revealed the existence of a subterranean cavity, which, it is thought, may prove to be the entrance to a considerable system of caves, similar to that at Chislehurst, two and a half miles away to the south, where thirty miles of galleries have been explored since the caves were rediscovered in 1902. Marks of deer-horn picks, still clearly visible, show where prehistoric man cut away the chalk. Although it will not be possible to attempt to explore the caves at St. Mary Cray until the fallen subsoil has been removed, entrance to two chambers, it is stated in *The Times* of March 4, has been made by Mr. Gibson-Cowan and Mr. Geoffrey Edwards, who found them to be about five feet high by thirty feet long. Probing with a pole ten feet long at the end of the farther chamber failed to encounter obstructing chalk, and it may be concluded, therefore, that they extend in this direction, while the existence of an earlier subsidence a quarter of a mile away, suggests that there may be a system of connected caves of considerable extent. The Chislehurst caves have produced few archæological relics; but as an Elizabethan villa has been shown to have had direct access to the caves by means of a stair, and the caves were used as refuges, disturbance must have been considerable. At St. Mary Cray, there is no evidence of occupation, at least since Roman times. It is possible, therefore, that they may serve the needs of the archæologist to better effect, and it may be, throw further light on the prehistoric excavators of the chalk, to whose activities the dene holes, notably near Croydon, bear witness. Exploration of the newly discovered caves will begin as soon as the subsided clay has been removed and the roof of one of the chambers has been supplied with the necessary shoring.

Modern Developments in Broadcasting

IN a paper read before the Institution of Civil Engineers on February 16, Sir Noel Ashbridge traced briefly the growth of broadcasting transmission and television, and referred to some of the recent developments arising from the researches carried out by the B.B.C. The paper dealt at some length with the design of studios and the effect of size, shape and materials upon their acoustic properties. The advantages of the ribbon microphone over its predecessors were referred to, and the principal methods of sound recording were described. Improvements in the design of transmitting stations are broadly covered by schemes for economizing the power required for producing a given radiation output, and by the use of high vertical aerials, which tend to concentrate the radiation in the horizontal plane so as to give the most efficient service area. Sir Noel remarked on the difficulty of accommodating all the European broadcasting stations within the available wave-length band, and described the expedient of sharing wave-lengths between two or more transmitting stations by synchronizing their carrier waves. Next, a reference was made to the Empire broadcasting service, and the reasons which necessitated the use of short waves for this purpose were outlined. As a result of research carried out on the design of short-wave aerials to give the most efficient radiation, a considerable improvement is to be expected in overseas reception when the new short-wave transmitters of the B.B.C. are brought into operation in the near future. The paper concluded with a brief description of the methods and technique being employed for the transmissions from the London Television Station on ultra-short waves. The results of field strength surveys round London were given, and reference was made to the effect of interference from motor-cars and electrical apparatus.

Ultra-Short Wave Broadcasting

THE broadcasting service from the Alexandra Palace television station has already illustrated the suitability of ultra-short waves as a medium for the transmission not only of high-definition pictures but also of speech and music of very high quality. The latter achievement arises from the fact that in the ultra-short wave-band, the permissible band width available for the modulation frequencies is many times that obtainable amidst the present congested conditions in the medium and long-wave broadcasting bands. It is rather natural to suggest, therefore, that more use might be made of the ultra-short wave-lengths for high-fidelity sound broadcasting. This matter was referred to in a note in *The Times* of February 18, in which it was pointed out that this aspect has been under consideration by the B.B.C. for some time past. Indeed, experiments were carried out some years ago with a transmitter installed on the roof of Broadcasting House and operated on a wave-length of six metres. Further experiments are being conducted, but it is stated that no plans have yet been made for the development of a public service on these lines. A large-scale extension of the ultra-short wave broadcasting of sound would be complicated by at least two factors. First is the fact that the B.B.C. is not the only user of the band of wave-lengths below ten metres, for some other national services already have vested interests there. Secondly, there is the difficult problem of interference from the ignition systems of motor-cars, which cause very unpleasant noises in neighbouring receivers working on ultra-short waves. It would seem to be unlikely that broadcasting on these wave-lengths will become really popular until the fitting of suppression devices to such ignition systems is made compulsory.

Radio-Elements as Research Tools

IN a lecture to the Society of Chemical Industry on March 1, Prof. F. A. Paneth discussed "Radio-Elements in Chemical and Biological Research". Owing to the extreme sensitivity of electrometric methods it is possible to detect radio-elements in much smaller concentrations than any other chemical substances; and as they are isotopic with ordinary elements we can in many investigations substitute a radio-element for its inactive isotope. Such use of 'radio-elements' as indicators is frequently of great help if the behaviour of an element in very small concentration has to be investigated Perhaps of even greater importance is a slightly different application. By mixing a fraction of a stable element with its radioactive isotope we can differentiate this fraction from the rest of the element, and then study the exchange of atoms of identical chemical properties. It is especially this use of 'indicated atoms' which opens the door to otherwise insoluble problems. Since the discovery of artificial radio-elements, almost every chemical element can be obtained in the form of its radioactive isotope, and the use of radio-elements as indicators has been greatly extended.

AMONG the problems to the solution of which radio-elements have contributed are the determination of the solubility of very slightly soluble compounds, the preparation of the volatile hydride of bismuth, the study of the permeability to air of almost completely airtight gas-mask fabrics, of the formation of alloys at low temperatures, the rate of solution of exceedingly thin films, and electro-deposition from extremely dilute solutions. With the help of 'indicated atoms' the diffusion of lead into lead, the determination of the surface of adsorbing crystalline powders, the exchange of atoms of one and the same kind in chemical reactions have been studied for the first time. The active isotopes of carbon, phosphorus, sodium, calcium and other elements of special importance in biology make it possible to investigate the metabolism of these atoms. The use of radio-elements as indicators is steadily increasing and it is to be expected that in future many chemical, physical and biological laboratories will avail themselves of the great possibilities offered by this method in the study of an infinite variety of problems.

Bird Preservation

THE British Section of the International Committee for Bird Preservation, of which Dr. Percy Lowe is chairman and Mr. D. Seth-Smith treasurer, is appealing for support. It is governed by a committee of sixteen drawn from the Royal Society, the Royal Society of Edinburgh, the Zoological Society of London, the British Ornithologists' Union, the Royal Society for the Protection of Birds, the National Trust, the Society for the Promotion of Nature Reserves and the Society for the Preservation of the Fauna of the Empire. The British Section is not only representative of bird protection interests in Great Britain but, in addition, is in direct communication with similar sections of twenty-six nations. Its work is essentially international in character and deals with problems which can only be solved by scientific and even 'political' work on a very wide front. These include the drafting of a new international convention for the protection of European birds; the destruction of birds by waste oil at sea; the protection of the quail, which is caught in thousands during the breeding season for export to European countries; the conditions under which live birds are transported by sea; and an inquiry into the status of the Anatidæ. This latter, which is regarded as vitally important by scientific workers and sportsmen throughout Europe, includes investigations ranging from the conditions obtaining in northern breeding grounds to the diminution of *Zostera marina*. Of paramount importance is a scheme for ringing duck in order to trace their lines of migration. To carry out this work adequately it is essential that the income of the British Section should be greatly increased. All persons interested are therefore invited to become either patrons at three guineas or associates at 10*s*. 6*d*. a year. Subscriptions should be sent to the Secretary, Miss Phyllis Barclay-Smith, British Section, I.C.B.P., c/o Zoological Society of London, Regent's Park, N.W.8.

Town Planning and Decentralization

THE relationship of man to his work and his environment was explored from various aspects at a conference held by the Garden Cities and Town Planning Association, at the Housing Centre, 13 Suffolk Street, S.W.1, on February 27. Dr. Norman MacFayden, former medical officer of health for Letchworth, showed statistically that the satellite town has proved its great value from the health point of view; his comparative figures for tuberculosis and pneumonia were particularly convincing. He stressed the close relationship between man and Nature which is taken into account in the planning of garden cities, but which the modern congested cities, for example, London, Manchester, Glasgow, cannot provide. The case for the satellite town was further strengthened by papers presented by G. L. Pepler, Colin Clarke and Dr. D. H. Smith. Dr. Smith gave a full account of the uncontrolled location of industries in the Lea Valley on the outskirts of London, and pointed out that in the great majority of cases there was no reason why the factories should not have been located at a greater distance, within satellite towns. He listed a number of problems: noise, traffic congestion, traffic control, vulnerability in war time, journeys to work, as well as health and æsthetic aspects which should be further investigated and could be solved by decentralization. Mr. Colin Clarke estimated the change in the proportion of workers employed in manufacturing industries for 'export' and as compared with local industries and services, and concluded that the increase in the latter, following upon an increased standard of living, will also favour decentralization during the coming decades.

Electricity Supply in Great Britain

ON March 3, in reply to a question by Sir M. Macdonald, Mr. Hore-Belisha, the Minister of Transport, said that his Majesty's Government has decided to adopt in principle the recommendations of the McGowan Committee for a reorganization of electricity supply of the country. A few minor modifications would be added, which he understood would be generally acceptable. In the report it is stated that any attempt to carry through a scheme of reorganization on a voluntary basis would fail, and legislation must confer definite and adequate compulsory powers. It is also stated that schemes of reorganization should make provision for the possibility of ultimate public ownership of all undertakings, including those not at present subject to purchase by the local authorities. Complete standardization of systems and voltages and of methods of charge, as well as amalgamation of a large number of small undertakings into a smaller number of large ones will be necessary. As a result of such reorganization, considerable further development of rural areas should be possible. The scheme recommended by the McGowan Committee should result in a general, though necessarily gradual, reduction in costs. It rejects nationalization as a solution of the distribution problem, at least in the present stage of the evolution of the industry. It prefers to proceed by the gradual method of overhaul and consolidation and a more efficient grouping of existing undertakings. In a report published last December by P E P (Political and Economic Planning, 16 Queen Anne's Gate, S.W.1), the problem is summed up by saying that the public expects that the supply industry will hasten towards a future where the residential consumer, the farmer and the industrialist will have full freedom to use electricity to the greatest advantage. This will obviously take several years.

Nationalism and Use of Land

IN an article on "Nationalism and Land Utilisation in Britain" in the *Geographical Review* of January, Dr. Dudley Stamp directs attention to some of the results of a nationalistic policy in agriculture. Agricultural returns for 1935 and 1936 show an increase in arable acreage and in the total area of improved land, due to protective tariffs, marketing subsidy and, above all, the wheat quota. These schemes lead to excessive specialization in the commodities thus favoured, and they may, by bringing hill slopes under the plough, do more harm than good by the promotion of soil erosion. Again, the general application of, say the wheat quota, throughout the country overlooks the fact that though very little of the country is definitely outside the limits of wheat cultivation, a great part of it is not favourable, and would be harmed by constant soil disturbance. Another important consideration that is overlooked is the very small area of really first-class soils suitable for intensive arable farming such as market gardening, and yet near London and other great towns, where these products are most required, building is allowed to spread regardless of the value of the soil. Furthermore, in the 'reconditioning' of the land, or regrading to a fuller use, it is necessary to supplement the economic standard of judgment, cost per unit, by a standard of nutritional value, and pay more attention to meat and dairy products, poultry farming, and fruit and vegetable production.

Experiments in Resuscitation

A REPORT by the Soviet Union Year Book Press Service relates that ten years ago Dr. Sergei Briukhonenko carried out the following experiment. He removed the head of a dog and attached to it an apparatus which he called the autojector for artificial circulation of the blood, with the result that the severed head was kept alive for six months, reacting to all stimuli. Some years later, Dr. Briukhonenko succeeded in resuscitating a whole animal. A dog had its thorax opened and the action of the heart stopped. Death set in, but the animal was revived by the autojector. In 1936 the Institute of Experimental Physiology and Therapy was created to assist Dr. Briukhonenko in his researches. The result has been that not only has resuscitation been effected so long as half an hour after death, but also life has been maintained so that dogs which were put to death in various ways in August and September 1936 and then resuscitated are still alive and in excellent condition.

Lambeth Degrees

AN interesting note on these degrees, by Dr. Cecil Wall, appears in the "Brompton Hospital Reports", vol. 5, 1936. The power to grant such doctorates in any faculty was given to the Archbishop of Canterbury in 1534 through the Act of Supremacy and Succession. A number of degrees in medicine and science, apart from other faculties, have thus been conferred. The Lambeth doctorates were usually conferred for eminent service on those who were unable to conform with the university regulations for internal degrees. Among the men of science who received such degrees on the dates mentioned were Robert Hooke, physicist and secretary of the Royal Society (1691), John Woodward, geologist (1695), and Peter Dent, botanist (1678).

Books on Industrial Management

THE Management Library (23, Bloomsbury Square, W.C.1) has issued a list of forty-seven recommended books on industrial organization and management arranged under such headings as scientific management, finance and accounting, production management, distribution, advertising, commercial and industrial training. The Library contains some further three thousand volumes, and detailed lists, constituting a catalogue, are available free on (1) general management; (2) production; (3) accounting and company secretary; (4) distribution, including retailing; (5) rationalization; (6) psychology; (7) economics; (8) industrial biographies. Short critical reviews are published to keep members up to date as well as an annual cumulative subject-indexed guide to book selection.

Astronomical Society of the Pacific

AT the annual meeting of the Astronomical Society of the Pacific held in San Francisco on January 30, it was announced that the Catherine Wolfe Bruce Gold Medal for 1937 has been awarded to Prof. Ejnar Hartzsprung, director of the University Observatory, Leyden, Holland. In announcing the award, the president of the Society for 1936, Prof. A. O. Leuschner, gave an account of Dr. Hertzsprung's outstanding contributions to astronomy. Announcement has been made by the Director, Dr. W. H. Wright, of provision for an annual appointment to be known as the Alexander F. Morrison Memorial research associateship in the Lick Observatory. Appointments to the research associateship will be made by the regents of the University of California. "The appointee shall be an astronomer, or an authority on some other subject intimately related to astronomy, of wide and admirable repute by virtue of contributions of great value which he has made to the science of astronomy. The holder of the Research Associateship will reside at Mount Hamilton as a guest member of the staff for a certain portion of a year as would be agreed upon." Prof. Hertzsprung has accepted an invitation to be the first visitor under the new foundation.

A New Comet

A COMET of about the seventh magnitude was discovered during the evening of February 27 at the position R.A. $0^h\ 35 \cdot 3^m$: Dec. 19° 22′ N. (at $18^h\ 25 \cdot 1^m$ U.T.). It was first reported to the Central Bureau at Copenhagen by Prof. A. Wilk of the Cracow Observatory, Poland, but apparently the comet was discovered almost simultaneously by observers elsewhere. From observations made since February 27 at Warsaw, Meudon, Copenhagen, in England and elsewhere, two preliminary orbits have been computed, but the one given by Whipple and Cunningham of the Harvard College Observatory appears to fit the observations the better. The elements of this orbit give the date of perihelion as 1937 Feb 21·73 U.T. and perihelion distance as 0·620 ($\omega = 32° \ 9'$: $\Omega = 57° \ 3'$: $i = 25° \ 57'$). Thus during the present week the comet is receding from the sun, but its distance from the earth is decreasing. In consequence its brightness has remained nearly stationary, though possibly it may reach a maximum about March 13 or 14; although the comet is not a naked-eye object, it should be within the range of binoculars. On February 27, the comet was near the borders of the constellations of Pisces and Andromeda; since then it has been traversing the latter constellation, being near the bright star β Andromedæ in the evening of March 10; the comet's path, continued through Perseus, will have entered Cassiopeia on March 24. In Great Britain the comet has been photographed two or three times by Mr. G. F. Kellaway of Yeovil, Somerset; a short tail to the nucleus is shown on the photographs. Dr. A. C. D. Crommelin thinks that it is worth while to examine the possibility of identity of the present comet with that of the comets of 1532 and 1661.

Announcements

Honorary membership of the Royal Asiatic Society has been conferred upon Prof. Jules Bloch, of the University of Paris, Prof. Carl Brockelmann, of the University of Breslau, and Prof. J. Ph. Vogel, of the University of Leyden, in recognition of their eminent services to Oriental research.

The Royal Society of Edinburgh has awarded the Gunning Victoria Jubilee Prize for the period 1932–36 to Prof. C. G. Darwin, master of Christ's College, Cambridge, formerly Tait professor of natural philosophy in the University of Edinburgh, for his distinguished contributions in mathematical physics; and the Makdougall-Brisbane Prize for the period 1934–36 to Dr. E. M. Anderson, formerly of H.M. Geological Survey (Scotland), for his paper "The Dynamics of the Formation of Cone-sheets, Ring-dykes, and Caldron-subsidences", published in the Society's *Proceedings* within the period of the award.

According to *Science and Culture*, at the annual meeting of the National Institute of Sciences of India held at Hyderabad on January 5, the following officers were elected for the current year: *President*, Prof. M. N. Saha; *Vice-Presidents*, Prof. S. S. Bhatnagar and Lieut-Colonel R. N. Chopra; *Foreign Secretary*, Prof. B. Sahni; *Secretaries*, Prof. S. P. Agharkar and Dr. A. M. Heron; *Treasurer*, Dr. S. L. Hora.

At the annual general meeting of the Geological Society of London held on February 19, the following officers were elected for 1937–38: *President*, Prof. O. T. Jones; *Vice-presidents*, Prof. W. T. Gordon, Mr. J. F. N. Green, Prof. W. J. Pugh, and Prof. H. H. Swinnerton; *Secretaries*, Dr. L. Hawkes and Prof. W. B. R. King; *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, Mr. F. N. Ashcroft.

At the annual general meeting of the Society of Public Analysts and Other Analytical Chemists held on March 5 the following officers were elected for 1937: *President*, G. Roche Lynch; *Vice-Presidents*, A. L. Bacharach, H. E. Cox, B. S. Evans, A. R. Tankard, J. F. Tocher; *Hon. Treasurer*, E. B. Hughes; *Hon. Secretary*, Lewis Eynon.

The International Commission of Zoological Nomenclature has elected Mr. Francis Fleming to be secretary in succession to Dr. C. W. Stiles, who has resigned on account of ill-health. The Secretary's address is: British Museum (Natural History), Cromwell Road, London, S.W.7.

Beginning on April 1, the Victoria and Albert Museum, including the India Museum, and also the Science Museum, South Kensington, are to remain open on Thursdays, Fridays and Saturdays until 8 p.m. At present the Museums close at 6 p.m. The Museums will remain open until 8 o'clock on the Monday bank holidays at Easter, Whitsun and August.

The University of Lille has accepted the 15,000 francs awarded to Dr. Cloudesley Brereton for his book on France by the Commission du Tourisme, for a prize to be awarded in alternate years for the best essay on the works of M. Izoulet, of the College of France, and on Mr. Branford's work, "Eros and Psyche" (University of London Press).

Jean Chazy has been elected a member of the Section of Astronomy of the Paris Academy of Sciences in succession to the late M. Hamy.

Prof. Heinrich Gloël, of Wetzlau, has been awarded the Goethe Medal for Art and Science.

Prof. P. Rivet, professor of anthropology in the Museum of Natural History, Paris, has been created a Commander of the Legion of Honour.

Prof. L. van Itallie, of Leyden, recently delivered an address before the French Society of Clinical Biology, after which he was awarded the Pasteur Medal.

Prof. Karl Beurlen, professor of geology and palæontology at Kiel, Prof. Albert Dietrich, professor of pathology at Tübingen, and Prof. Hans Seger, director of the Silesian Museum for Art and Antiquities, Breslau, have been elected members of the Imperial Leopold Caroline German Academy at Halle.

The Rockefeller Foundation has made a grant of 10,000 dollars for the investigation of filterable viruses under the direction of Dr. George P. Berry, professor of bacteriology and associate professor of medicine at the University of Rochester (U.S.A.), and one of 6,400 dollars for the study of the biological effects of heat by Dr. Stafford L. Warren, associate professor of medicine and radiology.

NATURE

SUPPLEMENT

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Science and Industry in the Eighteenth Century

Matthew Boulton
By H. W. Dickinson. Pp. xiv+218+15 plates. (Cambridge: At the University Press, 1937.) 10*s.* 6*d.* net.

ADVENTITIOUS insertion of obituary anecdotes in lectures and text-books has done much to create a pardonable prejudice against the [illegible]istorical approach to science. This is regrettable [illegible]wo reasons. The first is that some of the most [illegible] hypotheses have been built with a scaffold-[illegible]logy and metaphor the significance of [illegible]ried in a forgotten social context. [illegible]at the history of science, which is [illegible]f the positive constructive achieve-[illegible]uman reason, is largely neglected by [illegible]ns. Hence the social culture of the [illegible]ury does little to reinforce confidence [illegible]er of rational co-operation. Of late, [illegible]en a new orientation, signalized in [illegible] by the publication of Hessen's much-[illegible]y, Prof. Woolf's book on seventeenth [illegible]ce and technology, a new appreciation of Hooke's work, Crowther's "British Scientists of the Nineteenth Century", and a series of memoirs in the *Economic History Journal*. The most notable of the last-named are: one by Lennard, who has edited the "Heads and Enquiries" into the prosperity of British agriculture issued in the first decade of its existence by the Royal Society, and an article on the relations of science to early English capitalism by Prof. G. N. Clark.

In one way or another, these authors show a new interest in the growth of science as a department of social history. They are less concerned with the admitted capabilities and domestic idiosyncracies of the principal actors than with the social circumstances which enlisted their interests, provided them with problems for inquiry and supplied the means of solving them. The influence of technical, ideological and institutional changes on the momentum of scientific research and the impact of new discoveries on the progress of technology, social habits and social organization are now being recognized as the professional business of the historian of science. Inevitably this makes more exacting demands than the serial obituary method. It also creates the need for a *genre* of social history which has not yet been written.

The history of science may therefore prove to be a substantial bridge between naturalistic and humanistic studies, and the beginnings of a truly scientific humanism. Many years must elapse before an authoritative work ranging over so wide a field as Whetham's "History of Science" can be undertaken with due regard to the fact that science is a social institution and that scientific workers are members of a social group. Meanwhile, the more modest task of compiling case histories concerning organizations and persons with a pivotal relation to the application of science in social life can do much to provide the necessary materials. Matthew Boulton is pre-eminently such a person, and Mr. Dickinson deserves our gratitude for a work of ripe scholarship and rich entertainment. Such is the new biography which he has given us.

It is a curious circumstance that much more has been written about the relations of science and industry during the seventeenth and nineteenth than during the eighteenth centuries. The outburst of zeal for the prosecution of scientific inquiry in Stuart times was predominantly related to navigation and the beginnings of capitalist farming. London as the centre of English mercantilism was also the centre of a highly localized culture directly or indirectly related to mercantilist policy. During the subsequent struggle between the chartered monopolies and local manufacturing interests, London forfeited its pre-eminence. Edinburgh, with the brilliant coterie which included Black, Francis Home, Playfair, Hutton and Roebuck; Birmingham, with its Lunar Society of Boulton, Erasmus Darwin, Wedgwood, Priestley and Watt; Manchester, with Henry, Dalton and James Watt, junior; and Bristol, with Beddoes and Davy, were foci of flourishing local activity in scientific research during a period when the official organs of education fully justified the pessimism finally ventilated in Babbage's tract on the "Decline of Science in England". As yet, none of them has been exhaustively explored for material relevant to the task of the historian of science.

For Birmingham the materials are most accessible. Not the least valuable part of Mr. Dickinson's biography are the opening chapters which trace its industrial development and personnel through what Nef ("Rise of the British Coal Industry") calls the first industrial revolution of Stuart times. Already in 1538, wrote Leland, "a great part of the Towne is maintained by Smithes who have their Iron and Sea cole out of Staffordshire". There the pottery industry, already flourishing in the seventeenth century, was destined to provide an early market for the partnership of Boulton with Watt. The propinquity of the Potteries proved important in more ways than one. Mr. Dickinson mentions the fact that Boulton's project to adapt the Newcomen engine for pumping water from the tail race to feed a mill-wheel "had been already adopted by other persons". From a recent article by Thomas in the *Transactions of the Ceramic Society*, it appears that it was first done by the master potter John Turner a few years before Boulton discussed the possibility with Benjamin Franklin. Extracts from this correspondence establish an interesting link between the Philadelphia Academy, the Lunar Society and the Edinburgh centre. Small, a Scots physician who had been professor of natural philosophy in the College of Williamsburg, Virginia, returned to his native country with an introduction from Franklin to Boulton, and was directly responsible for introducing Watt to the latter.

The close relations between the Edinburgh centre and the leaders of the Industrial Revolution in the eighteenth century would repay further search. The references to Black in the letters of Watt and the Wedgwood-Playfair correspondence included in the biographies of Smiles bear eloquent testimony to the unity of Scottish theory and English practice at this period. Mr. Dickinson gives us some relevant information about the business relations between Boulton and Roebuck (of sulphuric acid fame) and between Boulton and Keir, another Scots chemist, who set up an alkali factory about the same time as the introduction of the Leblanc process. The part which Birmingham played in the rise of chemical industry (in the modern sense) is not so widely known as its place in the history of power production. Watt himself was instrumental in getting bleaching powder produced on a commercial scale, and Murdoch's installation in the Soho factory started the commercial production of coal gas. The craze for 'bone china' sponsored by Spode at this period created a commercial demand for bone ash and possibly nursed into being the match industry.

James Watt, junior, who represented his father's interests in Manchester, is a direct link between the groups which respectively included Priestley and Dalton. How the new social need for theoretical guidance made it possible for them to pursue "knowledge for its own sake" has been sufficiently documented by Smiles. In the initial stages of the Industrial Revolution, chemistry was the science in greatest demand. Such was the social context in which chemical science was re-established on new theoretical foundations. It is a curious obliquity of vision to isolate the individual passion for truth from the historical circumstances which decide whether it is encouraged and along what paths it is guided.

Mr. Dickinson notes in his preface that no separate biography of Boulton has appeared since Smiles wrote "Lives of the Engineers: Boulton and Watt" in 1865. It will be recalled that t[illegible] same author also wrote a life of Wedgwood. [illegible] Dickinson, who has already given us a [illegible] volume on Watt, would perform a gr[illegible] if he added new materials to our kn[illegible] social milieu in which Priestley w[illegible] panion volume on the Prince of Po[illegible] a welcome supplement. If a less sp[illegible] than Boulton, Wedgwood, who co[illegible] Boulton in providing financial backin[illegible] was a more focal personality in re[illegible] scientific renaissance of their time. [illegible] interests in pyrometry and geology, [illegible] chemistry, closely followed the techn[illegible] the Potteries and ranged over a muc[illegible] There is a mine of new material at t[illegible] the University of London in a recent [illegible] dissertation by Thomas on the rise of [illegible] shire industry.

Mr. Dickinson writes with enthu[illegible] merges into hero worship, and pa[illegible] Men such as Boulton, Wedgwood a[illegible] were the finest flower of a stage in so[illegible] when the *entrepreneur* still discharge[illegible] function in organizing prosperity and [illegible] the advancement of knowledge w[illegible] prosperity possible. The book is bea[illegible] illustrated with photographs of Boulton's prod[illegible] and mechanical diagrams. A feature which wil[illegible] commend it to students of economic history is the account of Boulton's relations with the Mint and the technical problems of coining in his time.

L. H.

Place-Names and their Study

(1) The Place-Names of Warwickshire
By J. E. B. Gover, A. Mawer and F. M. Stenton, in collaboration with F. T. S. Houghton. (English Place-Name Society, Vol. 13.) Pp. li+409. (Cambridge: At the University Press, 1936.) 21*s*. net.

(2) The Concise Oxford Dictionary of English Place-Names
By Eilert Ekwall. Pp. xlviii+520. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 15*s*. net.

(1) THE volumes issued by the English Place-Name Society steadily increase in interest as the series lengthens. This is due in no small degree to the added skill which comes from experience in dealing with the material. The Warwickshire volume, it is true, is only the second excursion of the Society into the Midlands; but apart from the adventure of new country, the names on the whole have not the intrinsic attraction which is attached, for example, to the wealth of evidence relating to paganism in the volumes for Surrey and Essex, to name the most recent issues, nor can Warwickshire make a contribution equal in interest to that of the latter of these two counties in the study of early Saxon settlement.

The earliest reference to the name of the county is in the Anglo-Saxon Chronicle under the year 1016 in the form Waerincwicsir. It appears in a later reference as Waeringscir. That the area of the present county is not a homogeneous unit is indicated by the character and distribution of the place-names, which preserve the distinction, political indeed, but determined by geographical conditions, affecting the character of settlement, rather than by any adjustment of racial boundaries.

So long ago as the seventeenth century the famous Warwickshire antiquary, Dugdale, noted the distinction between the northern and southern areas of the county. This is to be seen in the fact that in the north, where are such names as Birmingham, Tamworth, Polesworth, settlement is of the hamlet type, whereas in the south there are large villages with the open field system, as around Oxhill and Tysoe. The settlements of the north are typical forest clearings. The Hwicce advancing into the south from the west, and founding their settlements along the valley of the Avon, found themselves on the edge of the great forest of Arden, which joins on practically continuously to the great Royal forests of Feckenham, Morfe and Cannock. Here they halted; and this northern area was left to the settlement of the Mercians, who advanced along the valley of the Nene. For them the forest determined that the form of their settlement should be the isolated farm and hamlet and not the village with its open field. The boundaries of the ancient sees of Worcester and Lichfield preserve the older civil distinction. In the Lichfield diocese, Mortimoe, near Radway, has been traced to an earlier form Mercna Mere, "the boundary of the Mercians".

Among the references to early conditions preserved in place-names one of the most interesting is Tysoe. This, the "hoe" or "hob" of Tiw, is the first reference to be encountered in the survey of the name of the old English pagan god of war. It clearly associates his worship with a spur of the Cotswolds, which forms the south-eastern boundary of the Vale of the Red Horse. Although no early reference to the latter name has been found, as the editors point out, it affords strong probability that the hills bordering the vale were once marked with a symbol appropriate to the war god. In any event, the name proves that the Hwicce were still sturdy pagans when they reached this point of their advance.

References to either Britons or Norse are not numerous. Walcots and Bretford are among indications of the former, while the latter appear only on the eastern boundary, as, for example, in the name Kirby, being confined here, as elsewhere, to the eastern side of Watling Street. Celtic derivations appear most numerously, as usual, in connexion with rivers and streams as in Anker, Avon, Arrow, Itchen and Leam.

Memory of the exploitation of the salt mines of Droitwich lingers in the name Salt Street, which appears three times on the line leading in the direction of Stratford.

Neither Norman-French nor purely French names have left a strong mark on the county. Among the latter is Beaudesert, the name of a castle in France, and among field names occur such as "le commun champ" and "le novel gardin".

(2) The volumes of the English Place-Name Society, while satisfying the need of general interest, are planned with the requirements of scholarship in view; but they have not yet covered the ground, nor will they do so for some

time to come. In the meantime Dr. Ekwall's admirable "Concise Oxford Dictionary of English Place-Names" is available as a source of information and instruction, both for those counties with which the Society has still to deal, and to meet the needs of those who are interested in the subject without being specifically students in this or related branches of research. Here the place-names are set out in alphabetical order, each with an indication of its component elements and derivation. Although the list is not complete, it is sufficiently full to meet all but an exceptional test. As a corrective of the uninstructed enthusiasm of the place-name mythologist, Dr. Ekwall provides a preface in which he has set out the main principles to be followed in the study of place-names, and indicates the principal provinces of study—archæology, local and national, and social and racial history—in which it has proved an invaluable aid to research.

Accidents

Accidents and their Prevention
By Dr. H. M. Vernon. Pp. ix + 336. (Cambridge: At the University Press, 1936.) 15*s.* net.

INCREASING attention is being paid to industrial accidents and their prevention throughout the world; the question has indeed become one of scientific study and inquiry into the proneness and incidence of accidents in relation to personal qualities and environmental conditions.

In Britain, in all good factories, the immediate treatment of minor injuries is being encouraged so as to minimize the time lost by absence from work. Systematic inquiry is being made into the cause of all accidents, and it is customary to hold a regular 'court-martial' into the more serious ones. Careful statistics are kept and exchanged with other firms, and trade associations give special attention to problems which are common to their industry. The Home Office is at all times helpful in a variety of ways.

Accidents are in the main due to human error, but it is the duty of the employer to remove so far as possible all temptations to err. The subject in some of its aspects occupied a session at last year's Chemical Engineering Congress, when the interesting fact was brought out that in Germany the after-care of the injured falls on the firm, whereas in Great Britain it falls largely on the insurance company.

In the main, in large establishments a great deal is being done, though this must be regarded only as a step towards even better conditions: in small factories and working establishments, there is doubtless still much to do, and it is these which require legislative stimulus to make them realize their responsibilities. The slogan "Safety First" is widely preached and the nation is slowly being educated to develop a safety habit of mind, though it would be obviously bad if all of us in consequence became over-cautious and were unprepared to take justifiable risks.

Enough is known about the generalities of the subject to make it possible to write about them in text-book form, and we know of no one more capable (both from his past experience and sympathetic attitude) to do this than Dr. H. M. Vernon. His book should be widely read, and will prove of particular value to safety officers and those others who are concerned in protecting their operatives. It deals, however, with much more than factory accidents, which are, as we know, only a small proportion of the total—there are accidents in the home, on the railways and most of all on the roads. Whereas the factories can be reached by legislation, the prevention of accidents elsewhere depends on a number of factors.

The question of the causes of the terrible loss of life and limb on the roads is far too thorny a one to be discussed in a review. It is a world problem and so serious as to constitute a major problem: it is known that it is receiving careful study on the lines discussed by Dr. Vernon in three of his chapters. The public at large is so obsessed with the desire for speed as to be unmoved by a casualty list which would spread horror in war time.

As against the danger of the roads, the railways have been rendered entirely safe by attention to the elimination of the risks. The air is relatively safe as the result of stringent regulations based on scientific study. The loss of life on an ill-found ship is followed by a searching inquiry and the fixing of responsibility.

There is very definitely a science of accident prevention, and it is to be hoped that this informative and valuable book will come into the hands of the largest possible number of readers.

E. F. A.

Cinematographic Anthropology

We, the Tikopia:
a Sociological Study of Kinship in Primitive Polynesia. By Dr. Raymond Firth. Pp. xxv + 605 + 25 plates. (London: George Allen and Unwin, Ltd., 1936.) 30*s*. net

THE cinema is characteristic of the age. It responds to a craze to see from an arm-chair an exact likeness of the reality in which we daily move. This spirit has invaded the social sciences. Archæology is giving up the attempt to *explain* civilization; its highest ambition is to photograph it at any given period. Anthropology has caught the infection in the most virulent form, because it is fatally easy to visit some obscure tribe, bring back continuous verbal pictures, and reel them off in volume after volume.

While we sit in our arm-chair, there pass before the mind's eye "sullen grey days with lowering clouds", the "sun-bleached thatch of sago palms", "down-drooping velvet-surfaced leaves of the taro". We can hear a servant's quavering laugh of fright, chubby little things welcoming father home, and (twice, p. 174 and p. 239) mother being notified of baby's lapse from propriety. As Dr. Firth sagely remarks, "banality about a tropic dawn is difficult to avoid when the scientist tries to range himself with the writers of fiction and belles lettres" (p. 51); but the temptation to indulge in belles lettres about the South Seas is too strong, and we have to resign ourselves to sit through an interminable "series of vignettes" (p. 110) for the sake of an occasional one which may be valuable because it serves for generalizations.

We have to sit through much that we might see at home. Read Cornwall, Manitoba, Peru for Tikopia in par. 1, p. 89, par. 3, p. 128, par. 3, p. 160, etc., and it will apply. Do we really send expeditions to the Antipodeans to come back and tell us that they are men who eat, work by day, and sleep by night, whose children cuddle up to them, and who may be good or bad parents?

So many of these "slices of life" (p. 89) are trivial. By that we do not mean small. An accent is a small thing, but it is not trivial because it has laws, alters sounds and affects etymology. Dr. Firth's excursion into "that unprofitable study, the etymology of Polynesian words", might have been more profitable if he had noticed the laws of Polynesian accent (p. 70). But to know that Sukimataranga is a bit of an acrobat (p. 14) is no good to anyone, and therefore trivial.

These vignettes are indeed accompanied by a commentary designed to bring out their scientific value. Unfortunately, the commentary often takes the place of the facts. The oft-repeated excuse is that space is lacking for complete "documentation". Surely room could be made by jettisoning lists of points there is no space to discuss (for example, pp. 429, 432), fine writing, trivialities, jettisoning even some of the texts. Text *S*.11, p. 244 might figure in a grammar, but the fact that it was heard used by a mother to her son does not make it a kinship phrase. Thus ample room could have been made for more of those illuminating statements by natives which Dr. Firth distributes all too sparingly (pp. 113, 191, 305, 332). His very valuable documents on conception (pp. 480 ff.) reward us for much long-suffering. Chapter xiii is one of the most useful because there Dr. Firth comes nearest to following his own advice that "the observer's theoretical explanations should be separated from the account of the actual happening" (p. 423).

Interpretations are no substitute for the "documents". Dr. Firth's interpretation is that for Tikopians English phrases have a talismanic value, but what Pa Tekaumata said was that they are a useful monopoly (p. 39). We should have liked to hear a Tikopian comment on the lines "your sky stands in the ocean" (p. 289), but the voice is Dr. Firth's in a 'belletristic mood'. A more prosaic interpretation is possible: "sky" in parts of Polynesia means "tomb". Compare these commentaries with Miss Alice Fletcher's "Hako" and it will be seen how much anthropological workmanship has fallen off in the last thirty-two years. As there is no vocabulary, we cannot check the translations.

Considered as contributions to theory, some of Dr. Firth's reflections are worth pondering, for example, on avoidance of kin (p. 322), and of the mother-in-law in particular (p. 314), on kinship and procreation (p. 247). Too many, however, are platitudes inflated with an uncouth phraseology. We knew that different societies have different marriage rites; the only thing we did not know was that it could be expressed as having "each their own mechanisms for dealing with the problem of transferring the major allegiance of a woman from her parents to her husband" (p. 574). It sounds more profound than it is to say that "a system of ownership of land is a mechanism of social stability" (p. 407), while to say that Tikopia "is not a community where the differential possession of wealth is an overt feature in the social structure" is longer but conveys no more than "there is no pronounced inequality of wealth" (p. 372). The functional school has fallen under the spell of the social science jargon of America, where it conceals the poverty of ideas.

Ideas are not the strong point of this book, facts might have been if the Tikopians had been allowed to speak for themselves throughout.

A. M. HOCART.

Fifty Years of Plant Physiology

An Introduction to the Principles of Plant Physiology
By Prof. Walter Stiles. Pp. xviii + 615 + 5 plates. (London: Methuen and Co. Ltd., 1936.) 27*s*. 6*d*. net.

THE publication of this book is, in some respects, a noteworthy event, as it is the first reasonably complete treatise on plant physiology published by a British author since the work of Vines in 1886. The enormous development of the literature of the subject during that period is illustrated by the long list of references included in this volume. This consists almost entirely of the more important papers published since that date. The present volume, therefore, deals almost exclusively with the plant physiology of the last fifty years.

It is of interest to compare the more noteworthy advances which are evident. The concepts underlying all branches of the subject have, of course, gained greatly in precision and, usually, they can now be illustrated by quantitative data. Especially noteworthy are the great advances in our knowledge of the properties of the leaf pigments and to balance this, a comparable clarification of the dynamics of photosynthesis. We can now distinguish mentally the role of diffusion, of photochemical change and of 'dark' reaction, even though the details of these stages in plants may still lack precision. Equally well advanced, in the relative sense, is knowledge of the absorption and conduction of water and of solutes by plants. The principle of osmosis had indeed already been established fifty years ago. But though we may now at least conceive (if with some misgivings) how water may be transported up a tree, we have been presented with still another problem in the physiology of conduction, that of accounting for movement of solutes through the phloem at rates of the order of tens of thousands of times greater than those observed in diffusion.

Again, although enormous strides have been made in understanding the mechanism of respiration, particularly in yeast and other fungi, the possible connexion in plants between fermentation and ærobic respiration, already suggested fifty years ago, is still not conclusively proved or disproved. In spite of much research, the problems involved in nitrogen and fat metabolism in plants still largely defy simple or comprehensive treatment; and considering the advances made in genetical knowledge, we are still curiously ignorant of the cell nucleus as a biochemical or physiological unit. Similarly, though very considerable advances have been made in the description and dynamical analysis of growth and of tropistic movements, it is only quite recently that much success has attended inquiry into the mechanisms underlying these phenomena.

In order to discuss such a variety of subjects adequately, Prof. Stiles, of necessity, has had to limit his treatment. He has done it by assuming a general knowledge of chemistry and by dealing mainly with the cardinal principles involved. These are considered under four main headings; (1) the general physiology of the plant cell (including respiration); (2) metabolism; (3) the physiology of growth and development; and (4) that of irritability and movement. In the introduction, the author expresses the hope that the book will be useful to undergraduates reading for pass and honours degrees. There is no doubt that this will be the case, and the treatment is, moreover, sufficiently comprehensive to make it also a valuable source of information to botanists in general. The author's name is a sufficient guarantee that it is well written, that its material is reliable and its conclusions well founded. In fact, only one slip, that in the formula for γ-fructose on p. 151, has been detected.

To some extent, the limitations imposed in choosing and compressing the available material must rightly tend to stifle criticism. Such a work as this must be viewed as a whole and not as a series of isolated chapters, and there are few who could or who would care to deal adequately with so many and such varied topics One reader might prefer to see more space devoted in the chapter on salt absorption to recent work on the energy relations of this process. The fundamental property of plant cells of accumulating ions against the concentration gradient seems to demand this treatment. Again, there are certainly some workers who would prefer to use the terms protease and peptidase rather than to employ pepsin and erepsin, on the grounds that the latter terms are not necessarily applicable to the majority of proteolytic enzymes in plants. The reference to cytochrome may possibly be regarded as somewhat brief, and the paragraphs dealing with sexual reproduction suggest that reference to recent work on sex differences might also be included. These features, however, detract from neither the broad scope nor the general utility of the book, and might well be allowed to be matters of individual preference. W. H. P.

Biological Control of Insects

The Biological Control of Insects: with a Chapter on Weed Control. By Prof. H. L. Sweetman. Pp. xii +461. (Ithaca, N.Y.: Comstock Publishing Co., Inc., 1936.) 3.75 dollars.

MUCH that has been written on the subject of biological control is of a scattered and rather fragmentary character. Some of these writings record successful application of the method; others are biological studies more or less incidental to practical issues; while a few are attempts to formulate the general biological principles involved The factors governing success or failure, where biological control is put into practice, are generally manifold and complex. We do not understand the operation of these factors sufficiently to be able to forecast an end-result with any certainty. Each project is of the nature of an experiment in itself which may, or may not, give the desired practical outcome.

The amount of information and data now available fully justifies judicious sifting and embodiment in book form. Prof. H. L. Sweetman is, consequently, to be congratulated on being the writer of the first text-book solely devoted to biological control. It had its inception, he tells us, in some teaching courses on the subject which he gave at the Massachusetts State College. The book is essentially scientific in outlook and acquaints the reader with the life-cycles, habits, methods of manipulation and of utilization of various organisms employed, or likely to be utilized, in schemes of biological control. It is, therefore, not wholly devoted to parasitic and predaceous insects. The general principles of parasitism and other phenomena come in for discussion, while the biological control of noxious plants forms the subject of a separate chapter.

Without going further into detail, the book is to be recommended as a sound introduction to the subject, which is treated from a broad point of view. It is both well arranged and well illustrated, while the literature is adequately covered in the 30 pp. of bibliography. Admirable as the book is, one cannot overlook the fact that it has been compiled to some degree by lifting whole paragraphs bodily from the writings of others. These excerpts bear neither parentheses nor reference numbers to the literature concerned. They are either copied verbatim or with some trivial alterations only. Such practices do not militate seriously against the undoubted value of the book, but they are disconcerting, and so is one of the portraits, which is not that of the person it is stated to represent.

A. D. IMMS.

Principles and Practice of Fruit-Growing

Hardy Fruit Growing
By Sir Frederick Keeble and A. N. Rawes. Pp. xi +334 +21 plates. (London: Macmillan and Co., Ltd., 1936.) 16*s*. net.

THIS is not a text-book, and it is certainly not a scientific treatise, but it is nevertheless one of the most valuable additions to horticultural literature we have had for some time. It is merely an unusually lucid, explanatory account of the practice of fruit-growing and an exposition of the scientific principles underlying the art. Chapter and verse for the statements made are not given, indeed only one reference to an original paper is quoted in the whole book, but so thorough and complete is the knowledge and so authoritative its presentation that one is left with the feeling that, even in subjects where controversy does exist, the methods advocated by the authors will at least give excellent results. The Worshipful

Company of Fruiterers, to whom the book is dedicated, is owed a debt of gratitude for conceiving the idea of so happy a collaboration. It is safe to predict that this volume will be the standard guide and reference book for many years to all who grow outdoor fruit.

The book is divided into three sections; Section 1 deals with the making and maintenance of the orchard and fruit garden, and comprises the main reading matter of the volume, in contrast with Section 2 which is intended for reference only. In this first section, the treatment of the subject of pruning requires special mention. All too often in works on practical horticulture this subject is treated in one or other of two ways. Either an attempt is made to describe in detail, often with complicated figures, the precise point at which any particular type of shoot should be cut, without more than a half-hearted effort to explain the why and wherefore, or else an involved account is given of the objects of pruning and the novice is left to infer for himself what to do in particular cases. In the book under review, the subject is treated in logical order, beginning with what pruning does and then explaining very clearly how to do it.

The chapter on where and where not to plant is also very well done, for advice on where not to plant is of as much importance as its more positive opposite, but is rarely to be found.

Section 2, however, will be to the experienced grower as well as the novice the most permanently valuable part of the book. It gives in condensed form details of culture, propagation, choice of varieties, and the more important pests and diseases and their control, for each kind of fruit separately. The amount of condensed information is astonishing. As would be expected from one who knows varieties so intimately as Mr. Rawes, the selection of varieties for different purposes is admirable and displays far more critical appreciation than in any previously published lists.

Section 3 is intended to serve as an introduction only to commercial fruit-growing. It is very short, and admittedly far from complete. Perhaps the best piece of advice in it is the indispensability to the commercial grower of Seabrook's "Modern Fruit Growing". The separate chapter on strawberries under glass is presumably added as information on this specialized line is difficult to get.

The format of the book is attractive and the print and paper of the usual high standard to be expected of the publishers. If a criticism may be made it is that more illustrations might usefully have been included. Those given are very good and mostly helpful, but refer mainly to apples. There seems no obvious reason why pear scab should have been picked out as the only fungal disease to be illustrated. However, it is refreshing to find that the usual valueless illustrations of one or two of the best-known apple varieties to be found in every other book of the kind have been omitted.

R. H. S.

Gem-Stones

A Key to Precious Stones

By Dr. L. J. Spencer. Pp. vii+237+8 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 5*s*. net.

DURING the past thirty years or so, much more interest has been taken, both by those in the jewellery business and by those who purchase their wares, in that part of mineralogy which is concerned with the stones used in jewellery. The former have found it imperative to be better informed about the stones that come into their hands, because of the increasing number of minerals which are being drawn upon for ornamental purposes. This moderately priced book is the latest on the subject, and comes from one whose career has well equipped him to write it. Dr. Spencer spent his official lifetime in the service of the Trustees of the British Museum, retiring as keeper of minerals, and in 1904 he gained an extensive grounding in the subject by translating Max Bauer's great treatise on precious stones.

The book is arranged on the usual plan. The first part, which is slightly the shorter of the two, deals with such portions of physics, chemistry and geology as are required for the proper appreciation of the properties of gem-stones, and the second part is concerned with the description of the several species. In his preface, Dr. Spencer points out that the determination and naming of the stones can be correctly done only with some knowledge of the principles of mineralogy.

Considering the long experience enjoyed by the author, it is strange that this book, which purports to be the key to the subject, should lack the lucidity and accuracy in the information wanted in practice. The characters generally used for the discrimination of cut stones are the specific gravity and the refractivity, especially the latter. In describing the use of heavy liquids in the determination of specific gravity, Dr. Spencer gives details of the elaborate set of tubes which he says that he has used for thirty years; but omits any reference to the diffusion column which is so convenient for a rapid test. A much more serious matter is the incomplete and inaccurate description of the refractometer and its use. He appears to have had little personal experience with this instrument; otherwise he would not state that in doubly refractive stones the greatest and least of the refractive indices may be found only if the facet under test is cut in a certain direction, whereas, as is well known to students of the subject, any facet will serve. Two interesting chapters on the geological occurrence and origin of precious stones and on their mining are included in this part of the book.

In the second part the properties and occurrence of the mineral species that have been used as gem-stones are discussed in twelve chapters. In order to keep the number of chapters so small, the second rank of species are grouped in pairs—spinel and chrysoberyl, beryl and topaz, garnet and tourmaline, zircon and olivine—and a host of minor minerals appear in the penultimate chapter, the final one as usual being devoted to the organic gems. In view of their importance, diamond and corundum with its well-known varieties, ruby and sapphire, are discussed in separate chapters, and both quartz and jade have been segregated. Opal has been linked with silica-glass; the author joined an expedition to the Libyan Desert to study the origin of the latter substance, a fact which perhaps explains the space devoted to its description, as it is unlikely to fill more than a humble place in jewellery. At the end of each chapter is appended a useful summary of the characters of the several species.

The book is illustrated by many drawings which appear in the text as well as by plates. There is also a plate in colour showing the principal gem-stones, but by a curious whim of the publishers it is printed on the dust-jacket. Considerable difficulty is still experienced in achieving a faithful reproduction of gem-stones in colour, and that in the present instance the result is far from true is not surprising. The key to the plate appears on the end-papers front and back. A good index adds to the value of the book.

Radio Communication for the Student

Wireless Engineering
By Prof. L. S. Palmer. Pp. xii+544. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 21*s*. net.

PROF. PALMER'S book on wireless was published in 1927 under the title "Wireless Principles and Practice"; the present edition bears the title "Wireless Engineering". This change of title is a consequence, we are told in the preface, of a rearrangement of the book and of the introduction of new matter. Comparison of the two editions, however, shows that as regards arrangement the new edition is very like the old, the heads of chapters and sections being almost identical.

As the arrangement of matter seems open to serious criticism, we summarize here the contents of the chapters to show their order: wave motion, theory of oscillatory circuits, description of miscellaneous apparatus and of aerials, theory of some special circuits, theory of thermionic tubes, description of spark and arc plant, theory of triode oscillators and descriptions of plant, wave propagation, detection of oscillatory currents, amplification, telephony and directional wireless. This order of presentation inevitably leads to difficulties in exposition and to the multiplication of forward and cross references. Also, clearly, the interpolation of a chapter dealing with a miscellany of apparatus between two chapters on the theory of oscillatory circuits cannot facilitate the task of learners. Similarly, the intrusion of a chapter on ancient spark and arc plant into the midst of the theory of triodes and triode oscillators produces another awkward break. Again, the chapter on directive aerials at the end of the book suffers by its distance from the section dealing with aerials in general. We had hoped that the opportunity of rearrangement opened by the call for a new edition would have been taken more wholeheartedly.

This lack of logical order in the chapters is often echoed inside them. For example, in the chapter on wireless circuits and aerials we find brief statements about dielectric losses, square law condensers, measuring instruments such as thermocouples, the self-capacity of coils, selectivity, together with photographs of great masts. It is to be regretted that these various items were not transported to happier positions during the preparation of this second edition. Similar comment may be made on the chapter on the detection of high-frequency currents, for this winds its tortuous way from coherers and crystal detectors to mercury arc plant for power stations, from the heterodyne method and the forgotten ticker to loud-speakers and the acoustic design of their horns.

These defects of arrangement do not, however, prevent a wireless expert from appreciating the general accuracy and wide variety of the information afforded, and the lucidity of the descriptions and explanations. But the wealth of small detail is sometimes fatiguing, and the procession of facts is sometimes packed so tight as to give an air of breathless haste. This, though useful as a memory refresher for the experts, may offer difficulties to the students for whom the book is intended, especially as the living and growing tissue is not distinguished from the dead wood.

In bringing a book on wireless engineering up to date, some authors would be influenced by the fact that in these days the number of wireless engineers concerned with apparatus for receiving signals is vastly greater than the number of engineers working on transmitting gear. But Prof. Palmer has not bothered about this; and therefore, we think, he has given far too little attention to, say, filter circuits, the matching of circuits, the use of padding condensers for yielding a constant-frequency difference between two varying circuits, decoupling connexions, and variable selectivity devices, all of which are necessities to the practising engineer, and, moreover, form instructive exercises for students. Further, in the chapter on thermionic tubes, the screen grid tetrode, perhaps the most important of all modern inventions in this field, gets short shrift, and the variable mu valve passes without any blessing. As for the great series of modern forms of tube, ranging from the pentode to the octode, and including such combinations as the duo-diode triode, these all remain unhonoured. Even such an important modern receiver as the superhet, of which hundreds of thousands are in use, gets less attention than the long-discarded arc transmitter, of which only odd examples survive.

Many wireless engineers and many students will no doubt feel that it would have been more helpful to them if these matters had been given some of the space allotted either to obsolescent things or to the analysis of the ionosphere, even though this last is admirably done and has intrinsic interest for physicists.

Infancy of Chemistry

Prelude to Chemistry:
an Outline of Alchemy, its Literature and Relationships. By Prof. John Read. Pp. xxiv + 328 + 64 plates (London: G. Bell and Sons, Ltd., 1936.) 12*s*. 6*d*. net.

THE early ages of chemistry possess a romantic glamour unshared by those of any other major science, which perhaps explains why chemists are so generally interested in the history of their subject. Prof. Read's interest reaches the level of enthusiasm, and though he expressly disclaims to have attempted to add to the formal literature of chemical history, his book—which may be appropriately classed among the *belles lettres* of chemistry—could have been written only by a scholar deeply and widely read in both primary and secondary authorities. His guiding principle has been to show the cultural relationships of alchemy, examining the numerous points of contact it made with religion, philosophy, mysticism, magic, mythology, literature and even music, and exhibiting it in proper perspective against its general social and intellectual background.

This treatment of the early history of chemistry is something quite new, and in Prof. Read's hands has resulted in a book of peculiar charm. An easy style, a nice sense of words, and a whimsical humour that never descends to facetiousness, add attractiveness to a story that has often been told, but rarely, if ever, in so delightful a manner. The professional historian of chemistry will, it is true, find few facts here that he did not know before, and may perhaps regret, according to his personal preferences, that certain periods and persons have received disproportionately small attention; but he will nevertheless enjoy the colourful tapestry of medieval alchemy which Prof. Read has woven with characteristically delicate skill. The general reader may be happy in the assurance that nothing of significance in recent work on the history of chemistry has escaped Prof. Read's notice. He mentions, for example, Prof. A. J. Hopkins's ingenious colour theory of alchemy, Prof. Tenney L. Davis's notable researches on Chinese alchemy, and Prof. J. R. Partington's investigations of chemical origins, as well as the work of Prof. Julius Ruska and others on Arabic chemistry; and in every case—as throughout the book—he is eminently successful in selecting the points of real interest and importance.

A further source of pleasure is provided by the admirable collection of illustrations, including a coloured frontispiece of the exquisite "Peacock in the Vase of Hermes" from a British Museum MS. of the "Splendor Solis". Alchemy relied very largely upon pictorial representation, so that its tenets cannot be properly appreciated without continued reference to such graphic aids ; the "Mutus Liber" (included in Manget's "Bibliotheca Chemica Curiosa") claims indeed to set forth the whole of Hermetic philosophy in a series of unannotated pictures.

Count Michael Maier (1568–1622) pressed another of the arts into the service of alchemy, setting to music—presumably of his own composition—Latin epigrams on secrets of "Chymical Nature". Prof. Read had the excellent idea of persuading a St. Andrews choir to learn and to sing some of these alchemical fugues, and since their rendering has been perpetuated in a gramophone record, anyone who wishes may hear it. In this part of his work he has had the assistance of Mr. F. H. Sawyer and Prof. H. J. Rose, whose modern chemical canon, "Hydrogenesis", written and composed in imitation of Maier's, shows 'a pretty wit' : "*Aëre cum crasso tenuis componitur aër ; adde Iouis fulmen, fit sonus, unda manet.* With a dense gas a thin gas is mixed ; pass the electric spark, and pop ! you have water." But it must have been Prof. Read who so thoughtfully added : "$2H_2+O_2=2H_2O$" !

E. J. HOLMYARD.

Quantitative Organic Microanalysis

Quantitative Organic Microanalysis of Fritz Pregl

By Dr. Hubert Roth. Third English edition translated from the fourth revised and enlarged German edition by E. Beryl Daw. Pp. xvi+271. (London : J and A. Churchill, Ltd., 1937.) 18*s*.

THE brilliant yet painstaking investigations of the late Prof. Pregl have placed quantitative organic microanalysis on such a sure footing that not only have such methods been widely adopted but also improvements and additions are constantly being introduced. Indeed, to-day, practically all the analytical procedures which the organic chemist is likely to require have been made available for him on the micro scale. This rapid development of the subject has made necessary a further edition of Pregl's well-known manual, which has now been brought up to date by Dr. Roth and translated into English by Miss Beryl Daw.

The book has been considerably enlarged and revised and, as hitherto, it opens with a section on the microchemical balance. To the matter in previous editions there have been added descriptions of a new Kuhlmann aperiodic balance, of two of the latest Bunge types, while a brief mention is made of ultra-microchemical balances.

The section dealing with elementary analysis has not been greatly modified A method of estimating carbon in the wet way is given, while the micro-Kjeldahl determination of nitrogen has been revised and a detailed description given of Friedrich's incineration with hydriodic acid. Other new procedures include a wet decomposition of halogen derivatives ; the determination of iodine as iodate ; the estimation of sulphur in the presence of nitrogen, chlorine and bromine

It is in the sections dealing respectively with the general groups and physical methods that the greatest alteration has been made, numerous new methods being included. These comprise the determination of active hydrogen by the Grignard reagent ; the titration of amino acids ; the volumetric determination of alkoxyl, alkylimino and S-alkyl groups ; the estimation of C-methyl and of isopropylidine groups ; catalytic microhydrogenation processes. New physical methods which are given include the microscopic determination of melting points ; the adaptation of Schleiermacher's principle to 'micro-boiling points' ; the determination of molecular weights by Barger's method of isothermal distillation ; the photoelectric measurement of absorption spectra ; the determinations of molecular refraction and specific rotation.

In the descriptions of the various procedures, there is given first a brief historical survey of the estimation, after which the apparatus and materials used are discussed. Then follows a very lucid and detailed summary of the course of the determination, while, finally, an actual sample analysis is given

The translator has performed her task quite creditably, although a number of small errors have been allowed to creep into the text. Fortunately, these are relatively unimportant, and do not detract from the great value of the book both to the organic chemist and to the analyst.

G. R. D

Short Notices

Archæology and Anthropology

The Dawn of the Human Mind:

a Study of Palæolithic Man. By R. R. Schmidt. Translated by Prof. R. A. S. Macalister. Pp. xxix+256+50 plates. (London: Sidgwick and Jackson, Ltd., 1936.) 12*s*. 6*d*. net.

DR. SCHMIDT in this elaborate and detailed study of the growth of mentality in primitive man, and more especially of *Homo sapiens* as he first appears as Cro-Magnon man, argues from both structure and the products of man's mind preserved in the archæological record. On one side, function is inferred from the development in organic evolution attained, more especially in growth and character of the brain, by the various early types of man from *Pithecanthropus* to *Homo sapiens*; and on the other, the basis of inference is the product, the artefact, interpreted as an indication of the mentality required to produce it, as well as of the cultural associations—social organizations, cults and the like—implied in its production. The analogy of peoples of backward culture of the present day support the argument with certain reservations.

Both lines of argument are familiar, though Dr. Schmidt is both bolder and more thoroughly logical than most in their application. The pioneer quality of his work, however, lies more particularly in the introduction of a third element into his analysis. This is interpretation through evidence afforded by a recapitulation in the child of the mental evolution of the race, analogous to the prenatal embryonic recapitulation of the phases of organic evolution. The argument is precarious, and in fact it is possible that no two observers would agree in drawing the line between this 'race-memory' and environmental influence. Nevertheless, by the aid of his theory Dr. Schmidt has produced an excellent and stimulating analysis of the culture of palæolithic man. Within its compass, his account of palæolithic art and his interpretation of it are as good as anything at present available. Prof. Macalister's translation of a difficult text is excellent.

Stone Age Africa:

An Outline of Prehistory in Africa. By L. S. B. Leakey. Pp. xii+218+14 plates. (London: Oxford University Press, 1936.) 7*s*. 6*d*. net.

DR. LEAKEY'S Munro Lectures for 1935–36, here expanded into book-form, present in summary a review of the evidence for the Stone Age in Africa. After a brief survey of the climatic and geographical conditions and the regional distribution of the distinctive fauna, recent and modern, the author gives an account of the cultural successions in East, South, North and West Africa, pointing out in dealing with the last-named that evidence at present is almost non-existent.

Recent progress in the study of African archæology has been rapid, and a correlation of this kind was badly needed. The task, however, is one for which an intimate knowledge of widely differing conditions is a necessity. In this respect there are few who are better qualified than Dr. Leakey. Nor is he afraid to assert an independent judgment, as will be noted in his critical attitude towards the work of his fellow archæologists in South Africa. In criticizing their system of nomenclature he raises a difficult question, on which for the moment it is perhaps best to reserve judgment. The extension of stone-age archæological studies to a world-wide field demands an open mind in approach to this question, until chronological and typological correlations have been more fully worked out.

Dr. Leakey does full justice to the valuable work of M. Vaufrey and other French archæologists in North Africa; but it is in East Africa, where he is on his own ground, that he is at his best. While accepting for the moment the criticisms which have been levelled at his chronological evidence, he argues inferentially for the early appearance of *Homo sapiens* in East Africa.

Misprints and slips in names and dates are regrettably frequent.

Naven:

a Survey of the Problems suggested by a Composite Picture of the Culture of a New Guinea Tribe drawn from Three Points of View. By Gregory Bateson. Pp. xviii+286+28 plates. (Cambridge: At the University Press, 1936.) 18*s*. net.

'NAVEN' is a ceremonial of the Iatmul, a head-hunting tribe of the Sepik River, New Guinea. Its preformance on occasions of importance in the life of an individual, more especially when something is done for the first time, as, for example, when a head is taken, has afforded Mr. Bateson the material for an elaborate study of the culture of the Iatmul people, in which different aspects of the one ceremony are made the basis of a detailed analysis of structure, emotional attitude and social relation.

Anthropologists who are interested in the origins of custom and religious ideas will find here much on which to exercise their theoretical faculty. This, however, is a branch of inquiry which Mr. Bateson deliberately eschews. His treatment is synchronous, and his theoretical interest is directed to the development of method in sociology and cultural anthropology on lines suggested by his investigation of 'naven'. The method here elaborated differs from the functional method of Prof. B. Malinowski, in so far as this is based upon the satisfaction of human needs. This the author consistently emphasizes, admitting, however, at the same time, that it is a development arising out of the practice of the functional school. So far, however, from discrete or classifiable needs affording the guiding principle, a single cultural element, such as the 'naven' ceremony, may be regarded from a number of aspects. Of these, three are considered here, the structural, the emotional and the sociological, and made, as it were, the matrix from which emanate lines of inquiry to embrace an analysis of the whole pattern of behaviour and the social complex. It deserves, and no doubt will receive, the careful consideration of all field anthropologists.

Biology

The Microscope

By Prof. S. H. Gage. Sixteenth edition, revised and enlarged by the addition of a Chapter on Micro-Incineration. Pp. viii + 617. (New York: Comstock Publishing Co., Inc., 1936.) 4 dollars.

This standard work passes to its sixteenth edition, which is thoroughly revised. Probably earlier editions are in the laboratories of every university and research institute, but there is not as much evidence in respect to their use as might be expected. Indeed, few laboratories can place at the disposal of their research workers the full equipment necessary for the microscopic examination of any animal or plant tissue. Teachers may explain the structure and use of a microscope, but cannot do more, since microscopy is a subject which can only be learnt by extended experience. The sole comparison of animal and plant tissues that have been killed, fixed and stained is out of date, and attention is concentrated first on the living tissues rather than on their artificial pictures; the final result has to be a composite, derived from all available means of observation.

As to the instruments, the bright-field microscope is generally mastered, but the dark-field, so invaluable for living organisms, is too little used largely because laboratories have no adequate illuminant for such. The polarizing and ultra-violet microscopes have limited use but must be available. The latter depends on the fluorescence of the substances, for example, chlorophyll giving red, and the living cells can be studied while the rays are affecting them; its use should be greatly facilitated by Dr. Gage's recent invention of an aluminium-vapour reflector, the film being deposited on polished quartz discs. No reference is needed to the chapters dealing with drawing, projection, mounting, section-cutting and other accessory technique as they show no great advances; for hæmatoxylin staining care should be taken that the Canada balsam used for mounting be alkaline.

Lastly, there is a useful chapter dealing with micro-incineration, as to which we first learnt as a practical process about four years ago, when a study was made of the distribution of the inorganic salts in the early development of the chick. The plan here is to eliminate the organic matter without unduly disturbing the mineral matter, which can be most conveniently studied on a dark-field; here spectrographic methods should also be useful.

Nature in Britain:

an Illustrated Survey. Introduced by Henry Williamson. With Contributions by R. St. Barbe Baker, E. G. Boulenger, L. C. Bushby, R. and E. Gathorne-Hardy, Seton Gordon and Frances Pitt. (The Pilgrims' Library, Vol. 3.) Pp. v + 250 + 97 plates. (London: B. T. Batsford, Ltd., 1936.) 5*s*. net.

This book, containing no less than 143 illustrations from photographs of animals and plants, written by experts in their several lines, is a remarkable production. Inevitably there must be compression, and the various chapters contain little more than brief descriptions and the more recognizable identification marks and habits of Britain's wild life. This, too, is necessarily unequal. While Miss Pitt tells us something about every one of our mammals, and Mr. Boulenger about our reptiles and amphibians, Mr. Seton Gordon cannot in thirty pages mention every British bird, or Mr. Bushby every one of several thousand insects.

As an introduction to the wild life of Britain which will compel even the blasé to take an interest, however, the book can be thoroughly recommended. It is simply written. The chapter on pond life is enough to send every boy off with a jam jar and net to the nearest pond. The illustrations are wonderfully clear, and give a good idea of the astonishing advances made in this department of photography. Where all is so good, it seems churlish to criticize, or to single out any particular chapter for praise. Nevertheless, the reviewer would have liked a little more information about certain quite common creatures; for example, there is no mention of the grass snake's offensive defensive, while "Do dragon-flies sting?" is a question only too frequently asked, and it is not answered here. Still, the amount of information given, and pleasantly given, is wonderful. If the youth of to-day is no longer interested in Nature, it is not for lack of inspiring and inspired naturalists

The Eggs of Mammals

By Prof. G. Pincus. (Experimental Biology Series.) Pp. ix + 160. (New York: The Macmillan Co., 1936.) 14*s*. net.

The subject of this book is the behaviour of mammalian eggs from the time of their genesis in the ovary to their implantation in the uterus. It opens with a discussion of the origin of the ovum, its growth and that of the follicle, and then passes on to its main theme, the physiology of fertilization, parthenogenesis and cleavage.

The mammalian ovum offers many special problems because of its close dependence on a particular environment, that of the maternal uterus, which is itself under the influence of various hormones elaborated in other parts of the body. These relationships are not yet by any means cleared up, but a promising beginning has been made in their investigation, largely by Dr. Pincus himself, many of whose results are here published for the first time. The author has also been responsible for important advances in the technique of handling and cultivating mammalian eggs outside the body, and has been able to initiate parthenogenetic development. It may be hoped that the remarkable phenomenon of ovarian atresia, the data on which are fully summarized, will throw some light on the conditions of activation of cleavage.

As is natural in a subject which has only recently been submitted to experimental analysis, the value of the book lies more in the questions which it raises than in any answers it may suggest; as the author states, "this is a book of interrogation, not explanation". It will be extremely valuable to those few who are already working in this field, and one may hope that it will lead to an increase in their number.

C. H. W.

The Principles of Bacteriology and Immunity

By Prof. W. W. C. Topley and Prof. G. S. Wilson. Second edition. Pp. xv+1645. (London: Edward Arnold and Co., 1936.) 50*s*. net.

It is not possible in a short review of this book to deal in any detail with the very extensive revision which has been carried out so successfully by the authors. Whole chapters have been rewritten and rearranged in order that the results of the very rapid advances which have taken place in bacteriology during the last few years could find their place. It is only necessary to read such chapters as those dealing with antigen-antibody reactions and virus immunity and to note the extensive additions which have been made in chapters on the Streptococci, *Brucella*, etc., to have some idea of the magnitude of the task undertaken and so thoroughly carried out.

The book has always been a really valuable work of reference, and we feel that the new edition will give it an even higher place in bacteriological literature. It will be more than a mere book of reference.

Part IV, which deals with applications of bacteriology to medicine and hygiene, will, we hope, be read by many who are not specialists in bacteriology. It might be considered as a thoroughly up-to-date textbook dealing with the practical problems of disease in man and the lower animals. To many of us this will be the most valuable, though perhaps not the most interesting, part of the book.

It is a book which every worker on the subject of bacteriology should possess and read and re-read. Our only criticism is that it is too bulky to read comfortably in an easy chair. We heartily congratulate the writers on the production of this excellent second edition.

J. M. Beattie.

The Animal's World

By Prof. Doris L. Mackinnon. Pp. xv+272. (London: G. Bell and Sons, Ltd., 1936.) 7*s*. 6*d*. net.

Too often the spoken word is lost. It was in response to many written requests by listeners to a series of broadcasts on simple biology in which Prof. Mackinnon took part that this entrancing book came to be written. As she explains in her modest preface, the author leans more to things zoological than botanical, and it is only when animals and plants become interdependent on one another that plant biology is introduced—hence the title.

Prof. Mackinnon has that rare combination—a wide and exact scientific knowledge with a facile and sympathetic pen. How animals move in air, in water, on land; how they breathe and why; how they talk to one another; what the world looks like through their eyes; why honeysuckle smells sweeter in the evening; why the heart beats; these and a hundred other questions she answers in the simplest and most direct language, such language that a child can understand and yet a grown-up can enjoy and learn from all the time.

Some of the most interesting chapters are on the senses of animals, especially those which deal with hearing and the ways in which animals communicate with one another. In connexion with the latter, an interesting example of the use of the microphone is given.

The book is profusely illustrated with many photographs of outstanding interest and beauty. In addition, there are drawings and diagrams which help to explain the text. There is also a comprehensive index.

G. M. V

British Grasshoppers and their Allies:

a Stimulus to their Study. By Dr. Malcolm Burr. Pp. xvi+162+6 plates. (London: Philip Allan and Co., Ltd., 1936.) 6*s*. net.

The sub-title of this little booklet expresses very neatly its purpose as a stimulus to the study of British Orthoptera, and there can be no question that it will serve the purpose in an admirable way. Although there are thirty-one species of Orthoptera and Dermaptera on the British list, they remain one of the most neglected groups of insects, and the distribution of the different species, to say nothing of their habits and ecology, are most imperfectly known. Determination of the recognized British species, and of such few as may be expected to occur in the British Isles, is very easy with the aid of short descriptions and figures of outstanding characters. Distributional maps are given for each species, but they serve mostly to show the lamentable paucity of records. General remarks at the beginning of the book, and scattered throughout its text, contain a host of suggestions for studies, both valuable scientifically and mostly easily carried out by any serious amateur naturalist.

The booklet, which is compact, well produced and cheap, should rapidly find its way into the pockets of field naturalists, with the desired stimulating effect on the accumulation of knowledge about this sadly neglected, but in many ways fascinating, group of insects.

B. P. Uvarov.

Aquariums and Fishponds

By A. Laurence Wells. (Warne's Information Series.) Pp. 64. (London and New York: Frederick Warne and Co., Ltd., 1936.) 1*s*. 6*d*. net.

Here are the main principles of fish-keeping and of the plants and animals suitable to an aquarium. Let it be square; cover the bottom with sand, then loam, and plant it with carefully sterilized vegetation.

Scatter the surface with pebbles, fill up and place it in the best light, taking care to cover with a glass plate to keep out dust—the organisms prefer vita-glass. When growth has commenced, introduce a few snails as scavengers, change ten per cent of the water weekly and remove debris. When all is well, introduce the fish, which must not be crowded. A pond may be constructed on the same principles and has the great advantage that the small crustaceans, insect larvæ, worms and other life will provide the necessary fish-food. For an indoor tank recourse must be had to dried foods, the best of which consist of the natural food dried, with small parts of meat, biscuit, egg and vegetable powder. We also catch live crustaceans —but any good food will do, provided that too much is not given. Chapters deal with the food and ailments of fish—we have found flavine most useful for fungus—and the plants are shown in thirty illustrations. This is a charming little book.

Cosmetic Dermatology:

with Dictionary of Ingredients; Discussion of Anatomic, Physiologic and Pharmacologic Bases of Cosmetic Application; "Shelf-tested" Formulary; and Appendices on Odor and Color in Cosmetics. By Dr. H. Goodman. Pp. xv+591. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36*s*.

This encyclopædic work, which forms a valuable addition to dermatological literature, is divided into two unequal parts. The first, which is entitled "Dictionary of Ingredients", contains separate descriptions of the official drugs of the United States Pharmacopœia and of the unofficial drugs used in the treatment of skin diseases. The second part, which forms the bulk of the work and is devoted to practical cosmetic dermatology, consists of fifty-four chapters in alphabetical order (acne–vitamins) containing an account of various skin diseases and modes of treatment. There are three appendixes dealing respectively with cosmetic colours, perfumery and weights and measures

Color Changes of Animals in relation to Nervous Activity

By Prof. G. H. Parker (University of Pennsylvania: Leidy Memorial Lectures.) Pp. ix+74. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1936.) 7*s*. net.

This volume is a somewhat extended form of the Joseph Leidy Memorial Lecture in science delivered in March 1936. Prof. Parker's recent work has led him to the conclusion that the chromatophores in fishes are controlled by neurohumors which are liberated by nerves. They may be divided into two classes—the hydrohumors, such as the substance liberated by the pituitary gland, which are carried in the circulation, and the lipohumors, which are oil-soluble substances liberated by nerve endings in the skin and diffusing slowly from one area of skin to another. The book describes the experiments on which these conclusions are based. It is well illustrated and attractively produced.

Chemistry

Industrial Chemical Calculations:

the Application of Physico-Chemical Principles and Data to Problems of Industry. By Prof. O. A. Hougen and Dr. K. M. Watson. Second edition. Pp. ix+487. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 22*s*. 6*d*. net.

The title on the cover of this excellent book is a very modest one, and gives little indication of the wealth of information and instruction to be found within. The objective of the book is the development of concise and logical methods by which complex industrial chemical problems may be solved from fundamental scientific principles. Its study is intended not to replace but to supplement a course in physical chemistry, and to prepare the student for advanced courses in chemical engineering. The first nine chapters of Part 1 deal with the more ideal low-pressure system in which simple algebraic methods can be used, and the last five chapters treat non-ideal cases by more general and complicated methods, involving considerable use of the calculus. The first four chapters deal with weights and compositions, stoichiometry, ideal behaviour of gases, and vaporization and condensation respectively. Thermo-physics and thermo-chemistry are the subjects of the next two chapters, which are followed by chapters on industrial reactions, fuels, weight and heat balances of combustion, and chemical and metallurgical processes. A detailed analysis is made, for example, of the chamber acid process and of a blast furnace. Part 2 of the book deals with entropy, free energy, and the other thermodynamic potentials, and their application to the study of chemical equilibria. Here the method of treatment is most helpful to the industrial chemist who desires to make use of all the assistance thermodynamics can give but who lacks the technique.

Detailed solutions of typical problems illustrate the application and combination of the various principles which receive treatment, and emphasis is placed on the necessity of giving each individual step in the calculation, clearly labelled, in order that a correct result may be reached, capable of quick verification. At the end of each chapter, problems are presented for solution by the reader, since only through actual practice can skill in analysing and solving problems be attained. There are more than twenty tables which provide useful physical data for a whole range of chemicals, and there are nearly a hundred figures. The price should place this book within the reach of every industrial chemist who feels the need of a more exact and quantitative approach to his problems. R. T.

Elements of Chemical Engineering

By Prof. W. L. Badger and Prof. W. L. McCabe. (Chemical Engineering Series.) Second edition. Pp. xvii+660. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 30*s*.

The first edition of this book was noticed in Nature of October 10, 1931. Time has proved its utility in America to the increasingly large number of chemical engineers who have received a college training. Now that the Imperial College of Science is starting a full undergraduate course in the subject leading to a degree at the University of London, chemical engineering may be expected to attract more students in Great Britain.

The new edition follows the old closely, with the new work incorporated; the principal changes are to be found in the chapters on flow of heat, evaporation, drying, distillation, gas absorption, extraction and filtration. Such technical works are necessarily full of symbols, the precise meaning of which it is difficult for the reader to retain: it is therefore convenient to find at the end of each chapter a list of all the symbols used therein. It is stated that, so far as possible, these correspond to the recommendations of a Committee of the American Institute of Chemical Engineers.

The book contains an introduction by Arthur D. Little, who has passed away in the interim: he was the gifted and inspired leader of the movement to make chemical engineering a science of its own.

(1) Recent Advances in Physical Chemistry

By Dr. Samuel Glasstone. Third edition. Pp. viii+477. (London: J. and A. Churchill, Ltd., 1936.) 15*s*.

(2) Recent Advances in General Chemistry

By Dr. Samuel Glasstone. Pp. ix+430. (London: J. and A. Churchill, Ltd., 1936.) 15*s*.

(1) DR. S. GLASSTONE has earned the gratitude of many chemists by writing his "Recent Advances in Physical Chemistry"; the appearance of a third edition within five years is sufficient testimony to the widespread recognition of the value of his reviews of modern work. The new matter in this edition is largely concerned with the application of wave mechanics to problems of molecular structure, and gives an account of the valency bond and the orbital methods as applied to a number of structural problems as well as a discussion of resonance phenomena in organic molecules.

(2) The new companion volume on "General Chemistry" opens with an account of atomic disintegration, and includes articles on deuterium, on electron diffraction and on free radicals. It also includes the discussions on solubility and on acid-base catalysis which had been omitted from later editions of the "Physical Chemistry" owing to lack of space. It is, however, the chapters on statistical methods and on the mechanism of reactions in solution which the reviewer has most admired. For entirely different reasons both subjects are difficult to deal with in a limited space, but Dr. Glasstone has succeeded in giving a clear and readable account of the fundamental theory of the former, whilst the discussion of reaction mechanism is an excellent survey of theory and experiment.

Chemists will find the new volume as helpful and as interesting as the earlier "Physical Chemistry"; it would be difficult to give it higher praise than this. S. S.

Physical Chemistry

By Prof. F. H. MacDougall. Pp. ix+721. (New York: The Macmillan Co., 1936.) 17*s*. net.

THIS text-book follows more or less traditional lines in the order in which the subjects are presented, but it possesses some special features worthy of note. Thus the thermodynamical aspect of physical chemistry is given more emphasis than in most English text-books of a similar standard, and the exposition of the first and second laws and their application to chemical problems is admirably clear and concise. Electrode processes and the theory of the E.M.F. of cells are also dealt with thoroughly and without the ambiguities which often mar the treatment of these subjects. Much modern work is included and the sections on extranuclear atomic structure and on theories of strong electrolytes may be mentioned as clear and useful introductions to these topics. S. S.

Disperse Systems in Gases:

Dust, Smoke and Fog: a General Discussion held by the Faraday Society, April 1936. Pp. 1041–1300. (London and Edinburgh: Gurney and Jackson, 1936). 12*s*. 6*d*. net.

AN article on some points raised in the general discussion organized by the Faraday Society on "Disperse Systems in Gases" appeared in NATURE of May 2, 1936. The papers, which are now available, are considered under the general properties of such systems and their industrial aspects, the latter being quite a short section though of great importance in relation to the amenities of life. We are all plagued by dust, by fog and by the deposition of dirt from smoke; many of the ills of the flesh are a consequence of their preventable existence. Dust produced in industry is the subject of legislation where it causes occupational diseases, but dust produced in the streets or in our homes, which we breathe laden with bacteria, is no one's concern. Nor is there any serious effort to restrict the production of smoke except by factory chimneys, in spite of the fact that so many alternative smokeless fuels to raw coal are available.

The Faraday Society was more concerned with the theoretical aspects of the question, the size of particles, their movement and the cohesion between particles. Many very useful papers are collected under the sub-heading of mist, cloud, hygroscopic nuclei, town and country fogs.

The discussions were most valuable and it will prove useful to have them in book form for reference.

A Text-Book of Inorganic Chemistry

Edited by Dr. J. Newton Friend. (Griffin's Scientific Text-Books.) Vol. 6, Part 5: Antimony and Bismuth. By W. E. Thorneycroft. Pp. xxviii+249. (London: Charles Griffin and Co., Ltd., 1936.) 18*s*. net.

THE volume of Dr. Friend's well-known text-book dealing with antimony and bismuth maintains the high standard of the series. The chemistry of these two elements is particularly difficult, and the author has wisely adopted a rather conservative attitude, in which the compounds are regarded as containing the element existing in one of two valency states, 3 and 5. The information includes the mineralogy and technology of the elements as well as the pure chemistry, and the physical constants of the elements and compounds are given in detail.

It is regrettable that a higher standard of accuracy in historical information is not generally required in text-books; in the present volume, two names are incorrectly given in one line on p. 14, for example. References to analytical methods are adequate. The literature appears to have been very well covered until about 1933, but there do not seem to be many references after this date. It should be noted that neither Thenard nor Regnault should be written with an accent.

Geography

The Preservation of our Scenery:

Essays and Addresses. By Dr. Vaughan Cornish. Pp. xiii+92+12 plates. (Cambridge: At the University Press, 1937.) 7*s.* 6*d.* net.

To Dr. Vaughan Cornish beauty of scenery is no mere luxury but a factor in the formation of national character, and he regards its preservation as essential to national well-being. Fortunately, there is a growing, but not yet sufficiently influential, body of opinion that subscribes to this view. The study of the mechanism of Nature is less important than its philosophical contemplation, and wild Nature must be protected from both the devastation of the builders and road makers and the frenzy of the collectors who may be termed the criminal classes among Nature lovers.

In the volume before us, Dr. Cornish has collected six papers and addresses which he has given to various societies on the subject of the preservation of the scenic amenities of Great Britain, and he has illustrated the volume with several of his charming sketches. One of the papers discusses the types of scenery suitable for national parks in England and Wales and the relative value of certain areas from this point of view. Another contains a strong plea for the preservation of English cliff scenery, and this is an even more urgent matter since the destructive hand of the bungalow builder is making serious inroads on some of our cliffs, notably in Cornwall.

All who value the beauty of our countryside will welcome this volume. It may be too much to hope that the vandals of our natural heritage will realize their iniquity from its pages, but the indifferent may be persuaded to abandon that attitude.

Markets and Men:

a Study of Artificial Control Schemes in some Primary Industries. By J. W. F. Rowe. Pp. ix+259. (Cambridge: At the University Press, 1936.) 7*s.* 6*d.* net.

One of the solutions for the economic troubles, which have recently 'depressed' production throughout the world, has been some form of control. The schemes have varied greatly. They have involved a world limitation of output to a percentage of the normal—tin, copper, rubber; paying the farmer not to produce certain products—cotton, wheat, hogs; actual destruction of the crop—coffee.

After a preliminary chapter on the origin and growth of artificial control schemes, the author describes those for coffee, wheat, sugar, American cotton, rubber and tin, and discusses the troubles which give rise to restriction schemes.

The language is simple, and the book is a useful record of experiments, the success or propriety of which is to-day a matter of keen controversy in political and economic circles.

Geology and Mineralogy

Rutley's Elements of Mineralogy

23rd edition, by Prof. H. H. Read. Pp. viii+490. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1936.) 8*s.* net.

The homely saying that the proof of the pudding is in the eating is well exemplified by this well-known text-book, now in its twenty-third edition, which has guided the footsteps of so many generations of students of mineralogy.

In Part 1, which deals with the properties of minerals, the chapters on crystallography and optics have been rewritten and a new chapter on the occurrence of minerals has been added. In the discussion of the elements of crystallography the treatment has been kept as simple as possible. Nothing, for example, is said about the reflecting goniometer, and only the eleven more prominent of the thirty-two classes of crystal symmetry are considered; possibly the number might have been expanded slightly so as to include the cuprite class in the cubic system, the chalcopyrite class in the tetragonal system, and the sulphur class in the orthorhombic system. Prof. Read follows all writers, except some in Great Britain, in the use of the Bravais symbols in the hexagonal system in place of the original Millerian indices. From the excellent account which is given of the optical properties of minerals the student can acquire the fundamental knowledge necessary in the determination of minerals by means of their optical characters, particularly in thin sections of rocks. The chapter on the occurrence of minerals is really an introduction to petrology and the subject of ore deposits.

In the second part, which comprises the description of minerals, the usual chemico-crystallographical classification originated by Dana has been given up in favour of one based upon economic and chemical considerations, the minerals being grouped according to the useful element contained in them and the order following the periodic classification of the elements. Care has been taken to retain the important rock-forming silicates in their natural families. Under each mineral the properties are clearly stated and attention is directed to the discriminative characters which serve to distinguish it from others with which it might be confused.

The usefulness of the book is greatly increased by the large number of excellent illustrations which are interspersed in the text and by the copious index. It is, indeed, a book which may be commended to every student of mineralogy, from whatever angle the subject be approached.

Getting Acquainted with Minerals

By G. L. English. Pp. xi+324. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 15*s*.

The veteran author of this book has long been known to those interested in the acquisition of minerals. In 1886–1904, he was actively engaged in mineral dealing under the trade name of George L. English and Co.; for the following nine years, until 1913, he was monazite expert to the National Light and Thorium Company; and finally he returned to his old life, first until 1921 as manager of the mineralogy and petrography department and then until 1934 as consulting mineralogist of Ward's Natural Science Establishment. Thus for forty-eight years he has dealt with minerals, and many of the American specimens obtained by collectors during those years have come to them through his agency.

In this book the author gives the amateur collector the benefit of his long experience. It is not and is not intended to be deeply scientific. In the first part a general but superficial account is given of the physical and chemical properties of minerals, which will serve to induce the reader to take still greater interest in the specimens already in his collection and those he hopes to acquire. Part 2 is devoted to the descriptions of minerals. As the Dana system of classification which is normally used in mineralogical text-books demands considerably more scientific knowledge than the author expects of the ordinary reader, he has adopted a classification in which the species are arranged according to the most important elements in their composition, a cross-reference being given where necessary, while the important group of rock-forming minerals are brought together in the second section. In Part 3 the rocks are briefly considered in three sections: igneous, sedimentary, and metamorphic. Part 4 is an important and original feature of the book. In it an attempt is made to identify any mineral specimen by means of three simple and obvious characters: lustre, hardness, and colour. It is a method which may be expected in skilled hands to yield good results. A novel feature of the book is the pronouncing vocabulary at the end.

The author has added to the usefulness of the book by introducing in the text a large number of drawings and illustrations from photographs, and the ample index is a great advantage.

Interpretative Petrology of the Igneous Rocks

By Prof. H. L. Alling. Pp. xv+353. (New York and London: McGraw-Hill Book Co, Inc., 1936.) 24*s*.

The igneous rocks arise by processes taking place in the physical chemical system of the magma, and the study of the genesis of these rocks is largely concerned with the application of physical chemistry to these systems. Few geologists, however, have this fundamental knowledge—their training has been too broad. It is the aim of this book to present to the geologist those principles of physical chemistry that will enable him to interpret the life-history of these rocks. The phase rule and its application to igneous systems are the basis of the treatment.

The principles of equilibria, solid solution, isomorphism and polymorphism are first examined, and then the various groups of the igneous rock-forming minerals are considered as solid solutions of end-members, or *minals*, and their thermal diagrams and optical properties dealt with. Then follows a series of what may be called essays on numerous topics of petrogenesis, such as the crystallization of magmas, diversification of igneous rocks, magmatic assimilation, end-stage processes, and many more.

Whether or not the author has succeeded in his intention of making physical chemistry plain and easy for the geologist—and opinion will certainly be divided on this point—he has at least written a book of great interest to petrologists already learned in this subject. He has, too, provided refreshing and stimulating essays on all those theories that make modern petrology so entertaining. The small scale of some of the illustrations, and a few rather awkward misprints mar an otherwise well-printed book.

Mathematics

An Illustrated Historical Time Chart of Elementary Mathematics:

for Senior and Secondary Schools, Training Colleges and Universities. By E. J. Edwards. In 5 sections, each 31in. × 22in. (London: University of London Press, Ltd., 1936.) Thick cardboard, varnished, 21*s*. net.

Many teachers of mathematics recognize the advantage of associating the subject with its history, but find difficulty in doing so in the time available. If they decorate the walls of their classrooms with Mr. Edwards's attractive charts, they will have available a stock of interesting information, illustrated with diagrams, maps and portraits, to which incidental reference can be made when appropriate.

The first chart (Beginnings of Mathematics) deals with primitives, Babylon, Egypt and China up to 2000 B.C. The second (Early Mathematics of Egypt, Babylon and China, 2000–1000 B.C.) sketches the development of integers and fractions, and of intuitive and practical geometry. The third (Ancient Greece, 1000–30 B.C.), perhaps the best of the five, deals with the work of seventeen famous mathematicians. The fourth (Dark Ages, Arab School) brings the account up to 1000 A.D. The fifth (Decline of Arabian and Beginning of European Mathematics. Modern Mathematics, 1000–2000 A.D.) attempts too much. Up to the time of the invention of the calculus the chart is good, if overcrowded (a fault emphasized by the lettering, which is more artistic than legible), but it would have been better to have omitted all reference to the eighteenth and nineteenth centuries rather than give such a meagre account, ignoring even Euler and Lagrange. The publishers might fill up the blank space (nearly a column) with matter selected from H. W. Turnbull's "The Great Mathematicians" (especially p. vii), or the works of F. Cajori and G. Prasad. H. T. H. P.

(1) Logarithmetica Britannica:

being a Standard Table of Logarithms to Twenty Decimal Places. By Dr. Alexander John Thompson. Part 7: Numbers 70,000 to 80,000. (Issued by the Biometric Laboratory, University of London, to commemorate the Tercentenary of Henry Briggs' publication of the "Arithmetica Logarithmica", 1624.) (Tracts for Computers, No. 20.) Pp. vi+102. (London: Cambridge University Press, 1935.) 15*s*. net.

(2) Tables of the Higher Mathematical Functions

Computed and compiled under the direction of Harold T. Davis. Vol. 2. (Published as a Contribution of the Waterman Institute for Scientific Research, Indiana University.) Pp. xiii+391. (Bloomington, Ind.: The Principia Press, Inc., 1935.) n.p.

(1) This part, the seventh to be issued, contains the logarithms of numbers from 70,000 to 80,000, leaving two parts still to appear. There are some interesting reproductions to illustrate the relation of Henry Briggs to Napier's "Constructio Canonis".

(2) The first volume of these tables appeared in 1933 and was reviewed in Nature. The present second volume maintains the high standard attained by the first. Tables 13–28 give the first four derivatives of the psi functions at varying intervals and from 10 to 19 decimal places. There is here some overlapping with Vol. I of the British Association Tables which appeared, as the director observes, when his work was far advanced. Tables 29–39 are concerned with Bernoulli's and Euler's numbers. Tables 40–49 give data for polynomial approximation up to the 7th degree. The volume gives errata to Vol. 1, and if the list is reasonably complete, the authors are to be congratulated on the small number of errors in so large an undertaking.

L. M. M-T.

Mathematical Snack Bar:

a Collection of Notes and Results. By Norman Alliston. Pp. vii+155. (Cambridge: W. Heffer and Sons, Ltd., 1936.) 7*s*. 6*d*. net.

This is a very unusual book and therefore somewhat difficult to review in a short notice. It comprises a collection of miscellaneous notes and conclusions in both geometry and arithmetic. As the author points out, a roving investigator accumulates a considerable amount of original material; but gleanings here and there do not necessarily provide the ingredients for a connected thesis. The apt title of the volume gives some clue to its contents, in so far that no single theme is systematically developed.

The text touches upon Diophantine analysis, Heronian triangles, theory of numbers, residues and many geometrical problems off the beaten track. Although the mathematical treatment is quite elementary, some very interesting facts are presented, notably in the determination of rational parts of a triangle, the expression of a biquadratic as a square, problems on tangencies and Fermat problems. There are indeed so many really valuable mathematical 'snacks' in the book that it is a great pity there is no reference index. A few minor inaccuracies in the print are noticeable; for example, index omitted on p. 2; sign in line 25, p. 25 and n for x on p. 87, line 3.

Elementary Analytical Conics

By Dr. J. H. Shackleton Bailey. Pp. v+378. (London: Oxford University Press, 1936.) 7*s*. 6*d*.

This interesting volume, by the headmaster of the Royal Grammar School, Lancaster, provides an elementary course in analytical conics for the use of pupils preparing for the various Higher Certificate Examinations and for scholarships. It opens with a lucid introduction showing that the conics are really plane sections of a cone—a vital point so often overlooked. Then follow seven chapters on the point, straight lines, equations and the transference of axes, the circle, parabola, ellipse and hyperbola. Chapter viii is devoted to a discussion of oblique axes, whilst the final section contains one hundred examples from recent Higher Certificate papers.

The course is thoroughly sound, and develops an admittedly difficult subject for beginners in a very stimulating way. The various parts, so often dealt with piecemeal, are here woven into a coherent whole, and special emphasis has been rightly laid upon parametric representation. The text is excellently printed and arranged, the principal formulæ being summarized at the end of each chapter.

The book may be confidently recommended, for the author has well fulfilled his aim by providing a sound foundation of the elements of co-ordinate geometry in a very attractive way which is admirably suited to the needs and age of sixth form pupils.

Interpolation and Allied Tables

Reprinted from the Nautical Almanac for 1937. Pp. ii+44. (London: H.M. Stationery Office, 1936.) 1*s*. net.

There is no wholly satisfactory text-book on interpolation, especially on the practical side. The Nautical Almanac staff have a wide experience of interpolation and sub-tabulation, and they have developed methods which appear to be superior to those generally known. This pamphlet will serve a useful purpose in making such methods more widely known, and the explanations are full enough to make it a working manual of interpolation for those who have an elementary theoretical knowledge of the subject. The method for inverse interpolation is new, and possibly more convenient than any of those already published. Special attention is directed towards 'critical tables', which are used without interpolation and have a maximum error of only half the usual amount. H. T. H. P.

Metallurgy

(1) The Journal of the Institute of Metals
Vol. 58. Edited by G. Shaw Scott. Pp. 325 + 30 plates.

(2) Metallurgical Abstracts (General and Non-Ferrous)
Vol. 2 (New Series). Edited by G. Shaw Scott. Pp. vii + 889.

(London: Institute of Metals, 1936.)

(1) "Metallic Wear" formed the subject of a general discussion at the last annual meeting of the Institute of Metals. The opening paper by Dr. H. W. Brownsdon is given in this volume, together with a record of the discussion, in which no fewer than twenty-one experts expressed their views on this important subject. Following the presidential address of Mr. W. R. Barclay, in which he dealt with organized development in the non-ferrous metal industries, are fourteen papers and related discussions, including "Effect of Molten Solder on Some Stressed Materials", "Test for Zinc Coating on Wire", "A Deep Drawing Test for Aluminium", "Magnesium Copper Alloys", "The Physical Properties of Nickel Silver Alloys" and "Experiments on the Electrical Resistance of Copper Wires". The volume concludes with an account of Mr. C. C. Paterson's May Lecture on "The Escape of Electricity from Metals: Its Practical Consequences". The author traces the effect which the liberation of the electron from metals has had on the trend of electrical engineering during the past twenty years.

(2) The second volume of "Metallurgical Abstracts" is larger than its bulky predecessor by ninety pages—a fact indicative of the ever-increasing volume of metallurgical work that is being published all over the world. The field covered includes properties of metals and alloys, corrosion and protection, electrodeposition, refining, analysis, apparatus and instruments, testing, temperature measurement and control, foundry practice, scrap metals, furnaces and fuels, refractories, heat-treatment, working, joining and the cleaning and finishing of metals. The present volume contains upwards of 10,000 abstracts, the index to which alone occupies 146 pages. It is indispensable to everyone concerned in any way with the use or application of metals and alloys. One omission which is still noticeable is a list of publications from which abstracts are regularly prepared.

Corrosion Resistance of Metals and Alloys
By Robert J. McKay and Robert Worthington. (American Chemical Society Monograph Series, No. 71.) Pp. 492. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 35*s*. net.

The remedy for corrosion in many cases is the use of the right alloy in the right place. The authors have taken this as a text in writing their book, which summarizes up-to-date information on the corrosion resistance of all the ferrous and non-ferrous alloys of any importance at all.

The first part of the book sets out to classify and explain the important points of the theory or mechanism of corrosion. The second and longer portion consists of detailed data on the corrosion of individual materials in given conditions. Chapters are devoted to: magnesium and its alloys, aluminium and its alloys, zinc and zinc coatings, cadmium plate, tin and tinplate, lead, iron and steel, molybdenum alloys, chromium alloys, chromium plate, nickel-iron alloys, nickel, nickel-copper alloys, copper, and high copper alloys. Each chapter gives a general discussion of the behaviour of the material, followed by a documented survey of knowledge of its resistance to a wide range of corrosive conditions, and an extensive bibliography.

In employing this method of presentation, metal by metal, the authors realize that it has the shortcoming that the answer to the question "What metal is best to use?" or "Is copper better than lead for sulphuric acid?" may not readily be apparent. But a uniform system of presentation enables a rapid comparison to be made once a preliminary selection of likely materials has been effected. The latter process is facilitated by a form of master-chart giving a cross-section of corrosion rates for each metal group in each of seven typical corrosive conditions. If the data given are then interpreted on the basis of the fundamental considerations set out earlier the reader will be able to obtain a clear idea of the material best suited to his purpose. It will thus prove invaluable to all metallurgists, chemical engineers and others who are faced with the problem of selecting materials to withstand particular conditions.

Miscellany

Changing Man:
the Education System of the U.S.S.R. By Beatrice King. Pp. 319. (London: Victor Gollancz, Ltd., 1936.) 10*s*. 6*d*. net.

Not even political prejudice can conceal the fact that the communist Russia to-day represents an immense social experiment of far greater interest and significance in political and social thought than the reversion to autocracies represented by modern Fascism. The success or failure of Communism under the conditions of to-day, whether in the execution of its successive five-year plans, or in the vastly enhanced extent to which the scientific worker has been placed in control, or again in the attempt to make the service motive a driving force comparable with that of the profit motive elsewhere, depends as much on education as on any one factor. In this book we are given a survey of the education system of the U.S.S.R., which should at least assist in judging as to the chances of success.

The survey is admirably done and apart from the larger question, the scientific worker will find much to interest him in the account of technical and professional education, of educational research, of higher education, discipline and examinations, etc. On many points of detail it is clear that the practice of Soviet Russia might well be adopted to some extent in our own educational system, as for example, in the efforts made to regulate the number of students entering different types of technical schools in accordance with industrial requirements, so as to prevent dislocation of industry or of social life. Similarly, the course of social science which is compulsory in university education might perhaps be adopted with advantage in our own system.

The author has given us a book which cannot well be passed over by anyone who, whatever his political creed, is interested in the impact of science on society and the capacity of man to adapt himself to new conditions.

The Philosophy of Religion *versus* The Philosophy of Science:

an Exposure of the Worthlessness and Absurdity of some Conventional Conclusions of Modern Science. By Albert Eagle. Pp. 352. (Manchester: The Author, University; London: Simpkin Marshall, Ltd., 1935.) *5s.*

THIS book is a somewhat emotional outburst written in an extremely unconventional style and evidently intended for the non-scientific reader. The author is a mathematical lecturer but he is violently opposed to 'relativity' ideas in physics and astronomy. He raises an interesting question too often overlooked by mathematicians—Is not mathematics merely a shorthand of symbols? Are not the fundamental realities of space and time based on the structure of our own minds and not on facts independent of us but observed by us? Is there a fundamental distinction between what Bergson calls 'duration', which is real time, and mathematical time, which is a convenient fiction? Was T. H. Huxley right when he said that mathematics is not a science but a machine?

Another object of the author's attack is the materialistic philosophy as preached by some biologists. It is well known that quite a number of biologists do hold the view that all the peculiar features of life are to be accounted for by the chemical composition of protoplasm, but this is not true of all; and as the author says, the most distinguished physiologists repudiate this conclusion. Dr. Eagle especially objects to a recent book on popular biology by some of the younger biologists—all of them specialists in narrow fields—in which occur dogmatic statements about materialism being the ascertained conclusion of science, and also on the nature of heredity and the method of evolution. Such a book is calculated to injure the cause of science by associating it in the popular mind with 'mechanistic' philosophy and morals.

E. W. M.

The Digestive Tract:

a Radiological Study of its Anatomy, Physiology and Pathology. By Dr. Alfred E. Barclay. Second edition. Pp. xxxvi+427. (Cambridge: At the University Press, 1936.) 36*s.* net.

IT is not surprising that within a very short time a second edition of a book of such outstanding merit as Barclay's "The Digestive Tract" should be called for. The foundation laid by the first edition is, however, so solid that, little being required in the way of alteration, the author can be content with merely bringing the book up to date. He introduces notes on the latest developments in technique, such as X-ray cinematography, a branch of the science of radiography, at present in its infancy, which should prove of great utility in investigations of the movements of the digestive organs in health and disease.

The author has for many years been concerned about the safety of workers in X-ray departments; it is reassuring to find that he now allows a higher safety limit of exposure than that laid down in his first edition.

The book not only has an appeal to the systematic reader who wishes to study the subject in its entirety, but also it will undoubtedly give many hours of pleasure to the more casual reader who merely wishes to 'browse'. It is written by one who is not content with blindly accepting the 'dicta' of his predecessors, who not only looks at his subject from widely different angles, but who also consistently probes beneath the surface. The illustrations throughout the book are of the highest quality and much may be learnt from a perusal of these alone.

Whilst appreciating that the book represents a radiological study of the anatomy, physiology and pathology of the digestive tract, one cannot help feeling that its value would be enhanced by a fuller account of the clinical aspects of the lesions described. This is not by way of a criticism, but is put forward as a tentative suggestion worthy of consideration in future editions.

R. E. ROBERTS.

Scientific Progress

(Sir Halley Stewart Lectures, 1935.) By Sir James Jeans, Sir William Bragg, Prof. E. V. Appleton, Prof. E. Mellanby, Prof. J. B. S. Haldane, Prof. Julian Huxley. Pp. 210. (London: George Allen and Unwin, Ltd., 1936.) 7*s.* 6*d.* net.

THE Sir Halley Stewart Lectures, 1935, reproduced in this volume were dealt with in NATURE at the time of their delivery. The collected volume offers the opportunity of intercomparison in relation to the aims of the Sir Halley Stewart Trust, with their concern for the prevention and removal of human misery, the social relationships of man, the development of body, mind and spirit in the individual, of just environment in the community, and of "peace on earth" through international goodwill. The placing of the six lecturers in this series on "Scientific Progress" is an excellent, if highly individual and invidious, exercise. One reader would unhesitatingly put J. B. S. Haldane first, would hesitate between Mellanby and Huxley for second place, and with renewed firmness put Sir James Jeans last. So much for a physicist's view. What would the biologist say?

Social Hygiene To-day

By H. E. Garle. Pp. 387. (London: George Allen and Unwin, Ltd., 1936.) 12*s*. 6*d*.net.

WITH some remarkable exceptions, such as Abraham Flexner, the authors of works on prostitution and venereal disease have been medical men. The present work is remarkable as emanating from a barrister-at-law, who possesses no medical qualification.

The book is divided into two parts. The first consists of ten chapters dealing with various aspects of prostitution and venereal disease, while the second part contains a digest of laws relating to prostitution and venereal disease in different countries. There are numerous appendixes dealing with international agreements made at Paris and Geneva for the suppression of the traffic in women and children and the facilities given to merchant seamen for the treatment of venereal disease, followed by a bibliography classified according to anthropology, biology and physiology, psychology, social applications and venereal diseases.

Albrecht van Borgunnien's Treatise on Medicine

(Sloane MS. 3002, British Museum). By W. L. Wardale. (St. Andrews University Publication, No. 38.) Pp. xlvii+80. (London: Oxford University Press, 1936.) 10*s*. 6*d*. net.

THIS work is a fifteenth century medico-astrological treatise written in Eastern North Low Saxon by a certain Albrecht van Borgunnien, about whom nothing further is known. Almost the whole text, which consists of a prologue and remedies for various diseases, appears to be founded on a methodical leech book which contained charms of a popular character and various medico-astrological treatises.

In addition to numerous external and internal remedies, the subjects dealt with in the work include urinoscopy, phlebotomy and the signs of the Zodiac, the four elements, the four complexions and the signs of life and death. A glossary and short bibliography are appended.

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Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 474.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Estimation of Vitamin A

SOON after the Second International Conference on Vitamin Standardisation (1934), it became apparent that the value of 1,600, which the Conference had provisionally allotted to the factor for converting results of spectroscopic tests for vitamin A into international units, might need reconsideration[1].

The Vitamin A Sub-Committee was reluctant to undertake experimental work on this problem which, it was hoped, would be settled before long by published work. When, by the autumn of 1935, this hope had not been realized, the Sub-Committee proceeded to collect unpublished data of biological and spectroscopic tests for vitamin A in various materials. These showed certain anomalies, which in the state of knowledge existing at the time, could not be harmonized. For example, a consistent series of biological tests, particularly of concentrates, showed a conversion factor of about 1,000–1,200, while equally consistent tests with some cod and halibut liver oils seemed to require a value nearer 2,000.

Further experimental work on this subject was therefore initiated by the Vitamin A Sub-Committee. The co-operation of as many laboratories as possible was enlisted, so that the results should command the maximum of confidence, and show whether any part of the discrepancy was due to variations in technique. It was obvious that with biological tests the most trustworthy results would be obtained by confining attention to a small number of materials and using as many experimental animals as possible. It was decided to investigate first whether the act of saponification, presumably effecting hydrolysis of the esterified vitamin, resulted in any change which might influence the conversion factor. Halibut liver oil, as the richest common source of vitamin A, was the material chosen. The Sub-Committee is indebted to Messrs. Parke, Davis and Co. for a quantity of a rich oil which was mixed with an equal quantity of an oil manufactured in Aberdeen.

The preparation of the concentrate and the dilution of the feeding-solutions of oil and concentrate, as well as the spectroscopic examination of all the materials including the carotene standard at the beginning of the experiment, and of the residues of the feeding-solutions from each laboratory at the end, were in the hands of Dr. R. A. Morton and Dr. J. R. Edisbury of the University of Liverpool. A special dilution of the β-carotene standard for use in the biological tests was prepared in the Department of Biological Standards of the National Institute for Medical Research. Special precautions were taken to minimize deterioration of all these materials, and great emphasis was laid on the importance of the tests for stability made on the residues of the actual solutions used for feeding. Sources of variation in technique, apart from the choice of basal diets and general treatment of the animals, were eliminated as far as foresight would permit. All the diluted feeding solutions were derived from one batch and distributed to the participants, ready for use. The relative, though not the absolute, dosage to be used was fixed and each worker used one dropping pipette for all the materials. The bottles of test material were stored continuously in a refrigerator from the time of arrival, only the approximate amount needed for dosage on any day being withdrawn at one time.

The materials were prepared in April 1936, and the last of the tests was completed in the following October.

The participants in the biological tests were:

A. L. Bacharach and E. L. Smith, Glaxo Laboratories, Ltd., Greenford.
W. A. Broom, Messrs. Boots Pure Drug Co., Ltd., Nottingham.
H. M. Bruce and K. H. Coward, Pharmaceutical Society, London.
A. D. Emmett and O. D. Bird, Messrs. Parke, Davis and Co.'s Detroit Laboratories (communicated by J. A. Freeman).
E. M. Hume, Lister Institute, London.
S. K. Kon, National Institute for Research in Dairying, Shinfield.
T. Moore, Dunn Nutritional Laboratory, Cambridge.
S. W. F. Underhill, Messrs. The British Drug Houses, Ltd., London.
H. Wilkinson, Messrs. Lever Bros., Ltd., Port Sunlight.

The results showed a surprising degree of harmony. They are now being subjected to a statistical examination. There will necessarily be some delay before this is completed, but it seems unlikely that the general conclusion will be modified. A preliminary announcement of the results is thought to be in the general interest.

After a suitable correction, to weight the means obtained according to the number of rats used by the different participants, the conversion factor for the halibut liver oil was found to be 1,470, the range of the individual values being 1,400 to 1,700. For the concentrate the values were lower, most of them lying between 1,000 and 1,200.

The spectroscopic tests for stability of the solutions administered, however, made it clear that while the halibut liver oil solution had remained relatively stable throughout the period of the tests, deterioration had occurred in the solution of the concentrate. When the individual tests were corrected for the degree of deterioration, the low value for the conversion factor disappeared, and little doubt was entertained that, in the case of this concentrate, its instability was sufficient to account for the lower values obtained. Since this deterioration took place in spite of special precautions, it seems possible that other vitamin A concentrates might behave in the same way.

It is concluded therefore that:

(1) In view of the margin of error inherent in the biological tests, the above results, giving a conversion factor of 1,470 for a halibut liver oil, provide no support for changing the value of 1,600 recommended by the International Conference (1934) for the conversion factor.

(2) Many apparent discrepancies with concentrates are likely to have been due to unsuspected deterioration in the course of biological tests, so that independent control of this source of error is essential.

(3) The ground has now been cleared for further experiments designed to test supposed variability of the conversion factor in materials derived from different species of animals.

Further co-operative experimental work is contemplated on other alleged discrepant materials from different sources, and, for this purpose, information regarding other materials showing well substantiated discrepancies would be welcomed.

E. M. HUME.
(Secretary, Vitamin A Sub-Committee of Accessory Food Factors Committee, appointed by the Lister Institute and Medical Research Council.)

Lister Institute,
London, S.W.1.

[1] Morgan, Edisbury and Morton, *Biochem J.*, **29**, 1645 (1935).

Chromosome Behaviour and Phylogeny in the Neuroptera

THERE has been disagreement on morphological and palæontological grounds as to the relationship of the groups of true Neuroptera and Megaloptera. In the first place, take the family Sisyridæ of the true Neuroptera (or Planipennia). Its members possess aquatic larvæ, and as they have some morphological features in common with Osmylidæ, the larvæ of which are semi-aquatic, Tillyard[1] in 1916 put forward the suggestion that it had to be regarded as a comparatively late offshoot of the latter. This view was then adopted by Withycombe[2], and recently Killington[3] in his admirable monograph of the British Neuroptera maintains the idea that "these two families are no doubt closely allied, and, indeed, it appears very probable that the Sisyridæ have been derived from an Osmyloid ancestor". On the other hand, Handlirsch[4] was not of the opinion that the families were very nearly related, and pointed out that Sisyridæ show a remarkable similarity with the then oldest known fossil remnants of true Neuroptera, that is, the Triassic Prohemerobidæ, the larvæ of which are supposed to have been aquatic also. Recently, Handlirsch[5] (and Beier), after having considered the discoveries of true Neuroptera in the Permian by Tillyard[6] and Martynov[7], also directs attention to the striking resemblance of some of these very old remnants with the living Sisyridæ, which group he still regards as a primitive and primarily aquatic one. Tillyard[8] seems later to have given up his original view and regarded Sisyridæ as "a specialized side branch" not very close to Osmylidæ. After much dispute, therefore, morphologists have come to no agreement on the relationships of the two groups.

The evidence of chromosome behaviour, on the other hand, proves to be unequivocal. From the work of Naville and Beaumont[9] we know that in Planipennia, including the Osmylidæ, the males possess an X and a Y chromosome, which show what Lorbeer has called "distance conjugation", that is, in the first meiotic metaphase the sex chromosomes always lie near the opposite poles of the spindle, apparently not having been in touch earlier. This property is not found in any other group of Insecta, and is extremely rare elsewhere. Now the Sisyridæ, which so far have been cytologically unknown, differ from all Planipennia, in having a normal behaviour of the sex chromosomes (Fig. 1 *a*, *b*). This is shown by their behaviour in *Sisyra fuscata*, which has $2n = 12 + X + Y$ in the male. X and Y pair like the autosomes in the first metaphase. (The stainless space between X and Y in the figure is a connexion, the existence of which is proved by a case where the XY-complex is bent at this point without any dislocation of their near ends.) This, I think, supports the view of Handlirsch.

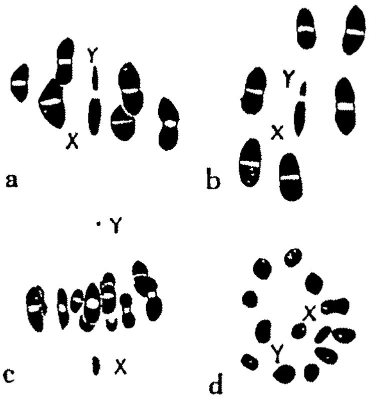

Fig. 1.

FIRST MEIOTIC METAPHASE OF *Sisyra fuscata* (*a*, *b*) AND *Raphidia xanthostigma* (*c*, *d*). PERMANENT ACETO CARMINE SMEARS, SLIGHTLY PRESSED.

Consider now the Megaloptera (Sialoidea and Raphidioidea). They have long been regarded as a single group remotely related to Planipennia. Thus Killington[3] does not include it in his comprehensive work. Tillyard[6], however, after having found fossils of Raphidioidea from so early a time as the lower Permian, and considering also the discoveries of Sialoidea by Martynov and himself from the same period, now considers these two groups to be as different *inter se* as they are from Planipennia. He refuses to give them ordinal rank as Handlirsch did (cf. also Withycombe[2], p. 401).

The chromosomes of a species of Raphidioidea, the whole group previously having been unknown cytologically, are shown in Fig. 1, *c*, *d*. The males have an XY-pair of sex chromosomes, the Y being very small, dotlike. These chromosomes show the "distance conjugation", known otherwise only among insects in Planipennia, and suggest a relationship with this group. The number of chromosomes in the male of the species investigated, *Raphidia xanthostigma*, is $2n = 24 + X + Y$.

The chromosomes of Sialoidea are described only in Japanese by Ito[10]. From his figures, however, I do not find any evidence of the occurrence of "distance conjugation" of the sex chromosomes. The number of chromosomes is $2n = 18 + X + Y$ in *Chauliodes* *japonicus* and $2n = 20 + \alpha + \beta_1 + \beta_2$ in *Protohermes grandis*.

The opinion put forward by Tillyard in 1936 on palæontological grounds therefore seems to be supported by the cytological evidence. Raphidioidea may be even closer to Planipennia than to Sialoidea, and the distinction between Megaloptera and true Neuroptera therefore unsound.

Note added in proof. Since writing the present note, I have received an article by Naville and Beaumont *Arch. d'Anat. micr.*, 32, 1936), which shows the same behaviour as I have found in another species of Raphidia.

HOLGER KLINGSTEDT.

John Innes Horticultural Institution,
London, S.W.19.
Jan. 29.

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[1] Tillyard, *Proc. Linn. Soc N S. Wales*, 41 (1916).

[2] Withycombe, *Trans. Entom. Soc. London* (1924)

[3] Killington, "A Monograph of the British Neuroptera", 1 (1936).

[4] Handlirsch, in Schroder's "Handbuch der Entomologie", 3 (1925).

[5] Handlirsch (& Beier), in Kukenthal's "Handbuch der Zoologie", 4 (1936).

[6] Tillyard, *Proc. Linn. Soc. N.S. Wales*, 51 (1926).

[7] Martynov, *Trav. Mus. geol Acad. Sci. U.S.S.R.*, 4 (1928).

[8] Tillyard, *Amer. J. Sci.*, (5), 23 (1932).

[9] Naville and Beaumont, *Arch. d'Anat. micr.*, 29 (1933).

[10] Ito, *Dobutsugakuzasshi*, 45 (1933).

Duality of the Reversibly Oxidized Forms of Vitamin C and the Polarization of its Dienol Group

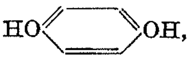
OUR recent work[1] on oxygen absorption of acid vitamin C solutions suggested the existence of the oxidized form: vitamin + ½ O, or vitamin − H. This form corresponds to the first step of the reversible oxidation of the vitamin, deshydroascorbic acid being the second. New evidence corroborates the duality of the reversibly oxidized forms of vitamin C. Phosphomolybdic acid ($P_2O_5(MoO_3)_{24} + 16\ H_2O$) mixed with an acid solution of vitamin C develops a blue or a green colour. The blue colour reaches its maximum intensity when the ratio $\frac{\text{ascorbic acid}}{\text{phosphomolybdic acid}}$ approaches $\frac{176}{3000}$. This colour fades when the quantity of the oxidizer, the phosphomolybdic acid, is diminished, and turns green when it increases.

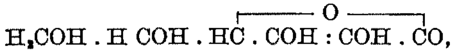
The blue colour may be obtained not only by the consequent increase of the concentration of vitamin, but also by adding to the weak ascorbic acid solution a substance such as cysteine. This last substance is not capable by itself of giving any colour reaction with phosphomolybdic acid, but acts by lowering considerably the potential of the solution. The changes from the blue to the green reaction and vice versa evidently depend upon the potential. Therefore these reactions must be evidence of the existence of two reversibly oxidized forms of the vitamin. To make this clearer, we have produced the maximum blue and green reactions and treated the solutions with hydrogen sulphide. Testing the liquids (after removal of hydrogen sulphide) with the Bezssonoff reagent $[3(MoO_3 17(WO_3)P_2O_5 + 24H_2O)]$ and iodine, we find about 94 per cent of the vitamin which was present before the colour reactions.

We also ascertained that after precipitation of the green colour by means of neutral lead acetate, and lead with sulphuric acid, the liquid no longer gives the reactions of ascorbic acid. Later treatment with hydrogen sulphide restores the vitamin reactions.

Phosphomolybdic acid gives similar blue and green reactions with hydroquinol but not with pyrogallol, nor with various other polyphenols. Catechol gives a completely distinct yellow colour reaction; however, it possesses like vitamin C the common group COH : COH. The presence of such a group in the vitamin C molecule[2] is shown by the well-established formula of Hirst and confirmed by means of a titanium sulphate colour reaction (Ettori[3]).

Thus, phosphomolybdic acid gives identical colour reactions with hydroquinol and vitamin C, but not with catechol, in spite of the presence in these last two substances of the same dienol group (COH : COH). It is therefore evident that the dienol groups of vitamin C and hydroquinol are subject to a common influence which does not occur in the case of catechol.

The structure of hydroquinol, , and of vitamin C,



$$\mathrm{H_2COH\,.\,H\,COH\,.\,\overset{\ulcorner}{HC}\,.\,COH:COH\,.\,\overset{\urcorner}{CO}},\ \text{(O bridge between HC and CO)}$$

indicates that in both substances the dienol group is polarized. This peculiarity does not distinguish the enol groups of catechol and of pyrogalol.

N. BEZSSONOFF.
MÉLANIE WOLOSZYN.

Clinique Infantile,
Faculté de Médicine,
Strasbourg.
Feb. 9.

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[1] Bezssonoff, N., et Woloszyn, Mme M., *C.R Soc. Biol.*, 123, 941 (1936), *C R Acad. Sci*, 203, 275 (1936).

[2] Pointed out first by Bezssonoff, *C.R. Acad. Sci.*, 180, 970 (1925).

[3] Ettori, *C.R. Acad. Sci.*, 202, 852 (1936)

Tyrosine in Diseased Pedipalps

THE value of X-ray methods in the identification of minute quantities of crystalline substances is well demonstrated in the following example. Dr. E. Warren has been studying part of the collection of Pedipalps (arachnids related to the scorpions) in the British Museum (Natural History), and in two series of *Hypoctonus formosus* Butler, from Further India, he has found evidence of a fungus disease (actinomycosis), which had affected at least 70 per cent of the specimens. Associated with the fungus centres, which are scattered throughout the tissues of the host, there are yellowish-white spherules measuring up to ½ mm. in diameter. These spherules are made up of radiating, birefringent needles which are probably pseudomorphous after the radiating fibres and hyphal tubes of an Actinomyces.

An X-ray photograph (using copper radiation) of one of the spherules yields a well-marked 'powder pattern' identical with a photograph of powdered artificial *l*-tyrosine, thus confirming Dr. Warren's preliminary determination based on solubility tests. Possible alternatives such as uric acid, the two hydrates of calcium oxalate, leucine, etc., are also excluded by their X-ray patterns. Moreover, two samples of *dl*-tyrosine, prepared by different methods, which were kindly sent to me by Prof. H. S. Raper, give patterns similar to, but not identical with, those of *l*-tyrosine. This distinction between *l*- and *dl*-tyrosine is enhanced in powder photographs of the hydrochloride derivatives. Hence tyrosine is present in diseased Pedipalps either as the *d*- or *l*-form, more probably the latter. It results from the decomposition of proteins in the host, and has been detected in vertebrates as a rare urinary sediment associated with acute yellow atropy of the liver, phosphorus poisoning and yellow fever.

F. A. BANNISTER.

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The Lachish Letters and the Use of Iron Inks in Antiquity

THE documents found early in 1935 on the ancient biblical site of Lachish, and now known as the Lachish Letters, were brought to London on the return of the expedition. During the summer of 1935, at the request of Mr. L. J. Starkey, I submitted them to a chemical examination. At the same time I made a more general investigation of the subject of early inks.

A survey of the literature indicated a consensus of opinion that iron displaced carbon inks at some time during the Middle Ages. I found, however, that the ink used in these letters contained both carbon and iron.

The problem is complicated by the presence of ferric iron in the body and on the surface of the sherds, and it was necessary to develop a special technique for testing the microscopic particles detached from various positions within and outside the lettering. It was observed that the better preserved writing was richer in iron, and the more eroded characters were primarily carbon.

A further search of the literature gave evidence of the early knowledge of iron inks. An examination was therefore made of the material available in the British Museum, and it was found that most of the writing on vellum of the early Christian period was in iron free from carbon. The earliest of these was the second century leaf from a Codex, concerning which Kenyon[1] says: "The earliest extant examples (of vellum) are probably two leaves, one in the British Museum containing part of Demosthenes' De Falsa Legatione (B.M. Additional MS. 34,473 i) . . ." A minute fragment of this taken from a broken edge of a paragraphing line, after subdivision into portions of about 0·02 mm. in size, was tested under the microscope. This gave the reactions for iron, the ink being entirely soluble and leaving no residue of carbon. Of the third and fourth century vellum documents or fragments, three out of twelve were carbon. Among the nine of iron type is the Codex Sinaiticus, which is a good example of this carbon-free brown iron ink.

Iron inks are decomposed with time to brown ferric oxide and hydroxides, which in the case of these early vellum manuscripts, appear as an almost transparent gel, combined perhaps as a complex with the vellum.

It can scarcely be doubted that the writers of antiquity insisted upon an ink of good appearance, comparable when fresh with a carbon ink, and as in these examples carbon is absent, the iron must have been in combination with a gall or tannin extract.

The ancient world was well acquainted with iron inks and with the various combinations which could be made with carbon, copperas, oak galls and gum; and it was with such an iron and carbon mixture that the Lachish Letters were written.

A complete account of the work will be found in "The Lachish Letters. I. The Wellcome Archæological Research Expedition to the Near East", which is now in the Press.

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[1] "Books and Readers in Greece and Rome", 43, 92 (1932).

Effect of Meteoric Shower on the Ionization of the Upper Atmosphere

OBSERVATIONS on the ionization of the upper atmosphere during a meteoric shower have as yet been very few in number and have all been confined to the Kennelly-Heaviside or *E* region. So far as we are aware, only two observations, one carried out in the United States[1] and the other in India[2], comprised direct measurements of the ion content of this region during the Leonid showers. Both gave strong evidence that ionization of this region increases enormously during such showers.

It seems natural to inquire if meteoric showers have any effect on other regions besides the *E* region of the ionosphere. Measurements with this object in view were carried out at Calcutta on five consecutive nights during the Leonid shower in November 1936. The dates of observations were centred around the night of maximum shower, November 14–15. The critical penetration frequency method was employed for the purpose; the range of frequencies used was 1–15 Mc./sec. Observations were made at intervals of one hour between 22.00 and 05.30 hours. The observed results are plotted in Figs. 1 and 2.

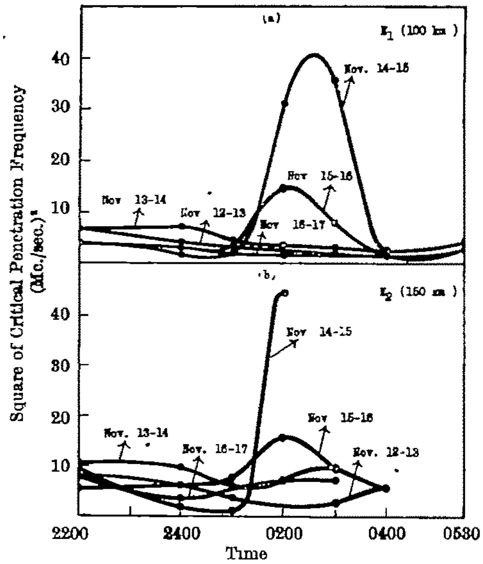

Fig. 1.

Fig. 1 (*a*), E_1 region. There is sharp increase of ionization between 01.00 and 04.00 hours, which is the period of maximum intensity of the shower in the nights of November 14–15 and 15–16.

Fig. 1 (*b*), E_2 region. Similar increase as in the case of E_1. The drop in the curve for November 14–15 could not be observed, presumably because the ionization fell below that of the E_1 region.

Fig. 2 (*a*), F_1 region. The ionization on an average diminishes for all the nights except for that of November 15–16.

Fig. 2 (*b*), F_2 region. The ionization on an average diminishes for all the nights.

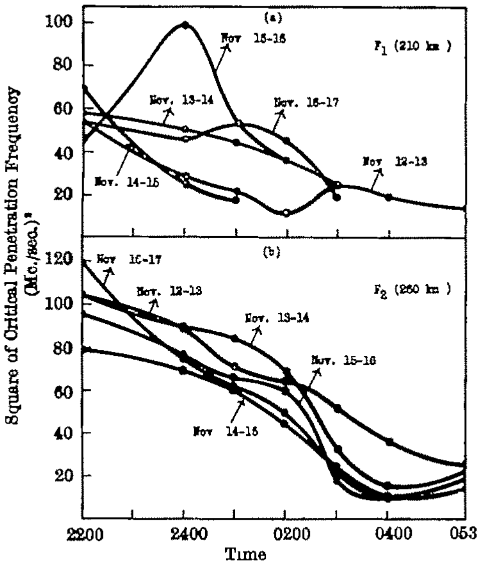

Fig. 2.

The increases in the ionization of the E_1 and E_2 regions (Fig. 1) on the night of November 14–15 are undoubtedly due to the impact of meteors. There was no other disturbing factor in this night. There might be some uncertainty with regard to the increases on the night of November 15–16 in E_1, E_2 and F_1 ionization, as there was a magnetic storm in progress during that night. Since, however, the time of increase in the ionization of E_1 and E_2 on this night corresponds, as on the previous night, to the hour of maximum intensity of the Leonid shower, and also since no significant correlation between a magnetic storm and abnormal increase of the ionization of these regions has, as yet, been found in our latitude, it may safely be inferred that these increases are also due to the meteoric shower. With regard to the increase in the F_1 ionization during the same night, it is very doubtful if meteors were responsible for this, since the time of increase does not correspond with the time of maximum shower. Further, as in the case of the two E regions, there was no increase of a similar nature on the previous night.

Since the heights of most frequent appearance and disappearance of meteors, visible to the naked eye, lie between 160 km. and 70 km., it is to be expected that any increase of ionization caused by the meteors should be confined within these limits. This is what has actually been observed. Though, in the course of our observations, we were able to detect each of the four distinct regions of maximum ionization, it was only the lower ones—E_1 and E_2—which were found to be affected by the meteoric shower. The fact that these regions showed increase separately and were not merged into one continuous region due to meteoric impact—as, at first thought, might have been expected—also receives an easy explanation if we remember that a region which is already ionized should undergo proportionately greater increase of ionization than a region which is not originally ionized.

An account of this work with fuller details will appear shortly in the *Indian Journal of Physics*. The author is indebted to Prof. S. K. Mitra and Dr. H. Rakshit for their kind interest in the work.

J. N. BHAR.

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Calcutta.
Jan. 18.

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[1] Skellet, A. M., *Proc. Inst. Rad. Eng.*, 23, 132 (1935).

[2] Mitra, S. K., Syam, P., and Ghose, B. N., NATURE, 133, 533 (~~1933)~~. 1934

Figures of the Earth and Moon

A RECENT paper of mine, noticed in NATURE for February 27, p. 381, needs a correction, since the next issue of the *Monthly Notices of the Royal Astronomical Society* (p. 126) contains a correction by Prof. E. W. Brown to the calculated motions of the moon's perigee and node, which had stood for about twenty years. The change for the perigee is about three times what appeared to be the probable error of the previous value. Brown, in a letter to me, has queried the probable errors that I used; but provisionally retaining them until better estimates are available, I have made a new solution, which is: $J = 0{\cdot}0016361 \pm 0{\cdot}0000059$; $1/e = 297{\cdot}19 \pm 0{\cdot}52$; $J' = 0{\cdot}000316 \pm 0{\cdot}000024$; $K' = 0{\cdot}000115 \pm 0{\cdot}000048$; $f = 0{\cdot}69 \pm 0{\cdot}06$.

The ellipticity of the earth is only slightly affected; the chief change is in the ellipticity of the moon's equator, which is proportional to K' and is more than doubled. It is now almost midway between the two inconsistent values of Hayn and Stratton, and affords no ground for preferring either to the other. The coefficient of $g_e \sin^2\phi$ in gravity will be increased to $0{\cdot}0052917 \pm 0{\cdot}0000059$.

The need for a modern series of observations to determine the moon's librations in longitude is clear; in the above determination, K' rests entirely on the motion of the perigee. If it is correct, the period of the free libration in longitude should be close to 50 sidereal months and the amplitude of the annual forced libration 0·84′.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

Planetary Positions at Sunset in 1937

THE hour after sunset is possibly the time most often chosen by many for noticing the bright planets, chiefly because Venus and Mercury scarcely let us notice them at any other time, except by insisting on inconvenient wakefulness before sunrise.

In the accompanying drawing (Fig. 1), and for the English sunset sky, the positions of the sun and the bright planets are indicated for the first day of every month of the year. Number 1 stands for the first day of January, 2 for the first of February, and so on, 13 standing for the first of January 1938. The positions of the setting sun on the first day of two months like January and December are not really the same, but they are sufficiently near to one point to be marked the same for the purposes of this diagram.

The positions of Mercury lie on a peculiarly tangled path, and the middle of April (the fourth month) seems the best time to look for that planet. It is then at a considerable altitude directly above the setting sun, but the small size of the spot marked 5—the spots are graded for relative brightness—indicates that the planet may not be very bright on those evenings. Venus will evidently be a magnificent object in March, over the south-west horizon and about half-way up to the zenith. The curve for Mars shows a singular loop in the autumn, and during August, September and October the planet is actually farther *east* each successive evening at the time of sunset. This loop, by the way, is not to be thought of as only the ordinary loop made relative to the background of stars, but rather as a loop made relative to the leafless branches of the old tree at the south end of my garden, as viewed each evening from the same spot, at the time of sunset. The hourly changes of position of any object may be judged from the seventeen little arrows showing the track of an equatorial star at sixteen hourly intervals, and some planetary positions are marked below the eastern horizon. Jupiter and Saturn are nearly as sedate as fixed stars.

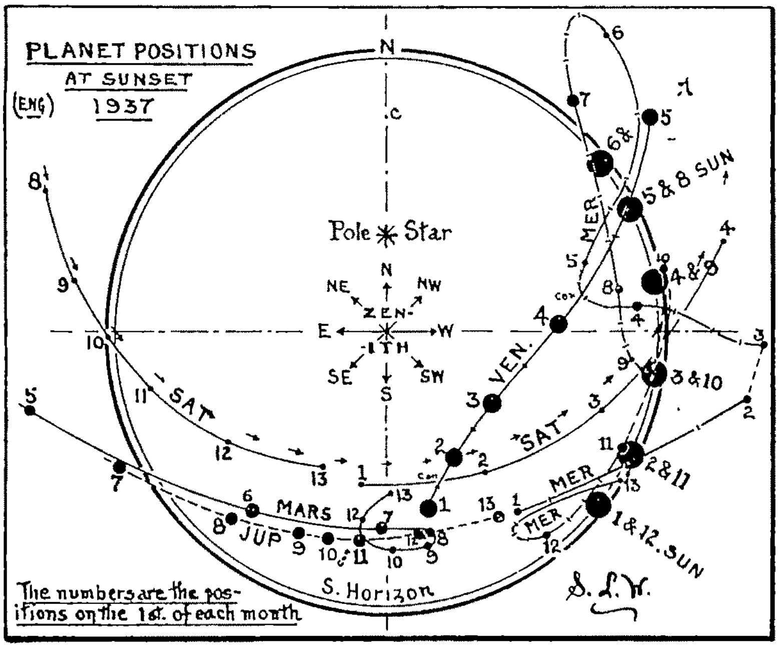

Fig. 1.

About the middle of January the planets Venus and Saturn appeared close together, and the same will be true of Venus and Mercury in April. Mars and Jupiter are to be so close together at the end of October that the one spot numbered 11 is allowed to mark the position of both.

S. L. WALKDEN.

London.
Feb. 2.

Latent Heat of Evaporation of Liquid Helium

THE letter of Dr. J. Newton Friend in NATURE of December 26, 1936, on this subject raises interest in his equation. I have tested it with the following results:

As many know, the variation of the coefficient of viscosity of a liquid with temperature can often be expressed—over a short range at least—by an equation of the type

$$\log_e \eta = A + \frac{B}{T} \quad . \quad . \quad . \quad . \quad (1)$$

Taking therefore Dr. Newton Friend's equation for latent heat and casting it in the form

$$\text{Molar } L = 4R \frac{T_1 - T_2}{T_1 T_2} \log_e \frac{\eta_1}{\eta_2} \quad . \quad . \quad . \quad . \quad (2)$$

we get by inserting equation (1)

$$\text{Molar } L = 4R \frac{T_1 - T_2}{T_1 T_2} B \left(\frac{1}{T_1} - \frac{1}{T_2}\right) = 4RB \quad . \quad . \quad (3)$$

which looks simple enough.

Taking the viscosity results on helium liquid I obtained in Toronto and plotting them over the range 3·5°–4·2° K. (I restrict myself to temperatures not far from the boiling point, 4·2° K.), I find:

$$\log_e \eta = A + \frac{9}{T}$$

There is no point at present in evaluating A. Substitution in equation (3) gives a value for the molar L as 72 calories. This is equivalent to 18 calories per gm.

If, however, we use the data obtained at Leyden, the latent heat of vaporization of liquid helium 1 is of the order of 5 calories per gm. (Reference to the Leyden entropy diagram of helium shows an increase of entropy of 1·2 units per gm. when liquid helium 1 evaporates at 4·2° K., and 1·2 × 4·2 = 5 calories very nearly).

Therefore whether we consider Dr. Newton Friend's result or the value I quote above as being more correctly obtained by his equation, we see that the agreement with the correct value is not good. Hence his equation must be in error.

JOHN SATTERLY.

Department of Physics,
University, Toronto.
Jan. 19.

I AM grateful to Prof. Satterly for directing attention to the discrepancy. Accepting 5 × 4 = 20 as the molar latent heat of evaporation of helium, the value 31·3 calculated with the aid of the Clausius-Clapeyron equation is certainly wide of the mark; so is 36·2 which I calculated from my equation using Prof. Burton's data. But as my equation was derived on the assumption that the Clausius-Clapeyron equation holds, clearly if the latter fails the former may be expected to do so also.

Both equations have, however, been found to give very satisfactory results with a large number of substances. Assuming the vapour pressure and viscosity data for liquid helium are correct, instead of suggesting that the equations "must be in error", would it not be better to suggest that helium is abnormal? That such may well be the case is evidenced by the curious fact that liquid helium II is much more fluid than liquid helium 1, despite its lower temperature, as Prof. Satterly has himself pointed out elsewhere[1]. It would be interesting to ascertain the absolute cause of this discrepancy.

J. NEWTON FRIEND.

Central Technical College,
Birmingham.
Jan. 28.

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[1] *Rev. Mod, Phys*, 8, 353 (1936)

Magnetic and Electrical Dimensions

IN NATURE of January 9, in a review of Dr. Lanchester's book on "The Theory of Dimensions", Prof. G. W. O. Howe devotes a portion of his review to the dimensions of electrical entities and his own views upon the same, and criticizes adversely a paper of mine upon this subject, which Dr. Lanchester had printed in full in an appendix in his book.

Prof. Howe proposes to write the fundamental equation of electromagnetism

$$f = \mu \,.\, \frac{ids}{r^2} \,.\, ids,$$

and he evidently intends μ to be the permeability, because he states: "The classical formula $f = mm'/\mu r^2$ is merely the above formula wrapped in mystery".

It will be noticed that in Ampère's classical equation given above, Prof. Howe has substituted μ for $1/A'$. He does this without any explanation or justification, unless, since $c^2 = A'/K$, it is merely to maintain the expression $c^2 = 1/\mu K$, whereas the full expression is $c^2 = A'/K = A^2/\mu K$, A, A', μ and K being the four fundamental constants in the classical theory. Now Maxwell assumed A' to be an undimensional constant numerically equal to unity, and this has been the established practice, hence K has the dimensions $1/V^2$ and even if $c^2 = 1/\mu K$, μ must be undimensional, a conclusion to which Prof. Howe objects.

With regard to Prof. Howe's mystery and his further reference to "such a fictitious complexity as a permanent magnetic point pole of unit strength", is there any more in this than the conventional application of our standard method of dealing with a system of distributed forces in a case where the forces are both attractive and repulsive, by finding the centroid of each system and calling these points the poles of the magnet? The resultants through the poles give the same magnetic moment as the magnet possesses, and the historical choice of the unit pole was a very natural one. How else would it be possible to deal with the interaction of magnets? It is a common physical laboratory experiment to determine the equivalent poles of a long bar magnet by means of an exploring coil or vibrating needle. Other "fictitious" complexities are found useful in other branches of science in order to make very abstruse problems easily tractable, such as point sources and sinks in hydrodynamics. Think of Rankine's work on streamlines by this method.

If magnetic forces are due to electric currents, then the two standard equations $f = ids \,.\, i'ds'/A'r^2$ and $f = mm'/\mu r^2$ must be co-dimensional, and the simplest solution is $m = iL$ and $A' = \mu$ dimensionally. No objection either physical or mathematical has yet been offered to this solution, which eliminates from electrical science that great bugbear, the dual system of dimensions, and no sacrifice is required in adopting it.

I would remind Prof. Howe that one International Committee has already recommended that μ is to be considered a dimensional entity, also that the final decision is to be made this year.

JAMES B. HENDERSON.

38 Blackheath Park,
London, S.E.3
Feb. 11.

IN reply to Sir James Henderson, I can only say that I was under the impression that I had given ample explanation and justification for introducing only one magnetic constant of space. If ferromagnetism is due to orbital movement of electrons, that is, to electric currents, then I cannot believe that the forces between magnetic poles involve one property of space and the forces between current-carrying conductors another property. I intended μ to be exactly what I stated in the review, namely, the space constant which makes the formula for the force between electric currents (or magnets) dimensionally and numerically correct, just as $1/K$ is introduced in the formula for the force between charges, and G in the gravitational formula.

I agree that point sources and sinks are excellent mathematical tools and that the unit pole is a very useful conception, but having invented the conception, let us not look to it as an oracle and expect it to answer questions on the ultimate realities of electromagnetism. As I have said elsewhere[1]: "the greatest danger in this subject is that of overlooking the fact that, having put various ingredients into the hopper and turned the handle several times, the result has not dropped from heaven but has come out of the machine and contains all the assumptions that were put in". For this reason I am not impressed by the statement that on certain assumptions "μ must be undimensional" or that the simplest solution of some equations is that $A' = \mu$ dimensionally.

With reference to the equations "$f = ids \,.\, i'ds'/A'r^2$" and "$A' = \mu$ dimensionally", to which Sir James Henderson says "No objection either physical or mathematical has yet been offered", seeing that this is equivalent to writing $f = ids \,.\, i'ds'/\mu r^2$ with μ in the denominator, I can only express my surprise that such a suggestion is put forward seriously.

I cannot understand why Sir James Henderson should remind me of the well-known fact that one International Committee has already recommended that μ is to be considered a dimensional entity. This is surely what I maintained in the review. I was under the impression that he was trying to maintain the contrary opinion. I am in entire agreement with the recommendation of the Committee and with Rücker, who pointed out the advantage of "not suppressing the secondary fundamental units such as μ and K" by "arbitrarily assuming that some one of the quantities involved is an abstract number".

G. W. O. HOWE.

University,
Glasgow.
Feb. 17.

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[1] *Wireless Engineer*, January 1937, editorial

Supraconductivity of Lanthanum

WE have investigated the magnetic behaviour of lanthanum below 10° K. The metal was kindly lent to us by Prof. F. M. Jaeger of Groningen; the analysis was given as lanthanum 98 per cent, iron 1 per cent and traces of carbon, silicon, aluminium and magnesium. Two lumps of irregular shape were tested by methods described previously[1, 2]. Strong diamagnetic susceptibility, which could be destroyed by a magnetic field, showed that the specimens became supraconductive. After supraconductivity had been destroyed by a magnetic field, the magnetic flux threading the specimens 'froze in' when the field was lowered again. The formation of such a supraconductive 'sponge' was to be expected in a specimen containing 2 per cent of impurities[3].

The transition point in zero field was determined by the decrease of the 'frozen in' magnetic dipole with increasing temperature[4]. The transition point was found to be 4·71° K. The threshold values, that is, the field strengths at which the last trace of supraconductivity disappeared, were found to be very high (steepness of the threshold curve more than 1,000 gauss per degree). The specimens behaved in all respects similarly to the samples of tantalum investigated by Mendelssohn and Moore[1].

So far, supraconductivity has been observed in all metals in Groups II*b*, III*b*, IV*a*, IV*b* and V*a* of the Periodic Table (except germanium, which is cubic like grey tin, and protoactinium, which has not been tested) but in no other group. The supraconductivity of lanthanum (Group III*a*) makes it probable that some of the other metals of this group also (scandium, yttrium, actinium) will become supraconductive. The question arises also whether the rare earths between lanthanum and hafnium will show supraconductivity. It has to be remembered, however, that the rare earths, owing to their incomplete *N*-shells, have strong magnetic moments which may make supraconductivity impossible. From this point of view, the element 71 (where the *N*-shell is completed) is the one in which supraconductivity is most likely.

K. MENDELSSOHN.
J. G. DAUNT.

Clarendon Laboratory,
Oxford.
Feb. 13.

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[1] Mendelssohn, K., and Moore, J R , *Phil. Mag.* (21), 7, 532 (1936).

[2] Mendelssohn, K., *Proc. Roy. Soc.*, A, **155**, 558 (1936)

[3] Keeley, T. C., and Mendelssohn, K , *Proc. Roy Soc.*, A, **154**, 378 (1936).

[4] Mendelssohn, K., and Babbitt, J. D , *Proc. Roy Soc* , A, **151**, 316 (1935).

Dr. Seeber in South Africa

IN connexion with the study of South African freshwater fishes, it is of interest to ascertain particulars about Dr. Seeber, after whom two fishes were named by Gilchrist and Thompson. Apparently Dr. Seeber corresponded with these authors about the years 1909-11, but I can obtain no information as to who Dr. Seeber was, where he lived or was stationed, or where he travelled in South Africa. The Medical Register and other local sources have failed, and this request is issued in the hope that one of the many readers of NATURE may have known Dr. Seeber. Any facts bearing on his residence or activities in South Africa will be welcome.

KEPPEL H. BARNARD

South African Museum,
Cape Town.
Jan. 8.

Points from Foregoing Letters

MISS E. W. HUME reports the preliminary results of an investigation on vitamin A standards, undertaken by the Accessory Food Factors Committee with the help of numerous collaborators. It appears that the discrepancies previously reported in the case of 'concentrates' have been due to unsuspected deterioration in the course of biological tests. The factor for converting results of spectroscopic tests into international units is found to be 1,470, with a range of individual values of 1,400–1,700. The previously accepted value of 1,600 recommended by the International Conference of 1934 is, however, retained for the time being.

According to investigations described by Holger Klingstedt, the behaviour of the sex chromosomes at meiosis indicates a closer relationship between sections of the Megaloptera and true Neuroptera than exists within these orders. The old distinction between them may therefore be unsound, as newer morphological and palæontological evidence also indicates.

The reversible behaviour of the blue and green solutions obtained by treating ascorbic acid (vitamin C) with phosphomolybdic acid is described by Prof. N. Bezssonoff and Mélanie Woloszyn. The authors consider this as further proof of the 'duality' of the reversibly-oxidized form of ascorbic acid and, by comparison with the behaviour of other organic compounds, conclude that the dienol group of the vitamin C molecule is polarized.

The identification of tyrosine by means of X-ray spectrograms in diseased pedipalps (arachnids related to the scorpions) is reported by F. A. Bannister. The tyrosine occurs in the form of radiating needles in museum specimens which have been affected by a fungus disease (actinomycosis).

A chemical examination shows that the ink used for the letters found on the biblical site of Lachish was of mixed iron and carbon type. A. Lewis has, in addition, investigated other ancient documents and concludes that iron inks, probably in combination with a gall or tannin extract, were frequently used in antiquity.

Curves based on the critical penetration frequency of radio waves, indicating a sharp increase in the ionization of the E_1 and E_2 regions of the upper atmosphere during the period of maximum intensity of the Leonid meteoric showers in November 1936 are submitted by J. N. Bhar. The ionizing power of the meteors appears to be effective in the region where they are visible to the naked eye (between 165 km. and 70 km.).

A new value for the ellipticity of the earth and that of the moon's equator, based on a corrected value for the moon's perigee and node, calculated by Prof. W. W. Brown, is given by Dr. Harold Jeffreys.

Prof. J. Sattorly points out that the value of the molar latent heat of evaporation of helium calculated from data on viscosity and vapour pressure, according to Dr. J. Newton Friend's formula, does not agree with the experimental value, and concludes that the formula is incorrect. Dr. Newton Friend suggests that, since the formula applies to a large number of substances, one may assume that liquid helium behaves abnormally.

Research Items

The Katanga Skull

THIS human skull belonging to a skeleton found in 1918 in some old native workings in the mine of Kambove (Katanga) in the Belgian Congo, has been made the subject of a study by Dr. Matthew Young of University College, London (*Mém. Musée Roy. d'Hist. Nat. de Belgique*, (2), 5). The skull is complete, with the lower jaw. It is undoubtedly of negro type, though showing signs which suggest admixture Unfortunately, the remainder of the skeleton was not preserved. Although stained green with malachite, it shows no signs of mineralization to any appreciable degree. The specimen is of moderate length, very narrow, with a notable post-orbital constriction, and relatively high with a well-arched vault. The forehead is fairly rounded and shows the median eminence characteristic of the negroid type, though there are distinct indications of frontal eminences. The supraciliary ridges are fairly prominent. The temporal ridges are strongly developed, which is said to be a negroid feature. They appear to be more convergent than usual. The face is long, the nasal bridge excessively flat. The nasal aperture is relatively wide. Prognathism is moderate, and the lower jaw robust. The lower central incisors had been extracted at an early age. The skull is adult and probably male. It most closely resembles the Teita series from East Africa collected by Dr. Leakey, except in regard to the length of the face and especially of the alveolar portion. In this respect, it resembles two Nuba females from South Kordofan. A similar type of unusually long face and development of the alveolar region, accompanying an exceptionally high palate, is seen in Leakey's Nakuru and Elmenteita types, which have been compared with the Oldoway skull. These are usually considered to be Hamites, while Keith regards Oldoway as proto-Hamite. The Katanga skull then is a negro of recent date, probably not later than twelfth century, and is more nearly allied to the East than the West African type. It may be the remains of a slave captured at some distance from the Katanga

Mule Deer of the Pacific Region of America

As a result of the examination of 602 specimens of *Odocoileus*, supplemented by the studies of former investigators, Ian M'Taggart Cowan finds that two species only inhabit the Pacific coastal region of North America—the white-tailed deer (*O. virginianus*) with two geographical races, and the black-tailed deer (*O. hemionus*) with nine. Complete intergradation was found between the latter and *O. columbianus*, formerly regarded as a distinct species (*California Fish and Game*, 22, 155; 1936). The monograph is a thorough one, but we can refer here only to two points of general interest. The pigmentation, particularly of the tail, shows great variation, and each colour grade is generally associated with a more or less uniform set of environmental conditions, but over the whole area the intensity of the coat colour seems to be related to the humidity of the environment. The races living in the humid coastal region have the darkest pigmentation, the desert forms the lightest; and in these respects the coloration agrees with what has been found in several other mammals and birds. The second point is that the races of the mule deer conform to the general truth known as Bergmann's law, that individuals of races inhabiting colder localities are larger than those of races inhabiting the warmer regions. Not only is this so, but also the northern races, as well as being larger than the southern, display greater sexual dimorphism in size of body.

Pinus radiata in New Zealand

A LEAFLET (No. 28. N.Z. State Forest Service, December 1936) has been recently issued dealing with the terminal hypertrophy in *Pinus radiata* in relation to frost damage. It is based on researches by Mr. T. T. C. Birch. Hypertrophied terminals are distinguishable from a normal leading shoot by the following characteristics: (1) length of terminal, from last whorl to apex, exceeds 4 ft. and occasionally reaches 12 ft. or more; (2) epicormic shoots and five-needle fascicles are often associated with the condition; (3) the larger hypertrophied terminals do not necessarily represent one year's growth, two layers of wood frequently occurring in the basal portions, without lateral branches; (4) abnormal turgidity and brittleness, primarily due to the large proportion of medulla in the shoots. As might be expected, hypertrophied terminals rarely escape some form of climatic injury, and owing to their brittle nature, many of those projecting above the normal crown-level of a stand, are broken or damaged by wind. Frost also is responsible, both directly and indirectly, for a considerable amount of damage to hypertrophied terminals. Mr. A. D. McGavock, director of forestry, says in a note that "Mr. Birch is conservative when he describes this leader as 'occasionally reaching 12 ft. or more'. This is correctly stated if he refers to a single year's growth only; but similar growth in subsequent years is frequently superimposed on this, and lengths of up to 22 ft. without a single lateral branch have been measured. Such a condition in itself is undoubtedly a sign of ill-health in a tree; but seemingly because it is not due to any pathogen nor to any apparent mechanical injury, it has not, so far as I am aware, received any attention from forest pathologists".

Respiration in Tropical Fruits

THE extensive studies of changes during ripening in fruits in storage under English conditions carried on at the Low Temperature Research Station, Cambridge, are now being very usefully extended to the tropical fruits, at the equivalent research station in Trinidad. Drs. C. W. Wardlaw and E. R. Leonard have two papers dealing particularly with respiration in tropical fruits in the *Annals of Botany*, 50, 1936, which are also issued separately by the Imperial College of Tropical Agriculture (July 1936). Two points of general importance in these communications are the further support given to the importance of the oxygen concentration in the internal gas concentration in relation to the initiation of that period of maturation frequently described as the climacteric, and the new suggestion that the subsequent onset of senescence may be associated with the difficulty in the movement of oxygen into the interior of the fruit as a result of the changes in texture, etc., associated with maturity, which hinder the ready access of oxygen from the outside air. Considerable attention has been paid to the internal atmosphere in these studies, such hollow fleshy fruits as the papaw readily lending themselves to the necessary technique for sampling the internal gases.

A Halo-Spot of Tomatoes

THE prevalence of tomatoes covered with a number of silvery spots has been noticed on many occasions. Insects were thought to be the cause, but Dr. C. L. Walton has shown (*Gard. Chron.*, Jan. 2, 1937) that this is not so. The trouble appears when 'top-watering' to simulate rain is practised. Drops of water fall upon the fruit, and if a burst of sunshine occurs, they evaporate very rapidly, and the skin of the fruit is scorched. This kind of trouble is probably more widespread than is often realized, and the lens-shape of the drops may even cause necrotic spots or other puzzling symptoms.

Cordierite in Pegmatites from Japan

THE results of an important study of cordierite and its graphic intergrowth with quartz in Japanese pegmatites has been published by H. Shibata (*Jap. J. Geol. Geog.*, 205 ; 1936). The pegmatites are regarded, not as of purely igneous origin, but as syntectic products involving reaction with the invaded rocks. One from Sasago injects sandstone and slate ; in the central zone of graphic microcline-granite, rosettes of andalusite and intergrowths of cordierite and quartz occur. Another intrudes amphibolite of the Misaka Series (Higashidani). Soda diffused into the amphibolite, while reaction between magnesium silicate (from hornblende) and the pegmatitic liquid led to the crystallization of cordierite. In another example (Mujinazawa) cordierite also formed by reaction of magmatic material with hornblende. A zonal arrangement of minerals developed, with graphic intergrowths of cordierite and quartz in the intermediate zone. The analysed cordierites show large amounts of iron, manganese and soda. The author has systematized the physical and chemical properties of cordierites from all parts of the world. The various relationships between optical properties and chemical composition are summarized in a series of tables and diagrams.

Geographical Distribution of Deep-Focus Earthquakes

A RECENT paper by Messrs. B. Gutenberg and C. F. Richter (*Bull. Seis. Soc. America*, 26, 341 ; 1936) contains some interesting notes on the distribution of deep-focus earthquakes. Those with focal depths of about 100 km. occasionally occur in nearly all the seismic regions of the globe. Others with depths of about 200 km. are frequently found in regions, such as the eastern Mediterranean and the Hindu Kush, where there is at present no evidence of very deep foci. So far as is at present known, earthquakes originating at the greater depths (400-800 km.) are confined to a few regions adjoining the Pacific Ocean, such as Kamchatka and the Kurile Islands, Japan, the East Indies and western South America. In Japan and South America, the deeper the foci, the farther removed as a rule are the epicentres from the ocean basin. With regard to the origin of such earthquakes, the most probable conclusion at present is that normal and deep-focus earthquakes are caused by the same forces, which may act near the surface or at great depths.

Measurement of Upper Winds

THE measurement of upper winds by means of pilot balloons is the subject of a recent publication (M.O. 396) of the Meteorological Office, Air Ministry (H.M. Stationery Office, 1936. 1*s*.) This method of measuring upper winds has been in use for many years, and has developed greatly as the demands of aviation for information about upper winds have increased. It depends upon observations of the elevation and azimuth of a small balloon that ascends at a nearly constant speed and is carried horizontally by the wind at its level. These angles may be measured by a single theodolite, and the wind is then calculated on the supposition that the rate of ascent is strictly constant. Alternatively, two theodolites may be used at a known distance apart, or a tail of known length may be attached beneath the balloon and the angle subtended by the tail be measured by a graticule at the focus of a single theodolite. Each of these alternatives does away with the need for assuming a constant rate of ascent, and in expert hands provides reasonably accurate information about the upper winds. In M.O. 396 the practical details are set out, including the method of filling the balloon and giving the necessary free lift, the setting up of the special theodolite and the working out of the speed and direction of the wind from the observed angles. A full-sized drawing of the special slide rule used for these computations is included.

Air Conditioning in Modern Buildings

IN a paper read on February 19 by Mr. E. R. Dolby to the Institution of Mechanical Engineers the whole question of ventilation and air conditioning in modern buildings is discussed. It has been stated that the ideal condition of the air is that of a hillside on a bright spring morning. This is taken to mean that the air is free from dust, odours, etc., that the temperature should be moderate, say, 60° F., the humidity about 50 and that there should be a bright atmosphere with slight, but not excessive, movement. In the ideal suggested, the carbon dioxide in the air should be restricted to not more than 6-7 parts in 10,000, as compared with 4 parts in 10,000 in the external air. Mere ventilation as, for example, the system used in coal mines, where a large volume of external air is passed into the mine and the contaminated air in the mine extracted, differs from 'conditioned air' ventilation as now used in houses, shops, factories, theatres and ballrooms. In the latter case the vitiated air is evacuated and replaced by air so treated that dust, fog, deleterious gases and odours are eliminated. The temperature of the incoming air is raised or lowered and its humidity is suitably modified. At the same time the conditioned air must cause no unpleasant draughts. The maximum air velocity of the delivered air, for comfort, in sedentary occupations is assumed to be about 2 ft. per sec. In large works, hotels, exhibition buildings in which a kitchen or canteen forms part of the establishment, the installation of a separate ventilating and air conditioning plant is well worth considering.

The Beta-Ray Disintegration

A DISCUSSION on the β-type of nuclear transformation was held by the Royal Society on March 4. Papers were read by Prof. C. D. Ellis, Dr. J. D. Cockcroft, Dr. R. Peierls and Dr. H. O. W. Richardson; a number of other experimental and theoretical workers took part in the discussion. The main centre of interest seemed to be in the correctness or otherwise of the neutrino theory.

Prof. C. D. Ellis, in his opening address, gave a brief account of the development of our knowledge of the β-ray transformation in recent years. As is generally known, the fundamental difficulty is that the electrons (or positrons) are emitted with a continuous energy distribution although there must be a constant difference between the proper energies of the initial and final nuclei. This anomaly could be explained either by abandoning the conservation laws, or as suggested by Pauli, assuming that another uncharged particle, the neutrino, is emitted in the transformation and shares the available energy with the electron. This latter alternative is now generally favoured.

The neutrino has been given a spin equal to that of the electron, to enable angular momentum to be conserved in the transmutation; and a mass, which if not zero, is only of the same order as that of the electron. A particle with these properties would be very difficult to observe directly, and in fact the many attempts which have been made to detect the neutrino by any ionization it produces have all failed. The hypothesis can at present only be tested by its success in accounting for the features of the β-ray decay.

One consequence of the neutrino hypothesis can be seen without any detailed theory. The β-ray spectrum should have a definite upper limit at which the neutrino is emitted with zero kinetic energy, and this end point should be given by the difference between the masses of the particles before and after the transmutation. If these predictions were not fulfilled, the neutrino theory would have to be abandoned.

The evidence on this point was discussed by Dr. Cockcroft. In about six cases of β-transformation among the light elements, the end point of the spectrum is known with fair accuracy, and the difference between the initial and final masses can be obtained from other transmutations in which energy is certainly conserved. The results are sufficiently definite to show that the mass difference cannot be equated to the *mean* energy of the β-ray spectrum, but its identity with the experimentally determined end point is still rather uncertain. However, even this is very useful evidence. It is known that the total energy emission as measured in a calorimeter corresponds to the mean energy of the spectrum. As the change in mass in the transmutation is certainly greater than this, there is a definite surplus of energy which must either have disappeared or have been carried out of the calorimeter in the form of neutrinos.

Further data on the identity of the end point of the spectrum and the mass difference of the initial and final nuclei would be very important, as this is one of the few points on which the neutrino hypothesis is capable of being disproved. However, the determination of the end point of the spectrum is a matter of some difficulty, because the intensity approaches zero very slowly with increasing energy. The actual end point must be found by extrapolation. Here a theory of the form of the β-ray spectrum would be very useful. Unfortunately, the most successful theory, that of Uhlenbeck and Konopinski, disagrees with the observed spectrum just in this region, and extrapolations based on it give values for the end points which appear to be too high. In these circumstances, all that can be said is that the experiments do not disagree with the value for the end point given by the mass change in the disintegration.

The detailed mathematical development of the theory enables it to be compared with other experimental data. We may expect the theory to predict the form of the β-ray spectrum and how it depends on such parameters as the total energy released and the change of nuclear spin in the transmutation. Also the theory should give the value of the total probability of disintegration, or the decay constant. The general case of β-decay is one in which the final nucleus may be formed in one of a number of excited states. The β-ray spectrum is then built up of a number of partial spectra, each with a different end point and intensity. In examining such a spectrum, the experimenter depends on theoretical guidance on these points.

The theoretical aspects of the problem were dealt with by Dr. Peierls. The theory is based on the analogy between the transition of an atom between two stationary states with the emission of a light quantum, and the transmutation of a neutron into a proton with the emission of an electron and a neutrino. A remarkable consequence of this point of view is that it should be possible for a nucleus to be transformed by capturing one of its K electrons and emitting a neutrino—a new type of transmutation which has not yet been observed.

To proceed further, the theoretical worker has to assume some form of interaction between the neutrino and the heavy particles which give it birth. Here he has little to guide him but the demands of relativistic invariance and his æsthetic sense. The most simple and natural assumption was made by Fermi, but this led to a form of the β-ray spectrum which was definitely too symmetrical about the mean energy. Konopinski and Uhlenbeck remedied this by using a form of interaction which depended on the velocity of the neutrino as well as on its position. At first they appeared to have been very successful. Experiments with the large sources of light radioactive elements now available in the United States gave very satisfactory agreement with the new theory. A more detailed study has since shown that though the main part of the spectrum was given correctly, the high- and low-energy regions required modification. The evidence on this point was discussed by Dr. Richardson, who showed that whereas fair agreement with experiment was obtained for the low-energy part of the spectrum when account was taken of the Coulomb forces on the electrons, the Konopinski-Uhlenbeck theory gave too high an intensity for the high-energy electrons, in some cases by a factor of fifty.

Attention has therefore been turned to other possible modifications of the theory. A very wide choice seems to be possible, so that the theory could be made to fit almost any form of the experimental spectrum in several different ways. This elasticity is perhaps an advantage, in that there is no immediate danger of our being forced to abandon the neutrino theory and therefore the conservation laws, but it destroys much of the heuristic value of the theory. For example, although the β-transmutations can be classified into two groups, corresponding to the two Sargent curves connecting the decay constant with the energy of the end point, it is not known how this classification is connected with the change of nuclear spin in the transmutation.

In conclusion, the general impression given by this discussion was that although the neutrino theory is probably capable of explaining most of the features of the β-ray transmutation, it scarcely does so in the natural and unforced way which alone would reconcile the physicist to an unobservable particle. However, it remains a working hypothesis useful in directing attention to the points which still require experimental work, and in collating the data already obtained.

A. NUNN MAY

Lightning

AN instructive paper on lightning was read on January 7 by B. L Goodlet, of the Metropolitan-Vickers Electric Co., Ltd., to the Institution of Electrical Engineers. He discussed lightning first as a physical phenomenon and then gave the elementary theory of direct strokes to transmission circuits. He began by saying that although "Lightning" was the title of the Kelvin Lecture given seven years ago, yet the progress made during the last seven years is at least as great as that made during the previous seventy. He awarded due credit to the early pioneers, but modern research on the subject has been so intensive in high-tension laboratories, in the upper atmosphere and in connexion with the tens of thousands of miles of high-tension overhead wires now in continuous operation, that the modern research workers have large sources of experimental data from which they can test theories widely accepted in recent years.

The cumulo-nimbus cloud, or thundercloud, differs from the ordinary rain cloud in having greater vertical dimensions and in the existence of powerful upward air currents. Its formation is associated with convectional instability of the atmosphere, the separation of the electric charge being effected by the resulting upward currents of air. Lightning strokes usually discharge negative electricity into the ground, and consist of a preliminary 'leader' stroke from cloud to earth followed by a powerful return stroke from earth to cloud. Schonland found by means of a Boys camera that each flash is initiated by a streamer which shoots rapidly downwards from the cloud towards the ground, but becomes extinguished before it has travelled more than a fraction of the total distance. About 50 microseconds later, a second streamer follows closely on the track of the first and elongates the channel a little farther. This goes on until an ionized channel is blazed all the way from cloud to earth. The rate of growth of the channel is of the order of 100 kilometres per second.

The maximum current at the ground end of a lightning flash is deduced from the intensity of the magnetic field produced in the vicinity of transmission towers and lightning conductors struck by lightning. About 24,000 magnetic detectors were distributed over the lines of various German electric power companies in 1934. The results showed that the most frequent value of the maximum stroke current lay between 30,000 and 40,000 amperes. Currents greater than 100,000 amperes occur very rarely In 97 per cent of the cases recorded, the cloud discharged negative electricity to the earth. Presumably therefore the base of the cloud must have been negative. Similar results have been obtained in the United States.

The question has often been discussed as to whether certain localities receive an abnormal proportion of lightning strokes. The evidence in favour of localization of lightning flashes comes mainly from the records of electricity undertakings. It has been found, for example, that a certain 80 km. line received 43 strokes, of which 26 fell on one section 6·3 km. in length. Investigation showed that this section of the line was traversed by underground springs. A study of available data has convinced the author that the existence of 'danger spots' struck more frequently for a given storm exposure is a fact.

Some interesting lightning problems occur in connexion with aircraft. Ten cases are known of British aeroplanes having been struck by lightning. In nine out of the ten cases, the wireless aerial was hanging down and was damaged. Moored kite balloons are particularly troubled by phenomena of this nature. When an aeroplane or an airship is flown through a thundercloud, the metal parts of the machine, unless bonded together, acquire very different potentials. Shocks are experienced by persons inside the aircraft when they touch and when they leave go of metal objects.

The earth currents caused by lightning can be a source of great danger. If a current of 50,000 amperes enters the soil at a point and spreads out uniformly in all directions, the voltage drop on the surface as we go away from the point may be very large even at some distance away from the point. The voltage between two points on the earth separated by the length of an animal's stride may be quite sufficient to pass a lethal current up one leg and down another.

The second part of the paper was more technical, being concerned mainly with direct strokes to transmission circuits. In this case rather more than half the direct strokes to a line fall on the conductors in the span between the towers. The final potential of an insulated conductor so struck is probably never less than 2 million volts, and may be sixteen times as great The insulator impulse spark-over voltage of the most heavily insulated overhead line yet constructed is of the order of 2½ million volts. Wooden poles give additional insulation to earth, but cannot be relied on to withstand more than 100–150 kV. per foot. It seems highly probable, therefore, that practically every direct stroke to a live wire will produce some kind of flash-over.

Hence it is necessary to prevent direct strokes or to render flash-overs innocuous. The first can be done by an overhead earthed wire, which proves to be a reasonably effective interceptor; but in places where special protection is required, two earthed overhead wires should be used. In order to secure easy entrance for the current in dry soil, many modern lines are equipped with a 'counterpoise'. This consists of a length of bare cable buried in the ground and attached to the foot of the tower. Each circuit of the new Boulder Dam line in America is equipped with two parallel counterpoises, continuous from tower to tower.

The alternative to lightning-proof construction of the line is to ensure that lightning flash-overs on the line do not interrupt the supply. The best known method of doing this is to use a Petersen coil, which is in general use on the Continent but is less popular in Great Britain and the United States. Alternative methods were also mentioned. In the author's opinion, these methods will prove more popular than the overhead earthed wire, as they are much cheaper. Arc rupturing devices and lightning arrestors can be installed easily on existing unsatisfactory lines.

University Events

BIRMINGHAM.—Dr. Henry Pratt Newsholme, Medical Officer of Health for Birmingham since 1927, has been appointed to the chair of hygiene and public health in succession to the late Sir John Robertson.

CAMBRIDGE.—Prof. E. D. Adrian, Fellow of Trinity College, Foulerton professor of the Royal Society, has been elected as from October 1 to the professorship of physiology which will become vacant by the retirement of Sir Joseph Barcroft.

The subject for the Sedgwick Prize for the year 1940 is: "The Influence of the Idea of Evolution on some Branch of Geological Studies". The essays must be sent to the Registrary on or before October 1, 1939.

The examiners consider that the following essays submitted by candidates for the Smith's Prizes and Rayleigh Prizes are of distinction: H. M. Cundy (Trinity College), "Motion in a Tetrahedral Field"; E. R. Love (Trinity College), "Riemann-Stieltjes Integrals"; H. R. Pitt (Peterhouse), "Tauberian Theorems". The Smith's Prizes have been awarded to E. R. Love and H. R. Pitt and a Rayleigh Prize to H. M. Cundy.

GLASGOW.—Prof. G. G. Henderson, regius professor of chemistry, has sent in his resignation, to take effect from October 1.

Dr. J. Bassil Rennie has been appointed wholetime lecturer in the practice of medicine.

SOUTHAMPTON.—Dr. N. K. Adam, research chemist in Imperial Chemical Industries, Ltd., has been appointed professor of chemistry in University College.

Science News a Century Ago

Birds of Paradise of the Arru Islands

AT a meeting of the Royal Geographical Society held on March 13, 1837, a communication by W. S. Earl was read entitled "On the Key and Arru Islands". The Arru Islands, the author said, were about forty miles south-west of Papua, or New Guinea, and about a hundred miles to the north-east of Timor Laut. The Keys were a smaller group about thirty miles to the westward of the Arrus. The islands were small but closely grouped. Much commercial intercourse prevailed between the islands and the neighbouring coasts, the chief exports being tortoise-shell, bees-wax, ambergris, edible birds' nests and birds of paradise. The last were found in great numbers on the Arrus and the coasts of New Guinea. They were especially valuable, and from the numbers sent to Singapore appeared to be inexhaustible.

Valentyn, a Dutchman who wrote on the East in 1702, described seven varieties of these beautiful birds, while Le Vaillant, and later Guimard, gave descriptions of them. They were exported in great numbers to Arabia and Persia. Francois Valentyn or Valentijn, who was born in 1666 and died about 1725, was a protestant minister at Amboina, Banda and other places.

The Zoological Society

VARIOUS papers were read at the meeting of the Zoological Society held on March 14, 1837, one of them being by Darwin on the *Rhea Americana* and the newly discovered species, in which he described its mode of swimming, a fact unnoticed by earlier writers, but which he had witnessed in two instances. Their progress through the water was slow, very little of the body appearing above the surface, the necks being extended slightly forward. According to the Guachos, the males carried out incubation and not only hatched the eggs, but also attended the young until they were able to provide for themselves. Several females laid in one nest and the number of eggs deposited by each female during the season was from forty to fifty, or according to Azara, from sixty to seventy.

Physical Science in the University of Edinburgh

No one did more to further the study of physics in Scotland a century ago than J. D. Forbes, who instituted a complete working system of examining for degrees in arts in the University of Edinburgh by means of printed papers. His letters frequently contained references to his efforts to stimulate an interest in natural philosophy, and writing on March 15, 1837, to Airy, he said:

"I have been exceedingly busy, and not very well, which have been the causes of my silence. Among other occupations I have had to read five essays, which I have received in competition for a medal I proposed on the Undulatory Theory of Light, a new subject in Scotland, which I am delighted to find has stirred up our youth, and I have got some really respectable compositions. This is a proof to me that things are mending, and that exertion, private and personal, is not thrown away, even where public sympathy or support is not to be looked for.

"I have not abandoned my polarized heat, but have been much driven about this winter. I have got twelve thermometers sunk in different soils from three to twenty-six feet deep, to measure conduction."

Anniversary Meeting of the Statistical Society

At the anniversary meeting of the Statistical Society held on March 15, 1837, the third annual report of the Council was read. In the report, suggestions were put forth for furthering the object of the Society, which was instituted "for the purpose of procuring, arranging and publishing facts calculated to illustrate the conditions and prospects of society". Reference was also made to the advancement of statistical studies. A Statistical Society had been established at Bristol, and the Statistical Society of Glasgow had commenced to publish its proceedings. In foreign countries the collections of statistics had advanced rapidly. The French Government, following the example of that in Great Britain. had published a volume of statistical tables; the Belgian Government had published a similar volume and a statistical journal had been founded in Sicily. The total membership of the Statistical Society at this time was 392.

Societies and Academies

Dublin

Royal Dublin Society, January 25.

Paul A. Murphy: A ten-year experiment on the spread of leaf-roll in the field. The extent of spread was determined in relation to weather conditions in a uniform experiment. Most infection took place in June. Wet Junes were always marked by least spread, due to direct repression of aphids. The reverse did not always hold, the effect of dry Junes being more complex, affecting differently aphids, parasites and plants. Most spread generally took place when the rainfall of the month was nearly normal.

K. C. Dixon: Some aspects of carbohydrate metabolism.

Paris

Academy of Sciences, February 8 (*C.R.*, 204, 385–456)

Alexandre Guilliermond, Fernand Obaton and Roger Gautheret: Presentation of a film on the mitochondria in plant cells. This film, which is believed to be first taken of plant cells, proves definitely a certain number of essential properties of mitochondria concerning which many cytologists have held different views.

Antonin Gosset and Ivan Bertrand: The treatment in man of peripheral nerve sections by medullary heteroplastic grafting. Details of three successful applications of the method.

Marc Krasner and Mlle. Britt Ranulac: A property of polynomials of the division of the circle.

Jacques Hadamard: Remarks on the preceding communication. A. Lienard and Khintchine have given independent solutions of the same problem.

Szolem Mandelbrojt: The principle of regularization of functions.

Georges Valiron: The curves of constant modulus of integral functions.

Chi-Tai Chuang: Some theorems of the directions of Julia and of Borel of meromorph functions.

Pierre Dive: A heterogeneous fluid mass in rotation with a given kinetic moment.

L. Cagniard: The propagation of movement in viscous media.

René Swyngedauw: A new theoretical expression concerning a pulley with a thick belt.

David Belorizky: Resolution of the nebular lines in the spectrum of Nova Herculis 1934.

Théodore Kahan: The theory of the deuton: proton-neutron interaction of exponential tendency.

Ernest Baumgardt: The absorption of ultrasound waves by benzene.

René Lucas: New properties of the thermal elastic waves of liquids.

Douchan Avsec and Michel Luntz: Electroconvective vortices in a liquid sheet.

Mlle. Marguerite Quintin: The potential of copper in solutions of copper benzenesulphonate.

Léon and Eugène Bloch: Structure of the spectra Sb VI and Te VII.

Léon Grillet: The enlargement of the green line (5461 A. Hg) in mercury vapour arcs under high pressure. The green mercury line has been taken as the most useful basis for many measurements. The radiation of two mercury lamps has been studied with a prism spectrograph and with a grating. It is shown that the definition of the wave-length of this line requires special precautions.

Mlle. Hoang thi Nga: The colouring matters of the anthracene group and their photo-sensible capacity.

René Audubert and Henri Muraour: The emission of ultra-violet radiation in the course of the slow decomposition of nitrides (hydrozoates). The slow decomposition of nitrides when heated is accompanied by an emission of ultra-violet radiation. It is relatively intense with the nitrides of sodium, potassium, lead and silver, but very slight with the calcium and barium salts.

Pierre Bonneman: Contribution to the study of the condensed phosphoric acids.

Victor Auger and Mlle. Nina Ivanoff: The study of some phosphates of the type $M_{II}(NH_4)PO_4$.

Henri Moureu and Georges Wétroff: The phospham of Rose. It is concluded that phospham is not produced in the reaction between ammonia and phosphorus trichloride.

Louis Royer: The relations which exist between the gneiss, granitic and rhyolitic rocks of Djebel Arous to the north of Ménerville (Algeria).

André Rivière: The rational interpretation of the sifting 'spectra' of sandy sediments and the geological signification of the diagrams.

Jacques Bardet, Arakel Tchakirian and Mlle. Raymonde Lagrange: The determination of lithium in sea-water. Description of the methods employed for concentrating the lithium from 200 litres of sea-water: the purity of the lithium chloride separated was verified spectroscopically. The quantity found was 0·17 mgm. of lithium per litre.

Paul De Graeve: The evolution of puric nitrogen in the course of germination.

Robert Brunet and Antoine Jullien: The principal elements of myocardiac architecture in the Lamellibranchs.

Raoul Lecoq and Roger Duffau: The influence of acute lack of food balance of glucidic origin on the composition of the muscle of the pigeon.

P. G. Charpentier, Maurice Doladilhe and Charles Morel: The antibody property of the viscous protein of hæmolytic sera.

W. Kopaczewski: Gel formation of the blood constituents.

Brussels

Royal Academy (*Bull. Classe Sci.*, 22, No. 10 ; 1936).

L. Godeaux : Construction of an algebraic surface of divisor three.

T De Donder and Y. Dupont : New theory of the dynamics of continuous systems (2).

J. E. Verschaffelt : The application of thermomechanics to electrochemistry.

E. De Wildeman : Variations of generic characters which are specific, or belong to varieties, in plants, and some of their consequences.

P. Fourmarier : Preliminary observations on slaty cleavage between Boscastle and Newquay, Cornwall.

T. H. J. Lepage : Geodesic fields of the calculus of variations (2).

D. S. Mitrinovitch : Asymptotic lines of a class of surfaces and linear differential equations of the second order belonging thereto.

L. Pasqualini : Conditions of convexity of a plane curve or of a surface.

M. Linsman : Remark on the singular points of real surfaces.

Mlle. G. Schouls : Application of affinity and quantum statistics to catalysis.

Z. M. Bacq : Poisons of the nemerteans.

W. Robyns : Phenomena of pleiomery and synanthy in *Salpiglossis sinuata* Ruiz and Pav.

J. de la Vallée Poussin : Stratigraphy of the old formations in the region of the Great African Lakes.

J. Thoreau, R. Breckpot and J. F. Vaes : The monazite of Shinkolobwe (Katanga).

(*Bull. Classe Sci.*, 22, No. 11 ; 1936).

P. Bruylants and J. Jennen : Maleic and citraconic nitriles.

R. Godeau : (1) A class of surfaces the asymptotic lines of which have a given differential equation. (2) Remark on the paper "Asymptotic Lines of a Class of Surfaces" by Mitrinovitch.

Mlle. G. Schouls : Deduction and generalization of Arrhenius's formula with the aid of affinity and quantum mechanics.

E. Ruppol : Ultra-violet absorption spectrum of maleic nitrile.

J. Jennen : Maleic and fumaric nitriles. Preparative details, chemical and physical properties.

M. Florkin : True plasmatic glycæmia of a selachian (*Scyllium canicula* L.).

L. Lison : Vital coloration of the nucleoles in the Malpighian tube in *Forficula auricularia* Linn.

Geneva

Society of Physics and Natural History, December 17.

F. Chodat and R. Levy : Edaphism of moraine soils.

E. Guyenot and K. Ponse : The action of the urine of the ovariotomized woman on immature and adult female guinea pigs.

E. Guyenot : The action of the urine of the ovariotomized woman on hypophysectomized female guinea pigs.

Moscow

Academy of Sciences (*C.R.*, vol. IV, No. 7 ; 1936).

P. Alexandroff : Affine transformations of enumerably infinite multiplicity.

N. Günther : An integral analogous to the integral of Fourier.

P. P. Lazareff, Z. V. Boulanova and M. R. Semenovych : Influence of the latitude of the observation point on the adaptation in peripheral vision at different ages.

P. P. Lazareff and T. N. Čiževskaja : Change in the adaptation in peripheral vision with altitude above sea-level.

A. V. Lugovoj : Effect of short radio waves upon the life activities of cockchafer larvæ.

S. A. Neufach : Fate of glutathione introduced into the blood *in vitro*. Reduced glutathione can scarcely be detected in blood after 30 minutes.

V. Karasik and M. Lichačev : (1) Comparative biological activity of aromatic and heterocyclic arsonium bases. (2) The influence of the anion of dimethylphenazarsonium hydroxide salts on their biological activity.

A. P. Verner and A. A. Kovalev : The problem of the nitrogen-fixing power of *Bacterium radicicola*. The presence of bios is necessary for the reproduction of *B. radicicola* and for the accumulation of nitrogen by it.

N. A. Iljin : Homologous series in the phenogenesis of pigmentation.

B. S. Iljin : A new goby from the Caspian Sea, *Gobius nonultimus*, sp n. (Pisces, Gobiidæ).

A. A. Studitskaja : Formation of osteoclasts in cultures of skeletogenous tissue.

L. S. Berg : *Teleopterina*, n.g., a highly organized Acanthopterygian from the Carboniferous of North America.

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 673–713, December 15).

G. S. Avery, jun., P. R. Burkholder and Harriet B. Creighton : Plant hormones and mineral nutrition. Experiments with shoot tips of sunflower and tobacco plants grown in sand culture suggest that growth hormone production is unaffected by relative deficiencies of the common elements, or by variation of osmotic pressure of nutrient solution, but is most abundant in plants provided with a high concentration of nitrogen and scarcely detectable in absence of this element.

W. E. Castle : A simplified explanation of Bellamy's experiments concerning sex determination in tropical fishes.

M. J. Buerger : (1) The kinetic basis of crystal polymorphism. For a given temperature, there is a preferred vibration mode for the aggregate (or cluster) forming the unit of the crystal. This preferred mode requires a certain dynamic symmetry, and stable crystals are formed by the building up of a structure providing this symmetry. (2) The general role of composition in polymorphism. A theoretical discussion of the temperature-composition diagram with particular reference to solid solution.

E. R. Dunn : Notes on North American Leptodeira (Colubrine snakes of moderate to small dimensions).

Achille Bassi : New invariants of a manifold.

G. A. Miller : (1) Enumeration of the Abelian groups whose orders do not exceed a given number. (2) Groups whose prime powers generate a cyclic subgroup.

John von Neumann : Regular rings.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, March 15

Royal Geographical Society, at 5.—Prof. C. Daryll Forde: "A Study of Settlement in the Cross River Area, Southern Nigeria".

Tuesday, March 16

Eugenics Society, at 5.15—(at the Linnean Society, Burlington House, W.1).—Miss H. Holland, Dr. J. R. Baker and Dr. S. Zuckerman: "Birth Control: The Last Year's Work".*

Wednesday, March 17

Chemical Society, at 5.30—(at the Royal Institution, Albemarle Street, W.1).—Prof. V. M. Goldschmidt: "Principles of Distribution of Chemical Elements in Minerals and Rocks" (Seventh Hugo Muller Lecture).

University College, London, at 5.30.—Dr. V. Friedenreich: "Blood Groups and Genetics".*

Royal Meteorological Society, at 7.30.—Prof. D. Brunt: "Clouds, Natural and Artificial" (Symons Memorial Lecture).

Royal Society of Arts, at 8.—H. D. Henderson: "Problems of the Displacement of Labour by Mechanization".

Thursday, March 18

Chemical Society, at 4—(at Grosvenor House, Park Lane, W.1).—Annual General Meeting and Anniversary Dinner (at 7).

Royal Asiatic Society, at 4.30.—Dr. Li Chi: "The Culture of the Shang Dynasty".

British Institute of Radiology, at 8.—Prof. S. Russ and Miss G. M. Scott: "Some Biological Effects of Continuous Gamma Irradiation. With Notes on Protection".

Friday, March 19

Geographical Discussion at 4.30—(at the Royal Astronomical Society).—Discussion on "Instrumental Seismology" to be opened by J. J. Shaw.

Royal Institution, at 9.—Lord Rutherford, F.R.S.: "The Transmutation of Heavy Elements".

Institute of Physics, March 18–20.—Second Conference on Industrial Physics to be held at the University of Birmingham. Subject: "Optical Devices in Research and Industry".

March 18, at 4.30.—Prof. A. Fowler, F.R.S.: "Spectroscopy in Industry" (Presidential Address).

Appointments Vacant

Applications are invited for the following appointments, on or before the date mentioned:

Scientific Officer (air armament—ref. 308/*C*) and Assistant (grade II Experimental and design work—ref. 309/*C*) in the Directorate of Scientific Research, Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough (March 19).

Junior Scientific Officers and Assistants (grade III) in the Building Research Station, Garston and the Road Research Laboratory, Harmondsworth—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (March 19).

Assistants (grade III) for library work in the Department of Scientific and Industrial Research—The Establishment Officer, D.S.I.R., 16 Old Queen Street, Westminster, S W.1 (March 19).

Examiner in the Non-Metallic Section, A.I D. Test House, Kidbrooke—The Secretary (S.2 d,), Air Ministry, Kingsway, F.C.2 (March 20).

Tutor and Lecturer in Biology in the Maria Grey Training College, Salusbury Road, London, N.W.6—The Secretary to the Principal (March 20).

Chief Technical Instructor in the Government Trade School, Haifa—The Secretary (*SIR/CA*), Board of Education, Whitehall, S.W.1 (March 21).

Sub-Assistant Botanist in the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (March 22).

Three Scientific Officers in the Explosives Directorate, Research Department, Woolwich, S E.18—The Chief Superintendent (March 27).

Assistant (grade II—engineering) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E Branch) (March 27).

Research Palæontologist in the University of Western Australia—The Agent General for Western Australia, Savoy House, 115/116 Strand, W.C.2 (March 31).

Technical Assistant in the Information Department and Library of the British Non-Ferrous Metals Research Association—The Secretary, B.N F M.R.A , Regnart Buildings, Euston Street, N.W.1 (March 31)

Senior Lecturer in Social Anthropology in the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W C 2 (March 31).

Lecturer in Pure and Applied Mathematics in the Battersea Polytechnic, London, S.W.11—The Clerk to the Governing Body (April 17).

Lecturer in Geography and Demonstrator in Physiology in Bedford College for Women, Regent's Park, N.W.1—The Secretary (April 20)

Professor of Anatomy in Middlesex Hospital Medical School—The Academic Registrar, University of London, W C.1 (April 23)

Assistant Director of Pathology (with title of Nuffield Reader in Pathology) in the University of Oxford—The Secretary of Faculties, University Registry, Oxford (April 26).

Senior Lecturer in Physiology in the University of Liverpool—The Registrar (May 1).

Professor of Chemistry in the University of Western Australia—The Agent General for Western Australia, Savoy House, 115/116 Strand, W.C.2 (May 17).

Official Publications Received

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1706 (1416): Tests of Six Aerofoil Sections at various Reynolds Numbers in the Compressed Air Tunnel. By E. F. Relf, Dr. R. Jones and A. H Bell. Pp. 33. 4*s*. 6*d*. net. No. 1708 (2264): Effect of Surface Roughness on Characteristics of Aerofoils N.A.C.A. 0012 and R.A F. 34. By Dr. R. Jones and Dr D. H. Williams. Pp. 56. 8*s*. net. No. 1709 (2268): Experiments on a Heinkel He. 70 Aeroplane in the Compressed Air Tunnel. By Dr. R. Jones and E Smyth. Pp. 5. 1*s* net. No 1714 (2189): Interim Report on Systematic Model Research in Free Spins; Low Wing Monoplanes By R. H. Francis. Pp. 15. 2*s*. 6*d*. net. No. 1716 (2198): Oscillations of Elastic Blades and Wings in an Airstream. By Dr. W. J. Duncan, A. R. Collar and H M Lyon. Pp. 38. 6*s*. 6*d*. net. No. 1717 (2433): Tests of Aerofoils R A.F. 69 and R.A F. 89, with and without Split Flaps, in the Compressed Air Tunnel By D. H. Williams, A. F. Brown and E. Smyth. Pp. 24. 3*s*. 6*d*. net. (London: H.M. Stationery Office.) [52

Proceedings of the Royal Irish Academy. Vol 43, Section A, No. 5: Contact Conditions for Surfaces. By J G. Semple. Pp. 49–71. 1*s*. Vol. 43, Section B, No. 8; A Record of New Analyses of Tertiary Igneous Rocks (Antrim and Staffa). By Arthur Holmes. Pp. 89–94. 6*d*. Vol. 43, Section B, No. 7. The Synthesis of Diflavonals. By Dr. Joseph Algar and Dorothy E. Hurley. Pp. 83–87. (Dublin Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [52

Brompton Hospital Reports: a Collection of Papers recently published from the Hospital. Vol. 5, 1936. Pp. iv+143. (London: Hospital for Consumption) 3*s* [62

Other Countries

Meddelande från Lunds Astronomiska Observatorium. Ser. 1, Nr 145. A Graphical Method of determining the Absolute Luminosity Distribution of the Stars. By W. Gyllenberg. Pp. 11+1 plate. Ser. 1, Nr. 146: Eine Bemerkung zu den Spektralvergleichungen in der Bergedorfer Spektral-Durchmusterung. Von Erik Holmberg. Pp. 7. Ser. 2, Nr. 77 (Historical Notes and Papers No. 3): Two Early Conceptions concerning the Earth's Hanging Free in Space. By Knut Lundmark. Pp. 8 50 ore. Ser. 2, Nr. 81: On the Masses of the Stars. By Folke Berglund. Pp. 25. 2.00 kr. (Lund: Astronomiska Observatorium.) [112

U S. Department of the Interior: Geological Survey. Bulletin 868–C: Upper Copper and Tanara Rivers, Alaska. By Fred. H Moffit. (Mineral Resources of Alaska, 1934.) Pp. ii+135–143+plate 8. (Washington, D.C.: Government Printing Office) 10 cents. [122

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Promotion of International Peace

THE attention which has been given in Great Britain during the past few months to considerations of defence and the Government's programme of rearmament, despite all the scepticism expressed as to any effective defence against attack from the air, has rather over-shadowed the other side of defence against war—the removal of its causes. To this positive aspect of the question the International Peace Campaign has the great merit of directing attention, and the appeal for support of the British National Committee of the Campaign, which has recently been issued over the signature of Viscount Cecil, has claims on the interest of every scientific worker.

The need for a more balanced handling of the problem of peace and national defence is unquestioned by well-qualified observers. The International Peace Campaign, as Viscount Cecil points out, has come into existence for the sole purpose of arresting the drift towards war, and aims at strengthening and co-ordinating organizations which already exist and are interested in peace, and although its organization takes no part in party politics, it is all the more important that it should secure support from all sections of political opinion if its policy and development are to be free from bias, however unconscious or unintentional.

The four objectives of the campaign naturally include the reduction and limitation of armaments by international agreement and the suppression of profit from the manufacture and trade in arms. This objective is not, however, over-stressed, and its practical impossibility at the time need not deter the most convinced supporter of the Government programme from supporting the Campaign, while at the same time it serves as a reminder of the necessity of such action when international tension is lessened and a positive defence policy bears fruit.

The first objective of the Campaign, however, the recognition of the sanctity of treaty obligations, should command universal assent. However inapplicable the provisions of the Versailles treaty may be under the conditions of to-day, and however overdue their supercession, the method of unilateral repudiation adopted by Germany has dealt heavy blows at the assumption of international good faith and the respect for treaties upon which all international order and co-operation are finally based. It is not merely that Germany's other treaty obligations are viewed by other countries with the same cynicism and distrust as have been Italy's since her Abyssinian expedition—a cynicism which no announcements of Mediterranean agreements or understandings can dispel—but also confidence has been undermined, and mutual distrust, itself the chief enemy of peace, has been greatly multiplied.

It is on this main point that Dr. L. P. Jacks insisted in a recent thoughtful criticism of the League Covenant contributed to the *Hibbert Journal* under the title "Alexander Hamilton and the Reform of the League". Covenants between sovereign States can depend only on the good faith of the contracting parties, and if that is insecure nothing can be made safe. Coercive measures intended to circumvent bad faith are exposed to the bad faith they would circumvent, and indeed are more vulnerable to it, since they tend to emphasize any bad faith which exists, inflame it and afford fresh opportunities of mischief. Accordingly, Dr. Jacks urges that the elimination from the Covenant of the last traces of the coercive element and the fatal assumption upon which it rests would have an immense and salutary psychological effect.

This argument that the better atmosphere thus created would permit the League of Nations to achieve far more effectively its proper function of protecting human welfare by international co-operation on positive lines finds strong support in a careful study of public opinion as a safeguard to peace delivered by Prof. E. H. Carr as the inaugural lecture of the Wilson chair of international politics at University College, Aberystwyth, on October 14. Reviewing the various divergent sections of opinion, from the pacifist and the isolationist to the collectivist, which to-day are found supporting the cause of peace, Prof. Carr emphasizes the necessity of regarding international politics not as a pure but as an applied science, in accordance with Aristotle's assertion that "the end of the study of politics is not knowledge but practice". Accordingly, he does not regard a system of collective security involving automatic military obligations as likely to gain sufficient support in Great Britain to be practical. He believes, on the contrary, that in this country public opinion is not prepared to support war as an instrument of any kind of policy, whether in defence of collective security or not.

Prof. Carr maintains that support of the Covenant in Great Britain is, in fact, subject to the over-riding consideration that it involves no risk of bringing the country into war, and that public opinion will not be prepared for many years to apply the Sanctions article against a Great Power. Although he does not discuss the amendment of the Covenant, as a matter of practical politics, support of Dr. Jacks' suggestion might be read as a corollary of his remarks.

There will accordingly be perhaps less unqualified support for the third objective of the International Peace Council—the strengthening of the League of Nations for the prevention and stopping of war by the organization of collective security and mutual assistance. Though Prof. Carr's belief in the possibility of isolating war will not be shared by many, and though he asserts his disbelief that the time is ripe for the establishment of anything like an international police force, there is still plenty of ground in common with the supporter of collective security. Public opinion undoubtedly presents a far more determined obstacle to war-mongering in any form than it did a generation ago. The area of the world's surface over which war has become unthinkable has been immensely extended, and with wise handling might even yet be much greater, despite the great tragedies of missed opportunities which have marked the last two decades The increased power of Governments to-day of influencing public opinion, whether by broadcasting or through the Press, should warn us against overrating the restraining effect of public opinion in any time of crisis except in so far as it is really informed and independent. Moreover, the whole trend of events in Spain and in Abyssinia strengthens the case for organizing effectively collective force behind law if civilization is to be preserved.

The most urgent problem if peace is to be preserved and democracy survive is in fact that of peaceful change, which forms the fourth objective of the Campaign and upon which Prof. Carr lays the greatest stress. The establishment within the framework of the League of effective machinery for remedying international conditions which might lead to war is the most urgent task of our generation, and offers an immense field for impartial scientific investigation. There can be no rule of law unless there is working machinery for making and re-making law, and no sanctity of treaties without effective means for altering or re-making treaties which are no longer applicable to the prevailing conditions.

Nothing in fact is so imperative at the present time as the need for demonstrating that such questions as raw materials, population, colonial territories and the like can be dealt with justly and impartially by a process of peaceful change and not merely at the demand of *force majeure.* The greatest function of public opinion, whether expressed through the International Peace Campaign, or in any other way, is to insist on the Government exploring the possibilities in this way to the utmost so as to remove and not engender further friction. Nor should it be forgotten that peace is dynamic and not static, and, just as much as war, involves risks and ventures. Only as the nations and the Governments are prepared to run those risks and to make those ventures can we hope to develop a civilization and a social and international order in which in days of peace the human mind and spirit can find expression no less nobler than they have done in the past in days of national extremity or calamity in war. A creative peace is in fact a first essential if science, no less than art and religion, is to retain its full freedom of expression and bring yet richer treasures to the service and inspiration of mankind.

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A Compendium of Bengal

Life and Experiences of a Bengali Chemist
By Prafulla Chandra Rây. Vol. 2. Pp. viii + 469. (Calcutta: Chuckervertty, Chatterjee and Co., Ltd.; London: Kegan Paul and Co., Ltd., 1935.) 6*s*.

THE second volume of Sir P. C. Rây's "Life and Experiences" is concerned chiefly with economics and politics and very little with chemistry. The author calls it "a compendium of India under British rule"; but this description is rather too comprehensive. The book is written by a Bengali who loves Bengal and has devoted his life to its welfare. To him, the rest of India is an incident, sometimes even an encumbrance. Other patriotic Indians hold similar views regarding their particular province or State, and the reader may thus readily realize some of the difficulties which confront the Central Government and the reasons for the establishment of provincial autonomy.

A quarter of the book is devoted to an illuminating history of education. There is little doubt that education in India has gone seriously astray. The uneducated masses have no real desire for their children to be educated, and thus we meet the phenomenon of the school which hurriedly comes into existence on the arrival of the inspector, to vanish as rapidly when he has departed. In such circumstances, progress can scarcely be rapid. But what is progress ? Experts hold fundamentally divergent opinions as to what constitutes a suitable form of education, and, even if there could be some general agreement as to the system, how is the education of some three hundred million people to be paid for when they are too poor to contribute even fourpence a head per year (the amount of the much-debated salt tax)? It would seem that the only solution of the problem is for patriotic Indians in every village to devote an hour or so daily to the instruction of their weaker brethren.

It is generally assumed that universal primary education is a desirable goal, but is this so ? If any conclusions can be drawn from the thousands of luckless graduates who, after many years of self-denial and overwork, are unable to secure the salary of a cook or a chauffeur, even primary education may not always be a blessing.

A recitation of the misdeeds of the Government of India fills most of the remainder of the volume. No one will deny that blunders have been committed, the greatest of which, perhaps, was when, with seven dead Delhis before them, Government set to work to construct an eighth, and this not merely a temporary winter residence for officials but a city which was to surpass in magnificence and costliness any of its predecessors. Small wonder if critics assume that Government has no desire for economy and no real interest in the welfare of the country, and, indeed, that behind every action, no matter how well-meaning, there lurks some sinister intention.

A man of science, however, who knows how readily his carefully planned experiments may go astray, before leading to improvement and final progress, should be chary of finding fault with others until he can point out a better way. Granted that Government has made mistakes, is it not going rather far to accuse it of spreading malaria by building a railway embankment many years before the cause of the disease was known, or to speak of their "criminal and wilful neglect of irrigation" when they have initiated schemes which are the admiration of the world ? The peace which India has so long enjoyed is said to have emasculated the people, and communalism to have been deliberately fostered. Statements such as this, in which the book abounds, can do nothing but detract from its value. Nor does it help greatly to compare modern India with the more prosperous India of the past. Infant welfare, improved sanitation, inoculation against disease, albeit but a fraction of what might be done, and the reduction of famine mortality by the opening up of communications, have all resulted in the presence of three million extra mouths to feed every year. As the struggle for existence grows keener, individual strives against individual, community against community and province against province. Is this the fault of Government, or some inherent defect in the character of man ?

Japan and Italy are held up as examples of what may be accomplished, but there is a fundamental difference. The Japanese are bound together by a patriotism greater, perhaps, than that of any other nation, while the progress made in Italy is the result of a compulsion which would never find favour in India, even if it were administratively possible. The Indian, on the other hand, is essentially an individualist, although there have been many broad-minded and great men who have the country's interest at heart. Sir P. C. Rây is fully aware of this trait; indeed, he says: "A great drawback in our national character is that, as soon as the founder of the concern dies, his sons or successors quarrel among themselves as to who should manage it". He points out frankly many other shortcomings of his people and exhorts them to frugality, honesty of purpose, self-reliance and patriotism. Those who know him are well aware there could be no better preacher, for, throughout his long life, he has practised every precept he preaches with a vigour which is beyond admiration—yet how many heed his advice ? True reform must come from within; until the individual learns that service to others is as vital as self-interest, no Government on earth can bring prosperity in place of poverty and misery. H. E. W.

Shabti Figures

Shabtis

Illustrated by the Egyptian Collection in University College, London: with Catalogue of Figures from many other Sources. By Sir Flinders Petrie. (British School of Archaeology in Egypt and Egyptian Research Account, Forty-first Year, 1935.) Pp. x+16+45 plates. (London: British School of Egyptian Archaeology, and Bernard Quaritch, Ltd., 1935.) 25*s*.

IN this volume, which forms part of the series of monographs planned by the author to cover the development of the principal departments in the civilization of ancient Egypt, Sir Flinders Petrie has surveyed from its origins the history of the custom of placing one or more small representations of the mummy in the tomb. The survey is more complete than any previous study that has been attempted, and covers not only the collection at University College, London, numbering 650 examples, but also a further 565 from the Italian and other museums. In addition to the register or catalogue of these, there is a corpus of the inscriptions, and the types are illustrated in a series of excellent photographs.

In an analysis of the material which precedes the catalogue, Sir Flinders first examines the evidence bearing on the origin of the custom. Although the ushabti figure, properly speaking, does not appear until the Twelfth Dynasty, he traces the conception from which it grew back to the pre-dynastic custom of separating the skull from the disarticulated bones and burying it either in an unnatural relation to them, or above the pile of stones which covered them. Evidently burial had been delayed in order to secure the help of the ancestral spirit, possibly by keeping the skull in the house. Analogous customs of West Africa are quoted in support. By the Twelfth Dynasty the idea of the terrestrial habitation for the soul, involving the provision of house, furniture and other appurtenances of a life on earth, had given place to a translation to the realm of Osiris, where not only were pleasures to be enjoyed, but also duties had to be performed. When once the conception had gained currency that such duties were the function of the ushabti figure, it was only a step, though it was not a step taken until the end of the Eighteenth and beginning of the Nineteenth Dynasties, to the idea that the ushabti was not a representation of the deceased, but a slave. Then the one figure, hitherto single, except in Royal burials, took on added numbers, until it was necessary to include overseers with whips. In the later dynasties there were frequently so many as four hundred or just under. The duties the shabti figures were to perform were by no means light: originally the weaving of cloth, to this was added the carrying of sand and later the cultivation of the soil. Sir Flinders, by his study of the date at which variations in the inscriptions on the shabti appear, is able to trace the development at various periods in the conception which inspired their use.

The material from which the shabti figures were made varies from stone to wood, and even mud was used. The most familiar form is perhaps that made of pottery and covered with blue or green glaze. The form varies in like manner, and at times becomes almost shapeless.

In connexion with the use of wood for a figure with magical properties, Sir Flinders refers to the Greek parody of the idea in Lucian in the story in which a magician turns a piece of wood or a household article into a servant to perform any function for which he requires it, and then transforms it back again, the jest being that the teller of the story, knowing part of the formula, sets an animated piece of wood to carry water, but being unable to make it stop, cuts it in two and doubles the danger of inundation. Sir Flinders tells us that the story has been revived in a modern French symphonic poem; but there are many other versions. It was a familiar story in the Middle Ages and is told of a pupil of the thirteenth-century magician, Michael Scott, who tried to emulate his master. It is interesting to note that the duty of carrying sand associated with the dead in the realm of Osiris, also appears in connexion with Michael Scott, who set the Devil to carry sand on the shores of Fife.

Aromatic Diazo-Compounds in Industry

The Aromatic Diazo-Compounds and their Technical Applications
By K. H. Saunders. Pp. xii+224. (London: Edward Arnold and Co., 1936.) 12*s*. 6*d*. net.

IN this very concise treatise the author has summarized the history of the industrially important diazo-compounds since their earliest recognition by Peter Gries in 1858 until the present time. The various methods of preparing diazonium salts are reviewed, including the recent outstanding discovery made independently by Hodgson and Schoutissen that *o*-diamines can be made to give the reactions of bisdiazonium compounds.

The rapid development of industrial activity in the ice colours based on Naphthol *AS* and its analogues has led to many devices for stabilizing diazo-compounds. Among these the use of the stable forms of diazo-sulphonates is noteworthy as leading to valuable monoazo-dyes of the variamine blue class. The author presents a clear and comprehensive account of the abstruse researches on the constitution of diazo-compounds carried on for a number of years by Hantzsch, Bamberger and many others, and more recently by Angeli.

At present the industrial utilization of diazo-compounds is much in advance of our theoretical knowledge concerning their constitution. It is pointed out that the score or more of aromatic amines supplied commercially in a high degree of purity for ice-colour work could now furnish for research purposes diazo-derivatives which were not available formerly. In addition to the couplings which lead to industrially important hydroxyazo- and aminoazo-dyes, the diazo-compounds serve for many synthetic operations in aromatic chemistry, whereby the halogens, including fluorine, and several other non-metals and some metals are introduced into benzenoid nuclei. All these reactions are described and there is a full bibliography which includes references to the literature of heterocyclic diazo-compounds.

In spite of the intricacy of the subject matter, the text is remarkably free from errors and there are adequate author and subject indexes, although the former does not always tally with the references at the end of each section. This book may be recommended with confidence as the most up-to-date monograph on the diazo-reaction in the English language. G. T. M.

Racial Portraiture: a Sculptor's View

A Sculptor's Odyssey
By Malvina Hoffman. Pp. xxii+416+128 plates. (London and New York: Charles Scribner's Sons, Ltd., 1936.) 24*s*. net.

SIX years ago, the Field Museum of Chicago formulated a bold and novel project. Dissatisfied with the conventional lay-out of the anthropological section of the average ethnographical museum, it conceived the plan of a sculptural Hall of Man, to consist of one hundred sculptured heads and figures, modelled from life, and embracing the main surviving anthropological types—a far-sighted break with museum tradition, which, if judged solely on the statistical evidence of subsequent visitors, has amply justified the trustees' vision. To Miss Malvina Hoffman, who already at that time filled a unique and outstanding position in the world of sculpture, was entrusted this colossal task; and this volume—well named her Odyssey—leads up, through her early years of struggle, to the inner story of its achievement.

As an unassuming record of travel and observation, of perseverance in the face of unexpected difficulties, of the transport of the hundred precious clay figures in China and Japan, Java and the South Seas, Burma, India, and Europe, it is a fascinating piece of writing, though marred at times—particularly towards the close—by an odd sentimentality: but for the technical reader it has a wider and two-fold significance. Here was a comprehensive anthropological problem, which might have been approached *ex cathedra*, from the academic angle, each sculptured figure being created an elaborate synthesis of exact facial angles and accurate anatomical measurements. In practice, mercifully, the task was planned and executed by an artist: and, as Sir Arthur Keith writes of Miss Hoffman's work, "we professional anthropologists can never hope to obtain by mere measurements the accuracy of racial portraiture which comes by instinct to the true artist". In London, there is small opportunity to study Miss Hoffman's sculpture, though some idea is given by the two heroic figures above the entrance to Bush House: but the large success of her Hall of Man can readily be estimated from the magnificent plates in this volume.

A further significance of the book is implicit and to some extent explicit in Miss Hoffman's narrative. Hers is not an art in which the hand of the master is withdrawn immediately the original clay is modelled, leaving all subsequent work to plaster caster, *metteur au point*, or bronze founder. It is abundantly evident from her writing that Miss Hoffman has served an apprenticeship to her craft comparable to that served by the medieval and Renaissance craftsman: and while, obviously, the casting of a heroic bronze is essentially a piece of fine team-work, she has herself mastered in practice every detail—building the armature, modelling, plaster casting, and all the subtleties and scientific tricks of casting in bronze by the sand and lost-wax techniques. The book is an opportune reminder of the ancient gospel once more being preached to young artists and craftsmen—clear recognition of the limits imposed upon execution by the material properties of the medium: and complete mastery and understanding of technique, in contradistinction to mere empirical facility.

Not the least interesting section of the book is that which gives in compact form the succession of exact manipulations which lies between the clay model and the patinated bronze. Nevertheless, the book is essentially one for the non-specialist, for whom a friendly narrative of travel is woven through pages of magnificent photographs.

P. D. R.

Survey of British Agriculture

Regional Types of British Agriculture
By Fifteen Authors. Edited by J. P. Maxton. Pp. 318. (London: George Allen and Unwin, Ltd., 1936.) 12*s*. 6*d*. net.

ALTHOUGH Great Britain is a small country, it presents a surprising diversity of soils, a wide range of altitude and rainfall, and extreme variations in density of population. These factors have resulted in a large number of farming systems which only have one thing in common, namely, a very close suitability to the environment in which they have grown up. A good general knowledge of the type of agriculture carried on in the more important natural divisions of the country should be part of the equipment of all students and teachers of agriculture, and for the increasing numbers of those who, while not actually in the farming industry, are interested in its development in relation to national policy.

The description of farming systems has certainly not been an overworked field in the past. There are the classical county surveys done for the Board of Agriculture at the end of the eighteenth century, and numerous articles describing farming districts in the volumes of the *Journal of the Royal Agricultural Society*. We have also descriptions of farming tours made in recent years, of which those of Rider Haggard (1901–2), and Sir Daniel Hall (1910–12) are perhaps the best known. But much has happened since then, and types of agriculture that held their own for generations have yielded before the pressure of present-day economic movements, while others have entered into relative prosperity as a result of Government action.

The units of the present volume are the fifteen advisory provinces into which Great Britain is divided, and the agriculture of each is described in almost all cases by the head of the department of agricultural economics. Naturally the province is far too large an area to be treated as an agricultural whole, so that a system of farming zones within provinces has been adopted, and the characterization of the separate regions has been set out. Since some eighty separate regions are treated, it will be understood that descriptions are necessarily brief, and the authors have in many cases been compelled to hold very close to the matter in hand, avoiding the entertaining detours and personal touches that writers who have had more elbow-room have been able to allow themselves.

The treatment of each province is on uniform lines. After a general discussion of the physical and geological features of the area and a note on the distribution of population, the regions are set out and described in more detail. There are numerous references to the modification in classical systems of husbandry designed to meet changing economic conditions. Clear maps are provided showing altitude, chief features, towns and the boundaries of the separate agricultural zones.

The book makes a useful addition to the rather scanty and scattered information on regional agriculture in its present-day aspects. H. V. G.

Magnetochemie

Von Prof. Dr. W. Klemm. (Physik und Chemie und ihre Anwendungen in Einzeldarstellungen, Band 1.) Pp. xv+262. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936.) 18 gold marks.

By magnetochemistry is meant the examination of the problems of chemical structure in the light of magnetic measurements and modern magnetic theory, and it is clear that the author of this book has thoroughly studied the more important methods of susceptibility determinations and the theoretical significance of the results. He does not assume that his readers already know all about the matters on which he writes, and his work is a fine example of careful exposition based upon a proper attention to fundamental conceptions and definitions. The outline of experimental methods and technique is by no means exhaustive, but it should be adequate for the average chemist who is likely to read the book.

The author gives a very full discussion of the earlier theories of para- and diamagnetism, although he follows other writers in obtaining an expression for the molar susceptibility of a diamagnetic substance in which a 6 appears, without giving a complete explanation of how the 6 gets there. The survey of the newer quantum theory of magnetic moments is particularly good, and the explanation of the temperature-independent type of paramagnetism, predicted by Van Vleck, is very neatly set forth. The influence of temperature and chemical combination upon magnetic susceptibilities is also fully discussed.

A large portion of the book is naturally devoted to problems of chemical structure, and the treatment of the magnetic properties of inorganic compounds and metals is especially helpful, for it includes data which the reviewer has not found elsewhere. It can be cordially recommended to all who are interested in the magnetic aspects of chemical problems.

L. F. B.

Le plateau de Meghalaya (Garo-Khasi-Jaintia):

étude géographique d'une région naturelle de l'Inde. Par Dr. Shiba Prasad Chatterjee. Pp. 170. (Paris: Les Presses modernes; London: The Bibliophile, 1936.) 10*s.* 6*d.* net.

"Meghalaya" is the name given by Dr. Chatterjee to that isolated block of peninsular India which sticks out westwards like a promontory from the Naga Hills into the plain of Assam-Bengal. The meaning is 'abode of cloud', on the analogy of Himalaya, 'abode of snow'. Although the "Khasi and Jaintia Hills", as the name appears on maps, are connected by a high ridge with the Naga Hills, they form no part of them, being very much older.

Dr. Chatterjee, who is a geologist, is the right person to have written this little study, and he has done it very thoroughly. He clearly distinguishes between the Shillong Plateau in the centre, the Garo Hills in the west, leading down to the plains, and the Jaintia Hills in the east. The physiographical distinction, well shown in the contoured sketch map, is convincing, based partly on structural and partly on climatic differences; but to call them natural regions is to exaggerate their importance. The distinction is mainly one of relief.

The author gives a clear account, illustrated by line drawings and by sections, of the structure and evolution of the region, followed by a chapter on the climate. Cherrapunji has attained world-wide fame for its 600 inches of rainfall—not every year! The attempt to divide the flora of Meghalaya into three sub-floras, corresponding with the three physiographical areas, is not so successful; and the vegetation map naturally suffers from compression. The drawings by Mr. Frank Simpson are pleasant, and give a good idea of this interesting country of which we have heard little since Hooker's "Himalayan Journals".

(1) Heat Engines

By S. H. Moorfield and H. H. Winstanley. Second edition. Pp. vii+326. (London: Edward Arnold and Co., 1935.) 6*s.* 6*d.*

(2) Examples in Heat and Heat Engines

By T. Peel. Second edition. Pp. vi+146. (Cambridge: At the University Press, 1935.) 5*s.*

(1) For those beginning the serious study of the theory, Messrs. Moorfield and Winstanley's primer "Heat Engines" has already obtained recognition as a suitable medium of introduction to the subject. The second edition follows the lines of the first, but is enlarged by the addition of a chapter on steam turbines. It thus covers the work usually required for the Ordinary National Certificate and presents a difficult subject in an easy and convincing way very suitable for those of limited attainment in mathematics.

(2) "Examples in Heat and Heat Engines", by T. Peel, also in its second edition, contains fifty sets of graduated and arranged questions taken from *A* and *B* papers of the Cambridge Engineering Tripos or prepared in accordance with that standard—a very useful series for those preparing for the advanced examinations.

Lorenz Oken und Georg Büchner:

Zwei Gestalten aus der Übergangszeit von Naturphilosophie zu Naturwissenschaft. Von Jean Strohl. (Schriften der Corona, Band 14.) Pp. 106. (Zürich: Verlag der Corona; Münich und Berlin: R. Oldenbourg, 1936.) 5 gold marks.

Few people to-day have ever heard of Georg Büchner, while their ideas about Oken turn mainly on his "Lehrbuch der Naturphilosophie", a rather fantastic work, and his controversy with Goethe as to the vertebral origin of the cranium. They lived in a period of controversy which played around irrational theories but was often somewhat poetic in its conceptions. The philosophers of the early part of the last century were indeed imaginative and honest, but too abstract to provide a popular theory of life. The author of the little book before us, however, does not set out to expose this, but to produce a pleasant and readable book on two interesting personalities—and he has succeeded.

A New Alloy of High Density

By Dr. C. J. Smithells

THE use of large masses of radium in beam therapy necessitates the provision of adequate protection. At the same time, the actual container should be as small as possible if the radium is to be used efficiently, particularly in inaccessible positions. Absorption of the harmful γ-radiation by metals is directly proportional to their density, and for this reason a smaller container, or bomb, can be used if it is made of a metal of high density. The bomb and nose-piece, to give the necessary protection, weigh 50–100 lb. and have usually been made of lead, which has a density of 11·35 gm./c.c. The actual nose-piece has sometimes been made of gold, but this metal is too expensive to be used for the bomb itself.

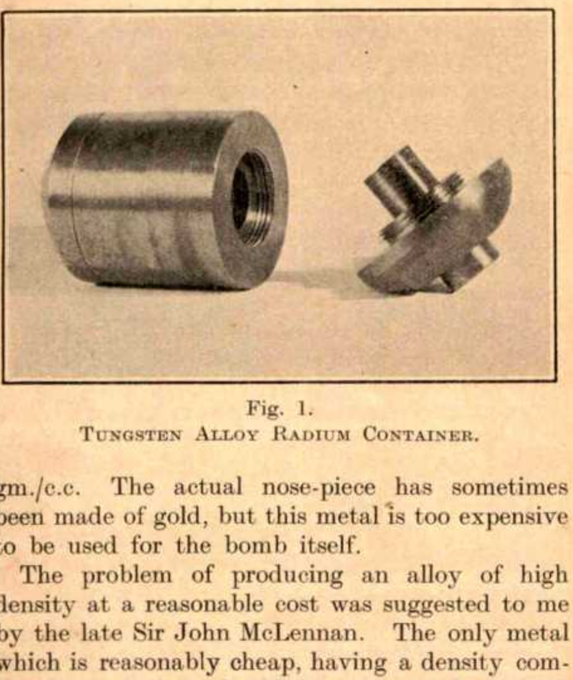

Fig. 1.
TUNGSTEN ALLOY RADIUM CONTAINER.

The problem of producing an alloy of high density at a reasonable cost was suggested to me by the late Sir John McLennan. The only metal which is reasonably cheap, having a density comparable with that of gold, is tungsten; but a high density is only attained when the metal has been sintered at about 3000° C., and no means are available for heating masses approaching 1 cwt. to such a high temperature.

The problem has been solved at the Research Laboratories of the General Electric Co. at Wembley by mixing tungsten powder with a small proportion of a metal of lower melting point, so that a liquid phase is formed on heating to a moderate temperature. If the tungsten particles are wetted by the liquid metal, shrinkage results, and densities closely approaching the theoretical are obtained. Either nickel or copper are suitable additions for this purpose. Copper melts at 1084° C., whilst nickel and tungsten form a eutectic melting at just above 1400° C. If the heating is carried out in an atmosphere of hydrogen, the tungsten particles are wetted in both cases. 5–10 per cent of either nickel or copper powders, or a mixture of the two, is added to the tungsten powder, which is then pressed to the required shape in a steel die and heated in hydrogen at 1450° C. for an hour. Since a linear shrinkage of about twenty per cent occurs during sintering, allowance must be made for this in designing the dies.

The alloy generally used for radium bombs contains 5 per cent copper and 5 per cent nickel, and the density of the finished pieces lies between 16·3 and 16·5 gm./c.c. With a smaller proportion of added metal it is possible to obtain densities in excess of 17. The density of the new alloys is therefore fifty per cent greater than that of lead, and a corresponding reduction in the size of the bomb is possible.

The microstructure shows particles of tungsten embedded in a matrix of copper, copper-nickel, or nickel-tungsten according to the composition employed. Although tungsten itself is practically not machinable, the alloys can be readily machined with ordinary tools, drilling, tapping and screw-cutting presenting no difficulties. Where large surfaces have to be machined, it is an advantage to use a tool of the cemented tungsten carbide type.

Owing to the difficulty of pressing very thick sections, it has been found most economical to construct radium bombs by welding together a number of annular rings. These may be up to one inch thick and five inches in diameter. Their surfaces are accurately machined and then placed on one another with 0·1 mm. nickel foil between them. On heating to 1450° C. in hydrogen, the nickel melts and forms a perfect weld. A complete bomb is shown in Fig. 1. About ten bombs have now been made in this way and are in use in various hospitals in Great Britain. One or two installations employing them have already been referred to in NATURE[1].

Although developed primarily for radium work, tungsten alloys made on this principle are finding several industrial applications. An alloy of this type has been used successfully for balancing crankshafts for internal combustion engines used in racing motor-cars. It seems likely to find a similar application in aircraft engines. It has also been used in gyroscopes and for similar purposes where high density combined with strength is necessary. The tensile strength of the sintered alloys is about twenty-two tons per square inch, but although they can be hot worked, they have very little ductility cold.

The largest application, however, is as a contact material for heavy-current circuit breakers. For this purpose, the alloy is applied as a facing brazed on to the copper contact arms. Contacts having a superficial area of about two square inches have been used successfully to break currents of 130,000 amperes at 6,000 volts. Tungsten has, of course, long been recognized as a useful contact material, owing to its low vapour pressure, but the pure metal could not be produced economically in the large sections required for high-power electrical engineering purposes.

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[1] NATURE, 139, 52 (1937).

The Starling in the United States of America

By Dr. Walter E. Collinge

THE dangers arising from the introduction of foreign species of animals have frequently been dwelt upon by zoologists of all nationalities. The results of such acclimatizations have nowhere been more pertinently summarized than by Palmer[1] in 1893.

The species to which we here wish to direct attention is the European starling (*Sturnus vulgaris* Linn). Thirty-five years ago we possessed a very meagre knowledge of the feeding habits and economic status of this bird, and it was introduced into various countries in the belief that it was distinctly beneficial to the farmer and fruit-grower.

The earliest record I can find of its introduction into the United States is that made by the Acclimatization Society of Cincinnati, Ohio, which liberated a number in the winter of 1872–73. In 1877 the American Acclimatization Society liberated a number in Central Park, New York, and again in 1890 about sixty birds were released. In 1889 and 1892 thirty-five pairs are reported to have been released at Portland, Oregon. In April 1890 eighty birds were released in Central Park, New York, and forty more in March of the following year. Later, smaller numbers were liberated in different localities.

From these various importations the starling has increased and spread throughout the whole of the north-eastern States, and it is gradually spreading westwards. The extension of the range and the methods of spread have been fully dealt with by Mrs. Mary Thacker Cooke[2], while a fully detailed account of the food and feeding habits has been published by Kalmbach and Gabrielson[3]. To this latter I shall refer later.

Few seem to have regarded the starling as a potential danger to the United States. Writing in 1916, Forbush[4] stated, "Already the starling has begun to show a capacity for harmfulness which may be expected to become more prominent as its numbers increase. . . . Perhaps it is too early yet to say what will be the final result of the introduction of the starling into this country. Its value as an insect destroyer is plain; but its unchecked increase may prove a calamity to several species of useful native birds, and from the experience of other countries we may assume that it is likely to become a pest to the fruit grower."

In any attempt to arrive at the true economic position of this bird, we must not lose sight of the fact that it is a powerful animal with a strong and formidable weapon of defence in the shape of its beak. Moreover, it exhibits great powers of caution and intelligence.

A further point of interest is its great fecundity; it is exceedingly difficult to estimate even approximately the actual number of pairs of breeding birds in the United States; but for the purpose of illustrating the rate of increase, we will presume that in 1933 there were 200,000 pairs, and that each pair reared three pairs of young, half of each sex, and that all lived together with their offspring. The progeny and parents in a single year would total 1,600,000. At the end of 1934 this number would have increased to 6,400,000, the addition in 1935 would make the total 25,600,000, while at the end of 1936 there would be more than 102,000,000 birds.

These figures are calculated on the basis of a single brood per year, though in many parts of the country there are two broods. Even allowing for a very high rate of mortality, it is clear that the annual increase is enormous. Herein lies a potential danger which should not be overlooked.

Knowing how injurious this bird has become in Great Britain and also in Australia, New Zealand

and Tasmania, let us consider the nature of its food in the United States. An examination by Kalmbach and Gabrielson of 2,157 stomachs shows that 57 per cent of the food consists of animal matter and 43 per cent vegetable matter, and of this animal content 41·55 per cent is composed of insects. The full details are as follows: weevils 8·50 per cent, ground beetles 5·71 per cent, May beetles 2·24 per cent, other beetles 3·14 per cent, grasshoppers 12·41 per cent, caterpillars 6·04 per cent, millipedes 11·71 per cent, Hymenoptera, Hemiptera, Diptera and other miscellaneous insects 5·93 per cent, animal garbage 1·32 per cent, cultivated cherries 2·66 per cent, other cultivated fruits 1·75 per cent, wild fruits 23·86 per cent, grain 1·16 per cent, vegetable garbage 13·57 per cent.

In Great Britain, we obtain rather different figures: animal food constitutes 51 per cent and vegetable food 49 per cent. Of the former, 26·5 per cent consists of injurious insects, 2·5 per cent of beneficial insects and 3·5 per cent of neutral insects, 8·5 per cent of earthworms, 6·5 per cent of slugs and snails, 1·5 per cent of millipedes, and 2 per cent of miscellaneous animal matter. Of the vegetable food, 20·5 per cent consists of cereals, 2·5 per cent of cultivated roots and leaves, 15·5 per cent of cultivated fruits, 7 per cent of wild fruits and seeds of weeds, and 3·5 per cent of miscellaneous vegetable matter. Summarizing these figures, we find that 36·5 per cent of the starling's food constitutes a benefit to the agriculturist, 41 per cent an injury, and 22·5 per cent is of a neutral nature.

A brief comparison of the figures resulting from the above two investigations shows that in Great Britain the starling has taken to feeding upon cereals and cultivated fruits to a much greater extent than in the United States, and we have little doubt that as this bird increases in numbers a similar change in its feeding habits will take place in America.

There was a time, no doubt, when in Great Britain this bird was a most useful and beneficial one to the agriculturist, just as it is at the present time in Ontario[5], but once let it reach the high-water mark of abundance, and it becomes equally injurious. It is this fact which we wish to stress, for once this bird reaches the high-water mark it will prove a much more serious pest than the European house-sparrow.

By the enactment of wise repressive measures this calamitous state of things may be averted; but if the situation is not properly realized and things are allowed to drift, then the agriculturists and fruit-growers of the United States will suffer as seriously as, or even more than, those of Great Britain.

Writing in 1912, I stated[6]: During the first six months of the year the food in an urban district was distinctly of an insectivorous character, and the evidence from the food generally would lead us to place the species amongst those birds beneficial to the agriculturist and horticulturist, but a similar record extending over the same period taken in an agricultural district would, in all probability, reveal the starling as a destroyer of newly sown grain, and extended over the summer months, would show that it inflicts considerable losses upon fruit growers. As the result of further investigations, I was forced to the conclusion that "the starling has become a plague in the land and a source of great national loss".

It is a pity that this undesirable alien was ever introduced into the United States, but that is past history; what must be looked to at the present is to see that a very careful watch is kept upon this bird from all aspects, and that its numbers be strictly limited. For the information of how this may best be done American citizens may look with every confidence to their famous and unrivalled Department of Economic Ornithology in the Biological Survey.

[1] Year Book, U.S. Dept. Agric. for 1893, pp. 87–110.
[2] U.S. Dept. Agric., Dept. Circ. No. 336, 1–7 (1925).
[3] *U.S. Dept. Agric.*, Bull. No 868, 1–66 (1921).
[4] Mass. State Bd. Agric., Circ. No. 45, 1–23 (1916).
[5] Lewis, Univ. of Toronto, Biol. Studies. No. 30 (1927).
[6] Second Rpt. Econ. Biol., 1912. pp 65, 66.

A New Method in Biogeography

THE last two or three decades have witnessed great progress in the studies of ecological and geological factors of distribution of plants and animals, but the results of these studies have had little influence on biogeographers, whose work is still mainly concerned in the parcelling out of the globe's surface into regions, provinces, etc., characterized by statistical ratios of endemic forms and those common to several divisions. The methods of biogeographical work remain generally the same as in the time of Wallace, and a great proportion of literature (zoogeographical in particular) is devoted to discussions of the exact boundaries between formal divisions. When, however, two types of fauna or flora, different in their geological origin and adjusted to different ecological conditions, have to develop in close geographical proximity, there can be no linear boundary between them. Their various elements will penetrate more or less deeply into the main area occupied by the other type, this process being usually favoured in the case of one of the types by slow climatic changes in a certain direction. When such changes, for example, favour the spread of forests over a steppe area, some 'islands' of steppe with their characteristic plant and animal population will still remain as evidence of former conditions. Usually, in calculating statistical ratios, such inclusions of alien fauna, or flora, are not distinguished from the elements of the dominating population, which is obviously incorrect.

The need for more careful analysis of populations of geographical areas is better realized by botanists than by zoologists, and modern plant geographers (Braun-Blanquet, Eig, and others) base their analyses on 'phytogeographical elements', and discriminate between continuous distribution of a species, its penetration into a strange area and its 'insular' occurrence in the latter. Zoogeographers, on the other hand, are generally satisfied with the old methods of characterizing the fauna of a country by the full quota of its species regardless to the type of their occurrence, and by drawing line boundaries where, at the best, a more or less broad transitional zone exists in Nature.

Partial attempts to improve on these antiquated methods are not lacking in biogeographical literature, but no definite proposals of a new way of representing distributional facts have been made until the recent paper by Dr. B. K. Stegmann "On the Principles of Zoogeographical Division of the Palæarctis as the Basis of a Study of Types of its Ornithofauna" (*Bulletin Acad. Sci. U.S.S.R.*, pp. 523–563 + 7 maps; 1936). Dr. Stegmann condemns the idea of mapping zoogeographical divisions separated by line boundaries, and bases his work on the 'types of fauna' which are characterized by the common ecology and past history of their members. The distribution of each type of fauna is to be shown on a map in a special colour, whether it is continuous, or disrupted and 'insular'. Unfortunately, no coloured map is given in the paper (which is only a preliminary one), but a series of black and white maps, each showing the distribution of one type of fauna, is most instructive. Two of these maps are reproduced here (Figs. 1 and 2) in the hope that this will make clear the principle, which is of course very simple.

In the Palæarctis the author distinguishes seven types of bird fauna, as follows:

(1) *Arctic type*, which has a circumpolar distribution, being connected ecologically with the arctic zone north of the tree limit. Some arctic elements occur discontinuously in the alpine zones of European and Asiatic mountains, so far south as the Pyrenees, the Alps, the Urals, Tarbagatai, Altai, Khankhai and Kentei mountains. They are absent from the Caucasus and Tian-Shan.

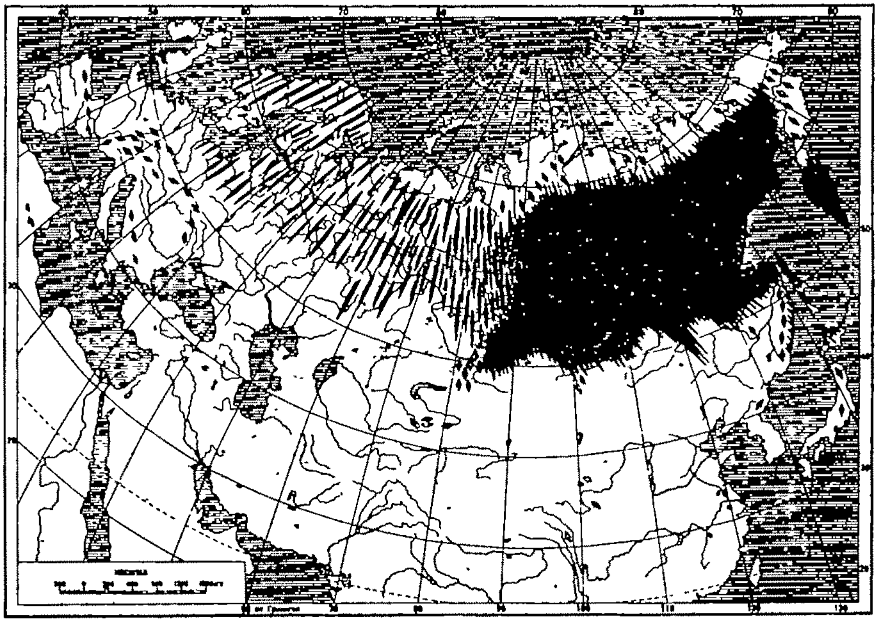

Fig. 1.

DISTRIBUTION OF THE SIBERIAN TYPE OF FAUNA.

(2) *Siberian type*, or the fauna of taiga (boreal coniferous forests). This populates a continuous area in Eastern Siberia and extends, with gradual reduction in the number of species, to the south Siberian mountains, and those of northern Mongolia, as well as through the northern half of western Siberia into Scandinavia. Some typical taiga birds occur sporadically also in the forests of Central European mountains, in the Pyrenees, in Tian-Shan and even in the mountains of Kansu, Szechwan and Khawin, south-eastern Tibet (see Fig. 1).

(3) *European type*, connected with the western European deciduous forests, and extending continuously, but in a gradually narrowing zone, to the southern Urals. Many species belonging to this type penetrate into northern Europe and south-western Siberia, while some occur sporadically in southern Siberia and even trans-Baikalia The forests of North Africa are also populated by birds of European type, and the same applies to forests of the Caucasus and Turkestan (see Fig. 2).

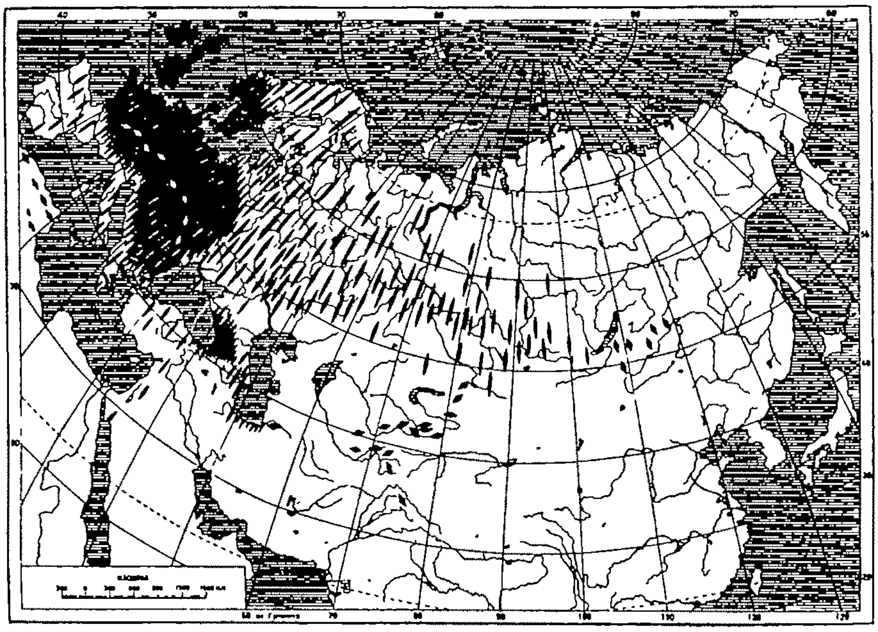

Fig. 2.
DISTRIBUTION OF THE EUROPEAN TYPE OF FAUNA.

(4) *Mediterranean type*, comprising species connected with xerophilous scrub, steppes and deserts. This fauna populates southern Europe, North Africa and south-western Asia up to Iran and Afghanistan. Only a few Mediterranean elements penetrate farther east to the Mongolian Altai and Alashan. Northwards, these elements extend to southern England, Germany, the Hungarian plain and the south Russian steppes.

(5) *Mongolian type*, consisting of species living in the steppes and cold deserts of Mongolia, whence many of them extend into Turkestan. A few Mongolian species occur so far west as Iran, Syria, Asia Minor, Egypt and even northern Africa (two species). In the north they occur in isolated steppe 'islands' in the midst of the Siberian taiga.

(6) *Tibetan type*, found in the alpine zone of Tibet and the Himalayas and, sporadically, on all high mountains of Palæarctis and even of North America.

(7) *Chinese type*, consisting of elements ecologically connected with broad-leaved forests of south-eastern Asia. It prevails in Japan and China, where it gradually passes into the Indo-Malayan fauna. To the west, this type of fauna extends over the Himalayan forests to Kashmir, a few elements penetrate to Afghanistan and Turkestan, and one even to the Caucasus. Northwards, many Chinese elements extend to Amurland and some even to trans-Baikalia and the Altai; isolated occurrences are recorded so far north as Yakutsk.

It will be seen, even from this very brief summary, that the result of a careful application of the new principle will be either a series of maps, each showing the distribution of one type of fauna (like the two reproduced here), or a composite map in colours showing the great complexity of population of the Palæarctis, and proving the futility of any linear boundaries, since these would inevitably cut across the actual faunistic and ecological connexions and produce a highly artificial picture. There can be no doubt, therefore, that this new method of biogeographical mapping represents a great step towards a more scientific treatment of distributional problems, as compared with the statistical biogeography of the present day. Of course, this type of investigation requires a thorough analysis of the ecology, phylogeny and past history of each taxonomic group before it can be referred to one or the other faunistic type, but this is the only way to put biogeography on a sound scientific basis.

The difficulties of such work are great and the pitfalls are many, as can be seen even in the example of the paper under review, where the Mediterranean type of fauna obviously includes at least two profoundly distinct faunas, those of the dry Mediterranean scrub and those of treeless deserts. Even in the case of birds, the differences are striking, and this is still more so for other groups of animals. However, this is only a minor fault of the paper, which should mark a new period in the development of biogeography, and deserves the serious attention of zoologists and botanists.

B. P. UVAROV.

Obituary Notices

Prof. Giuseppe Sergi

BY the death on October 17, 1936, of Giuseppe Sergi, professor emeritus of anthropology in the University of Rome, at the advanced age of ninety-five years, the science of man has lost not only its senior exponent, but also a student whose interests in that many-sided field of knowledge were both broadly distributed and profoundly rooted.

Giuseppe Sergi was born at Messina, Sicily, on March 20, 1841. He was educated at Bologna; and at the age of nineteen years, he took part in Garibaldi's expedition to Sicily. After that adventure, he devoted himself to scientific studies and in 1880 was appointed to a chair in the University of Bologna. Four years later he became a professor in the University of Rome, where he founded the Institute of Anthropology, of which he remained the head, occupying the chair of anthropology in the University until 1916, when he retired, receiving the title of professor emeritus. In retirement, however, he was far from inactive; and during the remaining twenty years of his life many publications, some of considerable importance, came from his pen. At the time of his death, he had made more than four hundred contributions to the printed literature of science, and in addition had written frequently on social and political subjects.

Sergi's early published work, of which the first recorded item appeared in 1868, was concerned with the history of certain concepts in philosophy; but it was not long before he manifested his interest in ethics and psychology. Like many of his countrymen, he had come under the influence of Herbert Spencer. Not only did he contribute an introduction to an Italian version of Spencer's system of ethics; but also he himself wrote a history of moral philosophy, and contributed to the discussion of Spencer's conception of the State as an organism. Psychology, however, proved a more lasting, or at least a more prominent, interest in his mental development, to which he returned time and again. He was one of the first to give attention to experimental methods in this science. Nor did he neglect psychic manifestations, upon which he produced a book in 1880; but here his point of view had special reference to the biological aspect, an aspect which is prominent in all his not inconsiderable work on abnormal and criminal psychology. His "Principi di Psicologia sulla Base della Scienza sperimentale", first published in 1873, appeared in several revised editions, and he was the author of a number of works on this subject of an authoritative character. He also wrote with understanding on the methods of pedagogy and discussed the merits of the Froebellian system.

During the years, formative as they may be regarded, between the late 'seventies and the early 'nineties, Sergi's attention had been turning more and more towards what was his main life-work. In 1876 he had been joint editor of the Bulletin of the Academy of Medicine at Rome, and not long after, as his publications show, he began to take a serious interest in anthropology. In 1882 he published a paper on an improved method of measuring the facial angle. It was, however, in the following year that a decisive interest determined his future bent. In the introduction to a little volume published towards the close of his life, "Alba Longa" (1934), he tells us how in 1883, when he was spending a holiday in the valley of the Po with his friend Eduardo Brizio, the archæologist, he was attracted by the problem of the ancient inhabitants of that region, and it was, he says, in three papers dealing with the Ligurians, the Celts and the necropolis of Villanova, which he wrote and published in that year, that he began the long series of studies which led up to and culminated in his determination of the physical characters and ethnic history of the Mediterranean race.

From this time onward, Sergi was busily engaged in preparation for his great work. Every skull to which he could obtain access, ancient and modern, not only from Italy and the Mediterranean, but also from every quarter of the globe, was carefully examined. The list of his papers published at this time bears eloquent testimony to his activity. Nor did he neglect collateral lines of inquiry. So far back as 1872, in a work entitled "History and Philology", a book of Indo-European studies, he had shown his interest in the derivation and history of the early peoples of Italy. He now gave renewed attention to the archæology of the Mediterranean area, as appears in a book on the method of racial history, "Antropologia e Scienzi Antropologici" (1889), which is remarkable for its insight into the nature of the problem and its breadth of view, especially when the date of its publication is taken into account.

A second product of these years of preparation was an innovation in the method of craniology, which Sergi himself undoubtedly considered his most important contribution to the method of anthropological science. Anthropological method, he maintained, should not differ from zoological method; and, therefore, he argued, more attention should be given to the morphology of the skull: the anthropologist should be able to determine race by inspection, just as the zoologist is able to determine species, whatever it may be, and whatever region it may come from. In reaction both from the extravagant comparisons of the day, in which similarities and identities were discerned in widely distributed types solely on the basis of similarities of craniological measurement, and from fallacies of interpretation, Sergi proposed to substitute for measurement the observational examination of the skull, more especially when viewed *in norma verticali*. He therefore classified skulls into groups, according to the outline, which he distinguished by various terms such as 'beloid', 'ovoid', 'pentagonoid' and the like. These revolutionary views were first put forward at the International Anthropological Congress at Moscow in 1893. Commenting some years later on the results of his researches on the Mediterranean race, Sergi said that he had followed the various peoples of the Mediterranean with their racial names in ancient and modern history, and had examined the ancient and modern skulls of the peoples of Iberia, Liguria, Central and Southern Italy, Greece, Asia Minor and Egypt, and among them all, from Spain to Hissarlik, he had found about a dozen forms of skull, and these were common to all, while the ancient cranial form invariably resembled the modern, whatever foreign influence might have intruded. Further, he maintained that these forms did not occur at all among other peoples of Europe, such as Celtic, Germanic and Finnic—a statement, be it said, which has been regarded by his critics as at least subject to qualification.

Sergi's great work, "Origine e Diffuzione della Stirpe mediterranea", which must be regarded as the crown of his labours, appeared in 1895. A German translation was published in 1897, and an English version appeared in 1901. This last contained so much additional matter as to constitute what was virtually a new work. It is of interest, and of indubitable importance in assessing Sergi's position, to bring "The Mediterranean Race" into relation with the anthropological thought of the time of its publication. Without in any way impugning Sergi's impartiality in viewing the facts, it may be said that he was inspired by a reaction against 'Germanism', the view then held in certain quarters that the early civilization of Europe, that is, the civilization of the Mediterranean, was due to the impact on the peoples of that area of a tall, long-headed, fair race, identified with the Aryans, who were held to have originated in Northern Europe, and further, were said to be represented in the modern population by the Germans and their racial affinities. In reply to this last contention, Sergi argued that the Germans were not to be distinguished from Celts and Slavs with whom they had always been associated, and with whom they were often confused; while the long-headed fair peoples of northern Europe, the Reihengraber and Viking types, were of Mediterranean origin.

Sergi, in fact, maintained that the neolithic population of Europe and the Mediterranean area, the Mediterranean race, the North African peoples, and the long-headed population of Northern Europe were three offshoots, or varieties of one original Mediterranean, or Eur-African race, which had sprung from Africa, and of which the Mediterranean was the centre of dispersal. The Mediterranean culture, which had ultimately blossomed into the civilization of Greece and Rome, was entirely a product of this Mediterranean race, developing a seed which had been brought from Asia Minor. So far was this development from being the work of the Aryan speaking peoples, that it was they, the peoples of Asiatic, and not European, origin who, he maintained, had been the destroyers of that culture. It will be remembered that at the time this was written, Sergi had before him only the evidence of the so-called Mycenean age, and the Minoan civilization of Crete, which would have added strength to his argument, was as yet almost unknown.

Any attempt to estimate the value of Sergi's work and methods in the subsequent development of anthropological studies must take into account at least two factors. Of these, one was the development at about the same time of the application of biometric methods to the study of man, which to a certain extent and with limitations rehabilitated anthropometric measurement as a means of observation; and the second was the publication of Deniker's classification of the races of Europe (1897 and 1904) and Ripley's work "The Races of Europe" (1901), which following more nearly traditional methods of study, appeared to afford greater precision in working than Sergi's scheme. Sergi himself, though continuing to employ his method of inspection and classification of form throughout his life, later abandoned his extreme attitude towards craniometry: but his arguments, though not adopted in full by his fellow anthropologists, have secured in an increasing degree that reliance should be placed on observational study of the skull to bring out differences which are obscured by or escape measurement.

Of Sergi's later work, considerable though it is in volume, little need be said here. It never attained the international importance of his Mediterranean studies. In 1908 he published the results of an application of his theories to study of the relation of the Mediterranean race to the peoples of Europe generally, and later extended his published work to cover the field of the races of man as a whole, and the question of the origin and descent of man, where he turned to consider the geological and palæontological evidence bearing on anthropological studies. In this field his most important work is "L'Uomo", which appeared in 1911. That he maintained fully his mental vigour and flexibility to the end is demonstrated in a remarkable book "La più antica Umanità vivente" (1930), in which he skilfully interpreted the evidence of Rhodesian man in tracing a line of descent from Neanderthal man to representative types in modern races. E. N. F..

Dr. A. Daniell

By the death of Dr. Alfred Daniell in Edinburgh on January 12, there passed one who had made a distinct mark in the world of science. Born at Llanelly eighty-three years ago, he early showed a bent towards educational attainment. In consequence, while still a boy, he was sent north to pursue his studies in the University of Edinburgh. He had a distinguished course in arts, medicine and science, obtaining many successes and distinctions, particularly in science. For a time he was lecturer in the Medical School. He also worked under Prof. (afterwards Lord) Lister in the old Royal Infirmary, where he had charge of the Out-patient Department. He was the author of the well-known "Text Book of the Principles of Physics" published by Messrs. Macmillan and Co. so long ago as 1884, and "Physics for

Students of Medicine". These publications were successful, especially the former, which was translated into various foreign languages.

In 1886 Dr. Daniell became an advocate of the Scottish Bar, and in 1894 he sought a wider sphere, becoming an English barrister—in each case seeking to utilize his scientific attainments in his new profession.

Dr. Daniell was faithful through life to his Alma Mater at Edinburgh, of which he became M.A., D.Sc., and LL.B. He took part in certain of its activities while health permitted. He was also a fellow of the Royal Society of Edinburgh.

The last twenty years of Dr. Daniell's long life were spent in Edinburgh. He was chiefly occupied in writing a new book called "Problems in Physics", which he was able to finish, but was not destined to see published. He also revised, and partly rewrote, his "Text Book". But for some time before his death, failing health greatly curtailed his activities.

WE regret to announce the following deaths:

The Right Hon. Sir Austen Chamberlain, K.G., P.C., Chancellor of the University of Reading since 1935, and chairman of the Court of Governors of the London School of Hygiene and Tropical Medicine and of the Governing Body of the British Postgraduate Medical School, on March 16, aged seventy-three years.

Mr. A. Gallenkamp, founder of A. Gallenkamp and Co., Ltd., makers of laboratory equipment, on February 26, aged eighty-eight years.

Prof. A. Pictet, honorary fellow of the Chemical Society and formerly professor of organic chemistry in the University of Geneva, on March 12, aged eighty years.

Dr. Elihu Thomson, the well-known American electrical engineer, who received the Hughes Medal of the Royal Society in 1916, on March 13, aged eighty-three years.

News and Views

Prof. T. C. Hodson

THE announcement of the impending retirement of Prof. T. C. Hodson from the William Wyse chair of social anthropology in the University of Cambridge in September next will be received with regret by all who are interested in the advancement of studies in that branch of the science of man, not only within the University but also at large. When Prof. Hodson was placed in charge of this subject at first in 1926 as reader in ethnology and from 1932 as occupant of the chair which he now relinquishes, he brought to the teaching of a subject which, more than almost any other in the academic curriculum, demands breadth of view and a sense of realities, a wide and varied experience. This began after he had taken his degree at Queen's College, Oxford, with some years as a member of the Indian Civil Service stationed in Assam, and embraced service with the Indian forces during the Great War, and a period as principal of an ex-Service men's college, of which the curriculum had been strongly influenced by his faith in the educative and broadening influence of the point of view of the anthropologist in the approach to educational and cultural problems. It is in some sense a mitigation of the regret which will be felt at Prof. Hodson's retirement that his successor, who has also served in India, by experience and by conviction, is well qualified to continue the work which Prof. Hodson has always had most nearly at heart, in the firm belief that a knowledge of anthropology is the best and the most essential qualification in the administration of the affairs of the varied peoples of the British Empire.

Social Anthropology at Cambridge

DR. JOHN HENRY HUTTON, of St. John's College, Cambridge, who is to succeed Prof. T. C. Hodson, was educated at Chigwell School, and Worcester College, Oxford. Dr. Hutton was appointed lecturer in the Faculty of Archæology and Ethnology at Cambridge last year, on his retirement from the Indian Civil Service. He entered the Service in 1909, serving under the Government of Assam, and being awarded the honour of C.I.E. in 1920. In addition to his administrative duties, Dr. Hutton was responsible as honorary director for the ethnographic survey of the tribes of Assam, and himself produced two volumes, one on the Angami Nagas (1921) and one on the Sema Nagas (1929) in the series of monographs on the Naga tribes published under the auspices of the Assam Government. Dr. Hutton's abilities as an anthropologist and as an organizer of survey work in anthropology and demography were recognized when he was seconded from the service of the Assam Government to take charge of the Census of India, 1931. As superintendent of the Census, he wrote an introductory study of the ethnic problem involved in the composition of the population of India, summing up and analysing the evidence which has accrued since the publication of Sir H. H. Risley's Census of 1901 and calling for modification in the views then put forward. Reference was made to Dr. Hutton's work in NATURE of September 5, 1936, p. 394. Mr. Gregory Bateson, of St. John's College, Cambridge, has been elected to the William Wyse studentship in social anthropology in the University of Cambridge for a period of three years. Mr. Bateson is the author of the recently published work "Naven" (see NATURE of March 13, p. 454) in which he gives an account of some of his observations among the Iatmul tribes in an expedition to the Sepik River, New Guinea, in 1933, and elaborates an extension of the 'functional' method in sociological investigation.

Iron and Steel Institute: Bessemer Gold Medals

THE Bessemer Gold Medals for 1937 of the Iron and Steel Institute have been awarded to Colonel N. T. Belaiew and Aloyse Meyer. Colonel Belaiew of Paris, a former pupil of Prof. Tschernoff of the Military Academy, Petrograd, has, during the last twenty-five years, published a number of papers of outstanding importance on metallurgy. These have dealt mainly with the crystallization of metals, and in particular steel. His studies of the constitution and solid geometry of pearlite, sorbite and troostite demonstrated the true width of the lamellæ in these structures and the relation between the angle of section and the apparent width. His suggestion of a definite unit of crystal size of iron has been confirmed from other sources. He also studied the primary and secondary crystallization in steel and the origin of the 'Widmanstatten' structure in steel and meteorites. His insight is strikingly shown by his insistence on 'granulation' in the austenitic zone, the explanation of which has been provided by the subsequent discovery of the delta-gamma change in iron at very high temperatures. He has studied the manufacture and uses of Damascene steel and related the results to the manufacture of high-class steels at the present time, in particular high-speed steel.

M. ALOYSE MEYER, of Luxemburg, is an honorary vice-president of the Institute, and is well known as head of the Société Anonyme ARBED, the great Luxemburg combine and the second largest iron and steel company in Europe. He has rendered unique services to the iron and steel industry as president, since 1928, of the Entente Internationale de l'Acier. In addition, his encouragement of the acquisition and diffusion of technical information and metallurgical knowledge in the Luxemburg-Lorraine district has been invaluable to the progress of the industry; he was actively connected with the introduction of the Thomas-Gilchrist process of steel manufacture into the district—the Hauts Fourneaux et Aciéries de Dudelange was one of the first works in Europe and the first in the Luxemburg-Lorraine district to adopt this method, which revolutionized the manufacture of steel on the Continent. Since the Great War, he has been responsible for the introduction of modern American blast-furnace practice in the works under his control.

Richard Anthony Proctor (1837-1888)

IN the mid-Victorian era there were no more popular books on astronomy than those of Richard Anthony Proctor, the centenary of whose birth falls on March 23. Possessing a remarkable power of lucid exposition and almost unbounded energy, in his comparatively short life he published about sixty separate works, wrote numerous memoirs and delivered many lectures in Great Britain, the United States and Australia. He was, however, no mere exponent, and in the little leisure he enjoyed he studied the planet Mars, plotted on a single chart the 324,198 stars of Argelander's "Durchmusterung" and made the important discovery of 'star-drift'. Proctor was the son of a London solicitor and was born in Cheyne Row, Chelsea. His father died in 1850 and left the family ill-provided for; so Proctor became a clerk in the London and Joint Stock Bank, but was able after a year or two to study at the University of London; at the age of nineteen years he entered St. John's College, Cambridge, graduating as 23rd Wrangler in 1860. He then read for the law, but this was soon abandoned for science, and in 1865 he published his first book, "Saturn and its System".

PROCTOR married before leaving Cambridge and for a time was in pecuniary difficulties. In 1868 he scored his first financial success with his "Half Hours with the Telescope". This was followed by his "Other Worlds than Ours". It was about the time this appeared that after working five years without a holiday he wrote, "I would willingly have turned to stone-breaking or any other form of hard and honest but unscientific labour if a modest competence in any such direction had been offered me." For a short time he taught mathematics in a school at Woolwich. He was elected a fellow of the Royal Astronomical Society in 1866; in 1872 he became honorary secretary to the Society, but this he resigned in order to undertake a lecture tour in America. The tour was a success and in 1879, after the death of his wife, he made a tour to Australia. In 1881 he founded the periodical *Knowledge*, and then returned to the United States, marrying a widow, Mrs. Crawley, and settling at St. Joseph, Missouri. A few years later he transferred his house and observatory to Florida. In September 1888 he was about to sail from New York on a visit to England but was attacked by fever and died in hospital on September 12, at the age of fifty-one years.

Printing and Allied Trades Research Laboratories

THE new Laboratories of the Printing and Allied Trades Research Association were officially opened by H.R.H. the Duke of Gloucester on March 9 in the presence of the Advisory Council of the Department of Scientific and Industrial Research and the Council and members of the Research Association. The laboratories are situated just off Fleet Street in the centre of London's printing district, and comprise about seven thousand square feet devoted to chemical and physical laboratories, library and offices for the investigation of the major and the day-to-day problems of the printing, newspaper, ink and paper industries. The basement has been converted into an optics laboratory for colour measurement in connexion with colour printing and the measurement of the opacity of paper, etc. A strong-room in the basement has been converted into a constant humidity laboratory where the temperature and relative humidity are maintained at 65° F. and 65 per cent.

All paper-testing work, on strength and printing quality, is carried out in this laboratory, where is also installed a small printing machine on which printing tests can be carried out under controlled conditions.

GENERAL offices and library are housed on the ground floor of the Laboratories. From the library, the Intelligence Section of the Association's work is operated and the "Review of Literature" published. The physics department is contained on the first floor where work on colour fading, examination of adhesives and bookbinding materials are carried out. This department also contains a section for photomicrographic work on paper fibres, inks, prints and printing alloys, and a dark room for ultra-violet and infra-red work. The upper floor has been converted into two chemical laboratories. One is mainly for analytical work in connexion with the day-to-day problems submitted by member firms, and the other set aside as a chemical research laboratory for dealing with the longer-ranged problems connected with the working properties and drying of printing inks, lithography, photogravure printing, stereotyping and electrotyping, etc. It is the aim of the Research Association to deal with both the day-to-day problems and the longer-ranged work connected with printing processes and raw materials, and to build up a scientific background to one of the 'craft' industries so that the inherent difficulties, now aggravated by increased speeds of production, can be eradicated and the future developments of the industry guided by scientific research.

The West Indian Volcanoes

AT the Friday evening discourse delivered at the Royal Institution on March 12, Sir Gerald P. Lenox-Conyngham described "Montserrat and the West Indian Volcanoes". The island of Montserrat has recently suffered from a series of earthquakes. They began about the beginning of 1934 and continued with varying intensity all through 1934 and 1935. In the autumn of 1935 the inhabitants sent a petition to the Governor praying that steps should be taken to discover, if possible, whether there was danger of an eruption. Their anxiety was due to their recollection of the events of 1902 when eruptions of the Soufrière of St. Vincent and of Mont Pelé of Martinique did terrible damage. Such an eruption in Montserrat would be most dangerous to the town of Plymouth. As a result of the petition, a small expedition consisting of a geologist and a physicist was sent out. Frequent severe shocks were felt up to November 1935. After that date the activity of the volcano became steadily less. A good measure of success was attained in locating the positions of the foci, and it is now known that they were all situated in a belt about four miles wide which crosses the island from south-west to north-east. The West Indian island arc bears strong resemblance to the East Indian arc that runs eastwards from Java. In 1929–30 Dr. Vening Meinesz of the Dutch Geodetic Commission made a gravity survey of the seas around these islands and found that there is a belt of negative gravity anomaly lying outside the island arc. The circular form of island and mountain arcs is suggestive. It is probable that the form is determined by the intersection of a thrust plane with the sphere. Mr. P. Lake has pointed out that the radius of the arc gives the dip of the fault where the thrust plane cuts the surface. It is believed that gravity determinations combined with the consideration of the curvature of the island chain and of the probable position of the over-thrusting foot of the tectonic arc on which the islands have been built up by volcanic agency will throw light on the structure of the region.

New University Studies

AT the recent annual meeting of the Court of Governors of the University of Birmingham, the vice-chancellor, Sir Charles Grant Robertson, noted a small decline in the number of students in the University, possibly due to the decline in the birth-rate (though periods of 'boom' in trade have on previous occasions been associated with a slackening in the entry to the University). The Faculty of Medicine, however, shows no such falling off. He commented with satisfaction on the success of the Appointments Board and the evidence of an increasing demand for the product of the University in industry—in fact, during the past year the demand on the Appointments Board exceeded the supply. Sir Charles dealt with the lack of the study of the social sciences in English universities. It has been suggested that the education of a university graduate is incomplete without some such study, but there is the difficulty of finding the time without omitting some other part of the curriculum. It appears probable that little can be done unless there is a specialist social science degree course, or the subject is made one for a post-graduate course of at least one year; and then there is the problem of finding posts for such graduates, with adequate pay and prospects of promotion, so long as the wide field of municipal civil service is barred to university graduates. Sir Charles expressed sympathy with the Government's desire to promote physical training in universities, but, in addition to the fact that the necessary trainers do not at present exist, the thorny problem of compulsion or non-compulsion would have to be solved.

The Universities and Social Science

A SPEECH entitled "A Citizen Challenges the Universities", delivered by Sir Ernest Simon at the summer, 1936, meeting of the Council of the Association of University Teachers in Cardiff, appeared in the *Universities Review* of November last, and a reprint of it has reached us. The challenge relates to the imminent threat to democracy involved in our tolerance of such conditions as those of South Wales and other depressed areas, and the universities' alleged neglect, in the face of that threat, to do their duty by the social sciences: their failure alike to provide adequate inducements, staff and equipment for research in those sciences and for specialized study in them, and to employ effectual measures for ensuring that students, of whatever schools, shall not graduate without an active and realistic interest in the broader problems of the world to-day. The challenge is not a new one, but its urgency grows with the growing prestige of 'corporative' States. It was an outstanding motive of the remarkable series of eight university supplements published in *Time and Tide* in 1935. To that series Sir Ernest himself contributed an article on "Where our Universities Fail".

SIR ERNEST SIMON's estimate of the responsibility of the universities in this matter is based partly on the assumption (the validity of which tends to diminish) that public opinion in Great Britain is largely determined by men and women educated at the universities, and partly on the influence the universities exert on the teaching in secondary schools through university scholarships and entrance examinations, and control over examinations in those schools. His argument finds some support in the last report of the University Grants Commissioners. But arguments must be cogent indeed to overcome the inertia of university governing bodies, especially since no provision was made for research in the social sciences when the Government of the day set up the Department of Scientific and Industrial Research. In a postscript to his paper, Sir Ernest announces that the Association for Education in Citizenship is proposing to appoint a committee on the whole problem of the universities and citizenship and invites communications from persons interested in this matter. His address is, Broom Croft, Didsbury.

Public Affairs Forums in the United States

ADULT civic education through "public affairs forums" is now being energetically pushed by the United States Federal Office of Education, the present head of which, Dr. Studebaker, played a principal part in the launching, several years ago, of the pioneer forums in Des Moines. The latest official publication on the subject, a pamphlet entitled "A Step Forward" (Superintendent of Documents, Washington, D.C. 10 cents), includes an account of ten forum demonstration centres in as many different States, managed by local educational authorities. A foreword by the Commissioner strongly emphasizes the principle of local responsibility and control, but the enterprise has been financed largely out of the Federal Emergency Relief Appropriation, and several hundred relief workers have taken part as assistant librarians, research assistants, artists, writers, accountants, typists, etc. The Secretary of the Interior, in commending the Commissioner's scheme, observes that it has brought about an essential and practical contact between "those few of our citizens who are concentrating their time and effort on the pursuit of truth in the field of social problems" and the average citizen who cannot devote much time to a specialized study of these complex questions. The success of the scheme hinges on finding competent leaders for the forums, for they have the difficult task of first presenting a topic in simple language in a way calculated to sustain interest, giving a fairly comprehensive and impartial outline of the problem and the alternative solutions, and then stimulating, leading and organizing a free discussion for forty or fifty minutes. Most of them have been obtained on leaves of absence from colleges and universities. The improvement of social intelligence for the democratic control of our material resources is, says the Commissioner, the challenge of our day.

Social Services in Great Britain

"PUBLIC SOCIAL SERVICES" (Cmd. 5310. London: H.M. Stationery Office. 4*d*.) portrays statistically what may, without much exaggeration, be called the social revolution of the twentieth century in Great Britain. It shows that in the first thirty years of the century the cost of the social services referred to increased just thirteen-fold, namely, from thirty-six millions to four hundred and sixty-eight millions sterling. The first decade was marked by a rise in expenditure under Education Acts from 20 to 34 millions and the coming of old age pensions which cost 7 millions in 1910. The next decade saw a leap in education expenditure from 34 to 90 millions and in old age pensions from 7 to 21, the introduction of unemployment insurance (11 millions), national health insurance (30 millions), the mental deficiency acts, and, of course, war pensions. Between 1920 and 1930 the expenditure under unemployment insurance increased to 102 millions and under old age pensions to 37½ millions, and the widows', orphans' and old age contributory pensions acts came into force, involving, in 1930, an expenditure of 34¼ millions. During this period, expenditure under the housing acts increased from 4½ to 40 millions.

Natural History Exhibition at Wye

THE Wye College Branch of the University of London Animal Welfare Society (ULAWS) held a Natural History Exhibition at the South-Eastern Agricultural College, Wye, on March 11-13. The greater part of the Exhibition was given up to natural history specimens exemplifying the classification of the animal kingdom. Several dissections caused much interest. A fine collection of beaks and feet of birds made by a member of the Branch was on view. Specimens of bacteria, minerals and other microscopic objects were shown. In addition, there were films of animal life, including the ULAWS film on the care of dogs, which proved to be very popular. At the entrance to the Exhibition were exhibits dealing with the oil menace and the rabbit problem. The former showed how the discharged waste oil from ships and tankers floats on the surface of the sea and covers the feathers of sea-birds. Very little is enough to kill birds, causing them to die of pneumonia due to the water being able to get at the skin. A live guillemot from which the oil had been removed was shown. In all cases so far, however, the solvent used to remove this has also removed the natural grease from the feathers, with the result that the bird gets sodden when placed in water. Further experiments are being carried out by Mr. R. S. Pitcher. A gin trap for catching rabbits was demonstrated and its unsatisfactory character explained. Instead of decreasing the animals, it often leads to an increase, as has been shown in Carmarthenshire and by experiment in Devon and Pembrokeshire. Various humane traps and snares were shown together with apparatus for cyanide fumigation, but the latter was put forward as by far the best method for the painless and effective control of the rabbit. A bookstall was provided by the Cathedral Bookstall, Canterbury, and departments of the College provided many of the specimens and the apparatus. Messrs. Flatters and Garnett, Ltd., W. Watson and Co., E. Gerrard and Co., Ltd., Thomas Murby and Co. provided material, and the Folkestone Museum lent some cases and specimens.

Physics in 1936

THE rapid advances now being made in our knowledge of the physical properties of matter have made it desirable that progress reports should be published at frequent intervals; three such reports have been issued by the Physical Society, and a number have appeared from time to time in the issues of the *Physikalische Zeitschrift*, the latest being on nuclear physics by Profs. S. Flügge and A. Krebs, which occupies twenty-four pages of the issue of January 1. The Physics Forum in the issue of the *Review of Scientific Instruments* of January occupies twelve pages devoted entirely to a review of some of the most noteworthy advances, by Prof. T. H. Osgood of the University of Toledo, Ohio. It deals with the collisions of slow and fast neutrons with atomic nuclei and the knowledge of the effective cross-sections of nuclei which has been derived from them; with the scattering of one type of nuclear particle by another and the applicability of gravitational and electrical inverse square laws of action of one particle on another; the changes of mass when atoms are built up of their constituent parts; the recent removal of doubts as to the validity of the momentum explanation of the Compton effect; the frequent transformations from matter to radiation and back again which take place in the path of a cosmic ray, which make complete investigation difficult; the discovery that the oscillations of the atoms in a crystal lattice are not isotropic and the question whether supraconductivity in metals, which is suppressed instantly by a magnetic field and more slowly by a rise of temperature, is due to a surface or a volume effect. Prof. Osgood also touches on the increased accuracy of newspaper articles on scientific subjects and on "the growing recognition of the importance of physics and the training which physics gives in industrial fields". His report will be much appreciated by readers who have not the time to devote to more detailed accounts.

Electricity Costs and Factors

IN a paper read to the Institution of Electrical Engineers on March 11, Mr. J. A. Sumner pointed out some of the modern factors which affect electricity costs and charges. He makes a brief comparison between rural and urban distribution and concludes that rural areas quickly become remunerative. He suggests that the expansion of demand must be preceded by a reduction of charges for domestic supply. and a halt should be called in the downward trend of charges for power. The alteration in charges must be accompanied by a greater unification of charges and tariffs, and this can only be achieved quickly by means of a single executive authority which would have the exclusive right to direct and initiate the unification of tariffs and charges. Prices for domestic supply are generally too high to permit an extensive use of electricity, and statistics show that reductions in price tend to follow an increased demand instead of preceding it. So far as the domestic consumer is concerned, for large modern undertakings the original Hopkinson definition, namely, that the fixed charge per quarter should be proportional to the greatest rate at which a consumer may ever use electricity, is no longer applicable. If we are to retain the two part system of charging for electricity, we must reconsider the basis to be adopted for charging. The correct kilowatt charge for each consumer depends upon the time of demand, the 'diversity' of the consumers' load and of the group of consumers with whom he is associated, the voltage of supply and many other factors. It looks as if it were a problem which would not admit in practice of even an approximate solution applicable to all cases.

Cotton Growing Research

AT a meeting of the Administrative Council of the Empire Cotton Growing Corporation held in Manchester on January 26, the director mentioned the extremely bad cotton season that had been experienced in Nyasaland. He said that information received by the Corporation indicated that the loss of crop has been caused to a large extent by insect pest damage, and if this is to be reduced effectively a close season for cotton of at least two months is a necessity. The Government is anxious to extend cotton growing on the Lilongwe Plateau. The Corporation's staff has pointed out, however, that the Plateau is at about the limit of altitude at which successful cotton-growing in Nyasaland is possible; it seems, therefore, that it would be wise to try cotton there on a small scale only, before any attempt is made at extensive production. A pest survey would also be needed as a preliminary in the adjacent area. The Director referred to the importance to the natives of Nyasaland of an economic crop as a means of restricting the present uncontrolled emigration of adult males into other countries in search of work, which is the cause of the breaking up of village life and much consequent poverty and distress.

THE report of the executive stated that over a large part of Africa insect pest damage is probably the limiting factor in cotton production. One insect, the jassid, has now been to a large extent controlled by the breeding of a resistant type of cotton by the Corporation's staff at the Experiment Station at Barberton in South Africa. This variety is now grown in many parts of Africa, including Rhodesia and Nyasaland, and in parts of Tanganyika and Uganda. The Corporation's staff have therefore been turning much of their attention to work on bollworms and stainers, and it is suggested that some increase in staff is necessary. The Director decided, however, that before he would feel justified in recommending the executive committee to sanction this, he needs to be assured that the work already being done is on the right lines, and that the methods by which the different problems are being attacked are those best calculated to lead to the possibility of devising some means of control of these pests. The executive committee accordingly invited Prof. J. W. Munro, professor of entomology at the Imperial College of Science and Technology, to make a tour of the experiment stations in South Africa, Rhodesia and Nyasaland, where the work is going on, and to advise the Corporation whether this work should be continued on the present lines or modified, and to report whether the prospects of success justify extension of the work, or its maintenance on the present, or on a reduced, scale.

British Bird Sanctuaries

THE biannual report of the Watchers' Committee of the Royal Society for the Protection of Birds, issued privately, covers the 1935 and 1936 seasons at the Society's bird sanctuaries in thirteen English counties, three Welsh counties and four Scottish counties, and contains the scheme and appeal for the purchase of Dengemarsh, a stretch of shingle on the south coast of Kent that, with the adjoining sanctuaries of Walkers Outland and the Open Pits shingle, will form a continuous 1,281 acres sanctuary for terns, waders and winter visitors. The Durham (Teesmouth) sanctuary has also a scheme for the extension of watching throughout the year to protect winter visitors. The most extensive reports are made by the watchers in Lakeland, Kent, Orkney and Shetland. All the Scottish sanctuaries report 1936 as being far better than 1935. The Orkney sanctuary at Stenaday reports hen-harriers, which include an albino strain, shelduck and eiders are increasing and merlins and short-eared owls decreasing there: red-necked phalaropes are holding their own where nesting on north Ronaldshay and have a new nesting ground at Papa Westray. In the Shetland sanctuaries gannets, eider, terns, great skuas, arctic skuas, fulmars, starlings, puffins, guillemots, mallard and shags have increased but kittiwakes, razorbills (in parts) and the common gull (which no longer nests on Hermaness) have decreased. Disease has wiped out the house-sparrows from Mid Yell. Very detailed returns are made by the Dungeness and Dengemarsh watchers of Kent, this sanctuary in addition to its ternary being very rich in migrants which last year included the black redstart. Stone-curlews and red-legged partridge have also nested successfully there, but oil and oiled birds are still frequent shore troubles.

The R.H.S. Lily Year-Book

THE Royal Horticultural Society's Lily Year-Book for 1936 (London, from the Society's Office, Vincent Square, Westminster, S.W.1, 5*s*. paper, 6*s*. cloth, 1936) includes a number of contributions to a scientific understanding of lily culture. Dr. Fred Stoker has made a study of the contractile roots of these plants. He shows that members of the *Eulirion* section of the genus *Lilium* possess such structures. Much interesting information as to how contractile roots of daughter bulbils penetrate the root-plate of the mother bulb, is imparted, and the microscopic anatomy has been investigated. An attractive feature of the volume is a bibliography of more than 550 references to published works upon lilies. This has been compiled by the Abbé Souillet, and although it appears comprehensive, it does not claim to have included a large number of articles which have appeared in English periodicals from time to time. A paper by Dr. M. A. H. Tincker shows that a suitable soil temperature of 65°–70° F. is an important factor in the propagation of lilies from bulb scales. It is interesting to note that soil heating by electric cables or hot-water pipes is suggested as an aid to this method of propagation. Many other papers communicate knowledge upon geographical or horticultural aspects of lily growing, and an interesting note by Mr. P. Rosenheim announces the discovery of an early treatise on the lily, contained in a German encyclopaedia by Kruenitz and Floerke, dated 1800.

Soviet Medical Films

ACCORDING to the Soviet Union Year Book Press service, moving pictures are being used in the U.S.S.R. for the treatment of nervous and mental diseases. Prof. Sukharebsky, of the Yakovenko Psychiatric Hospital in Moscow, has obtained remarkable success by showing epileptic patients films depicting calm lakes, picturesque landscapes, etc. He has also obtained good results by the use of a film in which he hypnotizes alcoholic addicts. A plan for a series of 102 short medical films has recently been approved by the Film Committee appointed by the Commissar of Health. The series includes brain operations and diseases of the spinal cord and brain. Other films are designed to assist surgeons to carry out rapid field operations in time of war. A film entitled "A Sick and a Healthy Heart" will be made under the direction of the heart specialist Prof. Zelenin, and another will deal with the development of the child between the ages of one month and two years. The last of the series will be a film entitled "Twenty Years of Soviet Medicine".

Early Man in Japan

EVIDENCE of the presence of palæolithic man is reported from an island in southern Japan. The discovery, it is stated by Science Service (Washington, D.C.), was made by Prof. Shigeyasu Tokunaga, geologist of Waseda University, who while exploring the Island of Itoe in the Loochoo group, found numerous fossil bones of deer, which bore marks of having been worked by human hands. The deer from which the bones were derived has long been extinct, having died out in the neolithic age. Numerous teeth, antlers and bones of the same species of deer of the same age, which Prof. Tokunaga dates at anything from 30,000 to 70,000 years ago, were found in a cave. If the bones in question have in fact been worked by man, this is the first evidence of palæolithic man to be found in Japan.

Acute Poliomyelitis

The Ministry of Health has issued a memorandum upon acute poliomyelitis, an infectious disease commonly known under the name of infantile paralysis, though it may occur in adults (Memo. 166/Med. London: H.M. Stationery Office. *2d.* net). The epidemiology, clinical characters and after-effects of the disease are described and discussed, and the special diagnostic features are considered, together with a description of the changes in the cerebro-spinal fluid which serve to differentiate acute poliomyelitis from the normal and from other nervous diseases with which it may be confused.

Ray Society

At the annual meeting of the Ray Society on March 12, Prof. F. E. Weiss was elected treasurer in succession to Sir David Prain. Sir David Prain and Mr. A. W. Sheppard were elected vice-presidents, and Mr. Chas. Oldham, Mr. H. R. Darlington and Prof. F. Balfour-Browne were elected new members of Council. The Council's report stated that a translation of Linnæus's "Critica botanica" by the late Sir Arthur Hort, with an introduction by Sir Arthur Hill, would form part of the issue for 1937, which would be completed later by Mr. P. Ullyott's "British Freshwater Planarians". Others works in preparation are "British Tunicata" by Dr. John Berrill and "British Freshwater Beetles" by Prof. F. Balfour-Browne. Inquiries regarding membership of the Society should be addressed to the secretary, Dr. W. T. Calman, c/o British Museum (Natural History), Cromwell Road, London, S.W.7.

Royal Academy of Sciences, Turin

The *Atti* of the Royal Academy of Sciences of Turin (72, Part 1, 1937) announces the opening of the one hundred and fifty-fourth year of the Academy's existence. It contains the address of the president, Prof. Vittorio Cian, relating the progress of the Academy during the year 1936. As in the case of other learned societies in Italy, new statutory regulations, approved by the Fascist Government, have come into operation. This publication also includes papers submitted to the Academy in the branches of mathematical, physical and natural sciences. It is intimated that the twenty-ninth Bressa Prize will be awarded during 1937 to a scientific worker of any nationality who shall have, in the opinion of the Academy, made during the period 1933–36 "the most noteworthy and useful discovery or produced the most celebrated work in the physical and experimental sciences, natural history, pure and applied mathematics, chemistry, physiology and pathology, not excluding geology, history, geography and statistics". The prize is valued at 9,000 lire, and candidates who wish to have their work considered by the Academy are invited to submit printed copies to the Secretary (3 Via Maria Vittoria, Turin) not later than March 31, 1937.

Comets

A telegram from the U.A.I. Bureau, Copenhagen, announces the discovery of a new comet, 1937 *d* (Kozawa), on March 9 in R.A. $11^{h}\ 17\cdot3^{m}$, N. Decl. 6° 19′, magnitude 10. The object is diffuse with central condensation, and a tail less than 1° in length. The telegram has the remark "Unconfirmed", and further details are awaited. The Rev. Dr. M. Davidson, using observations on February 4 at Harvard, February 15 at Lick, and February 26 by Steavenson at Norwood, finds that Comet 1937 *b* (Whipple) is moving in an elliptical orbit, the period being about 250 years. More recent observations have been sent in by Hay and Kellaway, and Dr. Davidson is recomputing the elements with the longer time-intervals to determine the exact period. The date of perihelion passage was previously given as January, owing to an error in the telegram; it should have been June.

Announcements

The Right Hon W. G. A. Ormsby-Gore, Secretary of State for the Colonies, and Sir Henry Tizard, rector of the Imperial College of Science and Technology, have been elected to the Board of Trustees of the British Museum, in succession to Mr. H. A. L. Fisher and Sir David Prain, who have resigned.

Prof. S. A. Waksman, professor of soil microbiology in the Rutgers University, New Brunswick, U.S.A., has been elected *correspondant* of the Section of Rural Economy of the Paris Academy of Sciences, in succession to the late Sir Arnold Theiler.

At the annual general meeting of the Institution of Petroleum Technologists held on March 9, the Redwood Medal was presented to Mr. Harry Ricardo, in recognition of his contributions to the advancement of the science and technology of petroleum. Colonel S. J. M. Auld, chief technologist of the Vacuum Oil Co., Ltd., was inducted as president of the Institution at the same meeting in succession to Sir John Cadman.

At the annual general meeting of the Microchemical Club, held on March 13, the following officers were elected: *Hon. Treasurer*, Dr. L. H. N. Cooper; *Hon. Secretary*, J. R. O'Brien; *Hon. Librarian*, Miss I. Hadfield; *Members of the Committee:* Prof. H. V. A. Briscoe, Dr. J. Matthew and Dr. S. J. Folley.

The British Drug Houses, Ltd., have issued a guide in eleven pages to the Addendum (1936) to the British Pharmacopœia 1932. This guide, which should be very useful to those who have not made a detailed study of the Addendum, will be sent free of cost to members of the medical profession.

Erratum.—The name of the new secretary of the International Commission of Zoological Nomenclature (see Nature, March 13, p. 442) is Mr. Francis Hemming.

University College of Science
PHYSICS Dept

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 513.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Isotope Effect in Hydrogen and Hydroxyl Bonds

THE substitution of deuterium for hydrogen has a characteristic effect on the bond lengths in hydrogen compounds, depending on the type of linkage involved. The effect has been described for ionic and covalent linkages[1]. In the case of structures involving intermolecular hydrogen bonds, no theoretical prediction of the effect could be made, because the nature of the hydrogen bond is not fully understood.

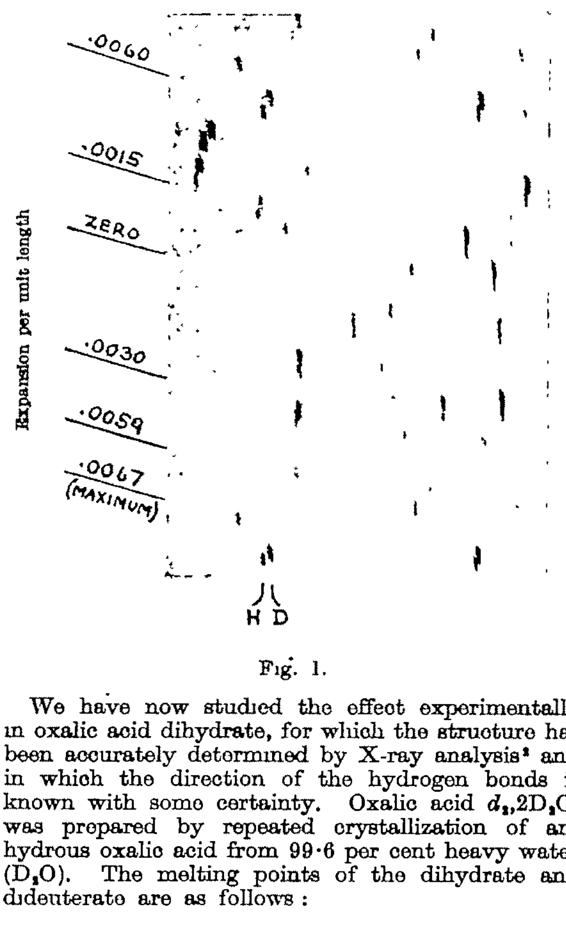

Fig. 1.

We have now studied the effect experimentally in oxalic acid dihydrate, for which the structure has been accurately determined by X-ray analysis[2] and in which the direction of the hydrogen bonds is known with some certainty. Oxalic acid d_2,$2D_2O$, was prepared by repeated crystallization of anhydrous oxalic acid from 99·6 per cent heavy water (D_2O). The melting points of the dihydrate and dideuterate are as follows:

ACID	M.P.
$(COOH)_2\,2H_2O$	99·8–100·7° C.
$(COOD)_2\,2D_2O$	95·9– 97·5° C.

This difference in melting points is in the same direction and is of the same order of magnitude as for succinic acid[3] and for other carboxylic *d* acids.

In oxalic acid d_2 $2D_2O$, there is a small *expansion* of the spacings of certain crystal planes, as compared with oxalic acid $2H_2O$, and this expansion reaches a maximum near the direction of the hydrogen bond. The effect is shown in Fig. 1, which is part of a moving film exposure taken with a Weissenberg type of spectrometer.

In this experiment a needle-shaped crystal of oxalic acid d_2 $2D_2O$, elongated along the *b* axis, was selected for comparison with a similar but slightly smaller crystal of oxalic acid $2H_2O$. The specimens were mounted in succession on the spindle of the spectrometer, with a small relative displacement in angular setting, and the reflections from the (*hol*) zones recorded on the same moving film, with copper *K* radiation. The reflections occur in overlapping pairs (cf. Fig. 1) the upper and darker component being due to oxalic acid d_2 $2D_2O$. The glancing angle of the reflection θ, and hence the spacing of the plane concerned, is given by the horizontal co-ordinate in the photograph, whilst the angular position of the reflecting plane in the crystal is given by the vertical co-ordinate. Sinθ varies from about 0·60 on the right to 0·97 on the left, and in this region, where the dispersion is large, the displacement of the oxalic d_2 $2D_2O$ lines is very marked. The expansions calculated from the displacements are shown at the side. On the extreme left the reflections split, showing the $K\alpha_1$, $K\alpha_2$ doublet.

The expansion of the oxalic acid d_2 $2D_2O$ lattice reaches a maximum near the top and bottom of the photograph, an interval which corresponds to a crystal rotation of about 180°, and in the middle it is practically zero. The directional nature of this expansion in relation to the structure is shown in Fig. 2.

Along the direction of the deuterium bonds, shown by the heavy dotted lines, the expansion is about 0·0063 per unit length. This corresponds to an expansion of the bond by about 0·016 A., or, if all the expansion occurs in the bond and not elsewhere in the structure, by about 0·044 A.

It should be emphasized that with the present technique the amount of the expansion can be measured much more accurately than the absolute value of the length of the bond itself, which is about 2·52 ± 0·02 A. This applies also to the axial ratios of the crystal. The monoclinic unit cell of oxalic acid $2H_2O$ has the dimensions

$$a = 6\cdot120 \pm 0\cdot020 \quad b = 3\cdot600 \pm 0\cdot010$$
$$c = 12\cdot030 \pm 0\cdot030 \quad \beta = 106\cdot2°$$

The comparative values for the cell of oxalic acid d_2 $2D_2O$, which roughly account for the observed expansion, are:

$$a = 6\cdot149, \quad c = 12\cdot074, \quad \beta = 106\cdot65°$$

So far, accurate observations have only been made in the (*hol*) zone, but any change in the *b* axis is probably small.

The isotope effect on the lattice parameter of lithium hydride[4] and on the alloy of palladium with hydrogen[5] is a contraction when deuterium is substituted for hydrogen, in agreement with the lower zero point energy. The converse effect of an expansion when deuterium is substituted for hydrogen in oxalic acid is apparently due to the resonance between *two* molecular structures[6] required for this type of linkage. When the isotope effect on each structure separately is considered, the energy and probably the dimensional difference between alternative deuterium structures will usually be bigger than in the case of hydrogen. Resonance will be less complete in consequence, and a larger distance between the associated groups will result when these are linked by deuterium atoms.

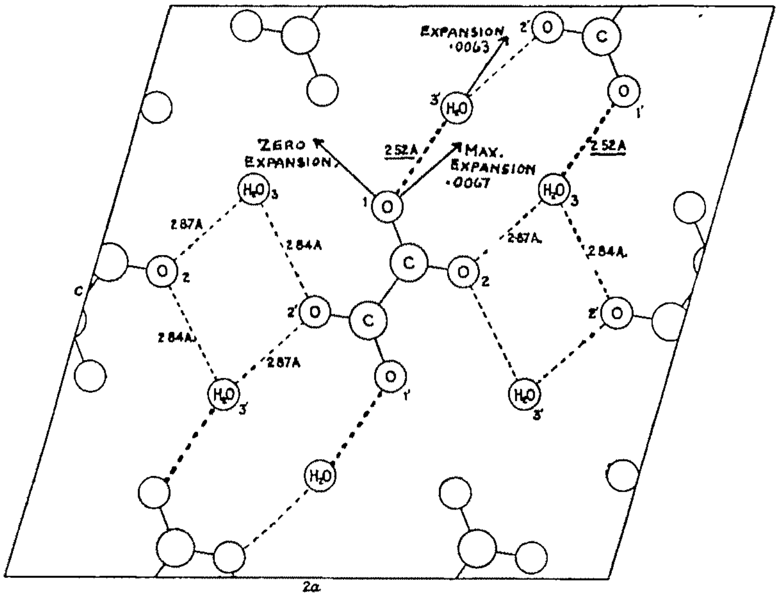

Fig. 2.

Preliminary results for other compounds under investigation show that the isotope effect depends upon the type of linkage involved. Thus, for the hydroxyl bond in α-resorcinol, the resultant effect is very small, which is in agreement with the observations of Megaw on deuterium oxide[7]. In addition to throwing light on the mechanism of the hydrogen bond, the results promise to be of considerable value in locating certain types of hydrogen linkage in complex structures.

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March 4.

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[1] Ubbelohde, A. R., *Trans. Far. Soc.*, 32, 525 (1936).
[2] Robertson, J. M., and Woodward, I., *J. Chem. Soc.*, 1817 (1936).
[3] Halford, J , and Anderson, L., *J. Amer. Chem. Soc.*, 58, 736 (1936).
[4] Zintl, E , and Harder, A., *Z. phys. Chem.*, 28B 478 (1935).
[5] Ubbelohde, A. R., *Proc. Roy. Soc.*, A, (1937), in the press.
[6] Sidgwick, N., *Ann. Rep. Chem. Soc.*, 31, 38 (1934).
[7] Megaw, A., NATURE, 134, 900 (1934).

Relations in β-Ray Transformations and the Neutrino Theory

IT is now generally agreed that the theory of the β-transformations of atomic nuclei developed by Fermi[1] on the hypothesis that a neutrino is emitted as well as a β-particle gives a formal explanation of the main phenomena. Fermi introduced an interaction of a new type between the heavy particles in the nucleus and the electron and neutrino. His theory was later modified by Konopinski and Uhlenbeck[2], in order to avoid certain discrepancies with experiment. Both the original Fermi theory and the Konopinski-Uhlenbeck form give a relation between the period of the transforming nucleus and the maximum energy of the emitted β-ray, and predict the shape of the β-ray spectrum.

Recent work[3] on the β-spectrum of radium D makes it possible to apply a stringent test to any formula connecting the period and maximum energy in β-decay. The three nuclei, thorium C″, thorium B and radium D, all give rise to permitted β-transitions and have periods in the ratios $1 : 2{\cdot}05 \times 10^2 : 3{\cdot}6 \times 10^6$. Taking the end-points of the β-ray spectra as 1790, 362 and 15 kV. respectively, the Fermi formula gives for the ratios of the periods $1 : 2{\cdot}7 \times 10^2 : 4{\cdot}6 \times 10^6$, in good agreement with experiment. The Konopinski-Uhlenbeck expression, however, predicts corresponding ratios of $1 : 3{\cdot}8 \times 10^3 : 2{\cdot}7 \times 10^{10}$; here the end-points must be taken as 2250, 510 and 22kV. respectively, in order to obtain agreement with the shape of the β-spectra at lower energies.

Thus the Konopinski-Uhlenbeck expression is in marked discrepancy with observation. On the other hand, there is no doubt, as shown by Bethe and Bacher[4], that it gives a correct representation of the relative periods of β-decays of high energy, that is, with end-points between about 2 MV. and 12 MV.

The recent results of Lyman[5] now show that neither the Konopinski-Uhlenbeck nor the Fermi expression gives the correct shape of the β-ray spectrum for radium E or for radio-phosphorus, ^{32}P. It is possible, however, to obtain close agreement with his results by a linear combination of the two expressions each using the same high-energy end-point ε_0, taken as the energy of the fastest observed electrons. The shape of the spectrum is then given by

$$N\,d\varepsilon = F \times \left\{1 + \left(\frac{\varepsilon_0 - \varepsilon}{K}\right)^2\right\} d\varepsilon,$$

where N is the number of electrons with energy between ε and $\varepsilon + d\varepsilon$ in units of mc^2, and F is the value of N given by the Fermi expression alone.

To fit the results for radium E and ^{32}P, values of K of 1·4 and 2·2 mc^2 are required respectively. If this difference in K between the two disintegrations is connected with a difference in the matrix elements of the heavy particles rather than with the higher value of ε_0 for ^{32}P, then the value of K may be expected to be approximately constant for β-decays of the same type. For small ε_0 the term involving K will be small, so that for low-energy spectra the shape and the relation of the period and energy should be given by the Fermi expression. For high-energy spectra the shape (except near $\varepsilon = \varepsilon_0$) and the period should be given by the Konopinski-Uhlenbeck expression owing to the dominance of the second term.

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Feb. 23.

[1] *Z. Phys.*, **88**, 161 (1934).
[2] *Phys. Rev.*, **48**, 7, 107 (1935)
[3] Richardson and Leigh-Smith, NATURE, **134**, 772 (1934)
[4] *Rev. Mod Phys.*, **8**, 82 (1936).
[5] *Phys. Rev.*, **51**, 1 (1937).

Dissociation of Ovalbumin in Urea Solvent

THE physical molecule in solution is that unit which will acquire from thermal vibrations an average of 1/2 kT ergs of energy for each of three translational degrees of freedom. It is becoming increasingly evident that the weights of protein molecules defined in this way may change with solvent temperature, dielectric constant, protein or salt concentration, and other factors. Numerous studies from this Laboratory have demonstrated the effect of change of pH of the solvent medium in the dissociation and association of the molecules comprising the fundamental component.

In connexion with work on the physical chemistry of zein, observations have been made of the sedimentation velocities of the light, predominant, and heavy constituents of the normal zein. Aqueous alcohol (60 per cent) and urea (50 per cent) were used as solvents. The zein was always dissolved in the aqueous urea solution immediately before the centrifuging was begun, and the resulting sedimentation constants agreed with those found by using the alcoholic solvents. A preliminary report of this work has already appeared in NATURE[1].

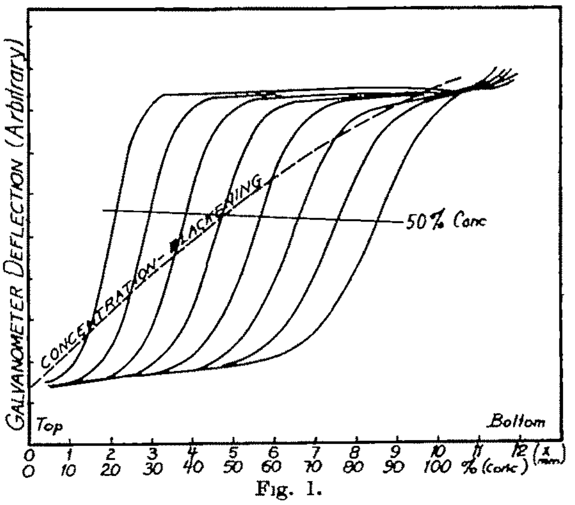

Fig. 1.

PHOTOMETER CURVES FROM SEDIMENTATION PICTURES OF OVALBUMIN IN AQUEOUS BUFFER SOLUTION, $pH = 6{\cdot}0$ ($0{\cdot}1\ m$ $NaCl$ + $0{\cdot}085\ m$ KH_2PO_4 + $0{\cdot}005\ m$ Na_2HPO_4). CENTRIFUGAL FIELD = 233,000 TIMES GRAVITY; EXPOSURE INTERVAL = 15 MIN. VISCOSITY RATIO = 0·810; $(1/v - \rho)$ RATIO (SEDIMENTATION 'DRIVING FORCE') = 1·027. $s_{20} = 3{\cdot}6 \times 10^{-13}$. IF SPHERICAL SHAPE IS ASSUMED, THIS CORRESPONDS TO $M = 36{,}000$.

At the time the use of urea as solvent for zein was begun, it was realized that this and other compounds containing nitrogen must influence, sooner or later, the condition of the protein in the solution. Accordingly, centrifugal studies were made of purified ovalbumin dissolved in aqueous urea (50 per cent). This protein was found to have been almost completely dissociated into a molecule having sedimentation constant $s_{20} = 2{\cdot}5 \times 10^{-13}$ cm./sec./dyne, so that the molecular weight of the product of dissociation is approximately a half that of the ordinary ovalbumin molecule. The effect of the urea solvent in dissociating the protein is shown clearly by Figs. 1 and 2, in which are presented sedimentation diagrams (light absorption method) for the normal ovalbumin in buffered aqueous solvent and for the dissociated ovalbumin in urea solvent. Sedimentation experiments were performed with the original ovalbumin in aqueous solution before and after the observations in the urea solvent.

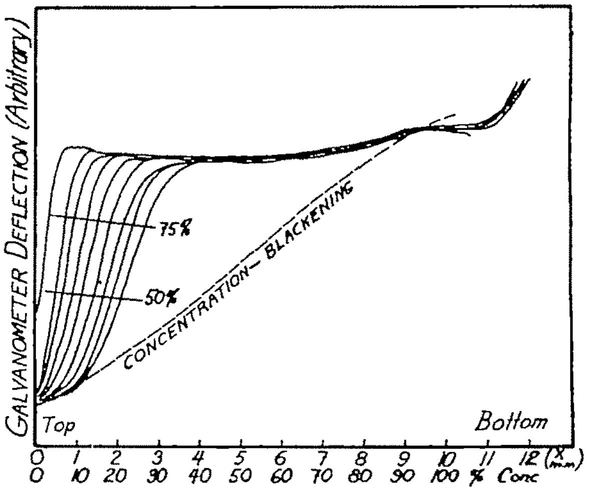

Fig. 2.

PHOTOMETER CURVES FROM SEDIMENTATION PICTURES OF OVALBUMIN AT ISOELECTRIC POINT IN 50 PER CENT UREA SOLUTION ($0{\cdot}1\ m$ KCl). CENTRIFUGAL FIELD = 220,000 TIMES GRAVITY; EXPOSURE INTERVAL = 23, 17, 20, 20 MIN.; VISCOSITY RATIO = 1·51 (AV) $(1/v - \rho)$ RATIO = 1·730. $s_{20} = 2{\cdot}5 \times 10^{-13}$. IF SPHERICAL SHAPE IS ASSUMED, THIS CORRESPONDS TO $M = 21{,}000$.

Further experiments were carried out to determine whether or not the dissociation is reversible. Purified ovalbumin was dissolved in the 50 per cent aqueous urea solution, and the resulting solution was placed in a collodion sack and dialyzed against $m/150$ phosphate buffer solution, $pH = 6$, to remove the urea. After a four-day period, the urea had been dialyzed out but a considerable portion (three fourths) of the ovalbumin had coagulated. The ovalbumin solution was then centrifuged. In spite of some inhomogeneity, the experiment demonstrated the presence of protein molecules having the same sedimentation constant as that of the original ovalbumin. Although this molecule, of normal sedimentation behaviour, must have been formed from the dissociated portions, we prefer to leave open for the present the question of the reversibility of the dissociation. Similar studies with several solvents, using observations of diffusion constants of the components to characterize the molecular species present, are now nearing completion, and we hope to give a complete answer to this particular question in the near future.

The experiments described above were performed during the spring of the academic year 1934–35. We wish to thank Prof. The Svedberg and his associates for their interest and assistance with the work.

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[1] Watson, Arrhenius and Williams, NATURE, 137, 322 (1936).

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Some Infra-Red Bands in the 3μ Region

IN view of recent communications[1,2,3] on the infra-red band arising from the O—H vibration in certain compounds, it is of interest to direct attention to certain analytical data obtained by us with comparatively high dispersion in the region 3μ, working with solutions about 0·1 mol/lit. in carbon tetrachloride.

In phenol, benzyl alcohol, diphenyl carbinol and triphenyl carbinol, we find that an intense O—H band is obtained in each case, the wave-length being highest for phenol (2·770 μ) and lowest for benzyl alcohol (2·764 μ). The association band[1] is found at 2·87–2·97 μ, the wave-length increasing with the intensity of the band; its shape as shown in Fig. 1 for benzyl alcohol is similar to that for ethyl alcohol in carbon tetrachloride[1]. The intensity of the association band was about the same for phenol and benzyl alcohol, was less for diphenyl carbinol, and with triphenyl carbinol was visible as a small 'hump' on the general absorption at 2·87 μ. These results suggest that the replacement of hydrogen by phenyl groups in benzyl alcohol suppresses intermolecular association.

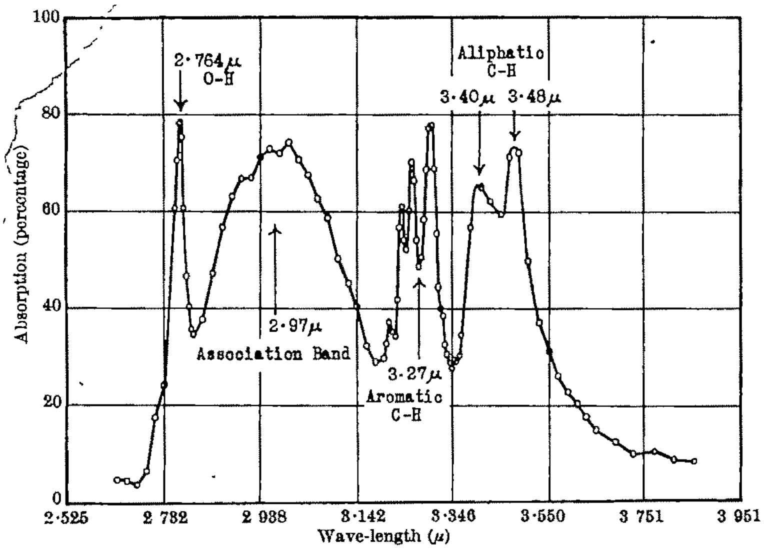

Fig. 1.

ABSORPTION OF A 1·3 MM. LAYER OF BENZYL ALCOHOL IN CARBON TETRACHLORIDE (0 169 MOL/LIT.) AT 18° C.

Dilution was found to reduce the intensity of the association band in the case of phenol much more rapidly than the O—H band (cf. Errera[2]). The former band dropped from 80 per cent absorption in 0·174 mol./lit. (O—H band 94 per cent) to 5½ per cent at 0·0145 mol./lit. (O—H band 58 per cent). The triphenyl carbinol showed 12·5 per cent for the association band at 0·066 mol./lit. as compared with 29 per cent for phenol at the same concentration.

Fig. 1 shows bands due to OH and association, the aromatic C—H bands around 3·27 μ and the aliphatic C—H bands at 3·40 and 3·48 μ.

A full account of the bands of these and other organic compounds will be described elsewhere.

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Feb. 17.

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[1] Errera, J., and Mollet, P., NATURE, 138, 882 (Nov. 21, 1936).

[2] Errera, J., *Trans. Far. Soc.*, 33, 120 (1937).

[3] Buswell, A. M., Deitz, V., and Rodebush, W. H., *J. Chem. Phys.*, 5, 84 (1937).

A Possible Acid-Dissociation of Metal-Ammonia Ions, and its Bearing on Certain Reactions

RECENT observations[1] on exchange reactions between heavy water and cobaltammines suggest a possible mechanism for certain reactions of the latter.

It would seem that the ammonia molecules in these complexes must, by co-ordination, have lost the ability to form ammonium ions, and therefore if we assume that the exchange reactions take place through the D+ ion, we must conclude that these co-ordinated ammonia groups can dissociate as acids:

$$\mathrm{(Co.6NH_3)^{3+} \rightleftarrows (Co.5NH_3.NH_2)^{2+} + H^+} \quad (1).$$

This seems plausible, since the co-ordination of the analogous water molecule enables it, as is well known, to dissociate as an acid:

$$\mathrm{(Co.5NH_3.H_2O)^{3+} \rightleftarrows (Co.5NH_3.OH)^{2+} + H^+}; \quad k = 2 \times 10^{-6} \quad (2).$$

The corresponding dissociation constant for the co-ordinated ammonia molecule would presumably be much smaller, but might still be appreciable.

On this basis it would be possible to account for the rapid replacement of acido-groups by hydroxyl ions:

$$\mathrm{(Co.5NH_3.Br)^{2+} + OH^- \rightarrow (Co.5NH_3.OH)^{2+} + Br^-} \quad (3).$$

This reaction is unique, in that such replacements by other anions only take place much more slowly if at all. Alternatively, it may be regarded as catalysis by hydroxyl ion of an aquotization reaction,

$$\mathrm{(Co.5NH_3.Br)^{2+} + H_2O \rightarrow (Co.5NH_3.OH_2)^{3+} + Br^-},$$

followed by instantaneous establishment of the hydroxo-aquo equilibrium.

Now the kinetics of the aquotization of acido-aquo complexes have led to the conclusion[4] that the hydroxo-acido ion undergoes this change much more rapidly than the aquo-acido ion with which it is in equilibrium, presumably in virtue of its smaller positive charge—a conclusion which harmonizes with the general observation that diacido complexes undergo aquotization more rapidly than mon-acido complexes.

By analogy, then, the acido-hydroxo replacement first referred to might proceed as follows :

I. $(Co.5NH_3.Br)^{2+} \rightleftarrows (Co.4NH_3.NH_2.Br)^{+} + H^{+}$

II. $(Co.4NH_3.NH_2.Br)^{+} + H_2O \rightarrow (Co.4NH_3.NH_2.H_2O)^{2+} + Br^{-}$

III. $(Co.4NH_3.NH_2.H_2O)^{2+} + H^{+} \rightleftarrows (Co.5NH_3.H_2O)^{3+}$

IV. $(Co.5NH_3.H_2O)^{3+} \rightleftarrows (Co.5NH_3.OH)^{2+} + H^{+}$.

I, III, and IV represent instantaneously established equilibria, while II would be much more rapid than the 'spontaneous' aquotization of the bromo-pentammine ion. The whole process would give a velocity equation of the same form as that for the direct replacement by hydroxyl ion and would account for the unique behaviour of the latter in this respect.

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[1] Erlenmeyer and Gartner, *Helv. chim. Acta*, 17, 1008 (1934); James, Anderson and Briscoe, NATURE, 139, 109 (1937).

[2] Brønsted and Volqubartz, *Z. phys. Chem.*, 134, 97 (1927).

[3] Brønsted and Livingstone, *J. Amer. Chem. Soc*, 49, 435 (1927).

[4] Brønsted, *Z. phys. Chem.*, 122, 383 (1926).

MR. GARRICK has very courteously allowed us to see the foregoing letter before publication, and indeed suggested that he would publish it only with our concurrence. This encourages us to give the following brief outline of certain results we have obtained during the last few months in our study of the rate of interchange between hexammine cobaltic chloride and heavy water, which have led us to precisely the same view of the basic reaction as that at which Mr. Garrick has independently arrived.

The direct exchange of covalently bound hydrogen for deuterium must necessarily involve high energies of activation. It must therefore be supposed that interchange reactions which proceed readily at room temperature proceed by way of the attachment of the deuterium ion, or of heavy water, to ions or co-ordinately unsaturated groups; in the latter case elimination of light water may complete the course of the reaction. In the case of hexammine cobaltic chloride, the nitrogen atoms of the ammonia groups are co-ordinately saturated, so that in our view interchange must pre-suppose either : (*a*) dissociation of an ammonia molecule :

$$[Co(NH_3)_6]^{3+} \rightleftharpoons [Co(NH_3)_5]^{3+} + NH_3,$$

followed by interchange of the hydrogens of that ammonia through addition of water, or (*b*) an ionic dissociation

$$[Co(NH_3)_6]^{3+} \rightleftharpoons [Co(NH_3)_5NH_2]^{2+} + H^{+}$$

such as Mr. Garrick also supposes.

The great stability of the hexammine cobaltic ion toward acids rules out possibility (*a*), so that we envisage the mechanism of hydrogen interchange on the scheme (*b*) as given by the following reactions :

(1) $[Co(NH_3)_6]^{3+} \rightleftharpoons [Co(NH_3)_5NH_2]^{2+} + H^{+}$

(2) $[Co(NH_3)_5NH_2]^{2+} + HDO \rightarrow [Co(NH_3)_5NH_2D]^{3+} + OH^{-}$

(3) $H^{+} + OH^{-} \rightleftharpoons H_2O$

Reactions (1) and (3), as ionic equilibria are sensibly instantaneous; reaction (2) is the step determining the rate of reaction.

We are led on this basis to an expression for the velocity constant

$$K = \frac{1}{t} \cdot \frac{[H^+]}{[A]^{\frac{1}{2}}} \frac{[HDO]_\infty}{\xi_0} \cdot \log_e \frac{[HDO]_\infty}{[HDO]_\infty - [HDO]}$$

in which [A] = concentration of hexammine cobaltic chloride,

ξ_0 = initial 'heaviness' of the cobalt-ammine,

$[HDO]_\infty$ = concentration of heavy water after complete interchange,

[HDO] = concentration of heavy water at the time *t*.

This particular form of the expression is adapted to the conditions of our own experiments, in which we have found it convenient to reverse the normal procedure by measuring the rate of interchange between heavy cobaltammine and light water.

In agreement with the above expression, we find that (*a*) the rate of interchange varies inversely as the hydrogen ion concentration ; (*b*) for constant [A], the rate of interchange is independent of the heaviness ξ_0 of the salt ; (*c*) for salt of a constant heaviness ξ_0, the rate of interchange varies inversely as $[A]^{\frac{1}{2}}$.

The underlying hypothesis of the ionic dissociation of the ion $[Co(NH_3)_6]^{3+}$ appears therefore to be substantiated. Further aspects of this, and in particular the significance of the term $[A]^{\frac{1}{2}}$ in the above expression, we hope to discuss in presenting our detailed results.

We would add that the velocity of interchange in unbuffered solutions indicates an acidity constant K_a about 10^{-12}–$10^{-11 \cdot 5}$ for the hexammine cobaltic ion.

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H. V. A. BRISCOE.

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Calculation of Constants for Band Spectra

IT has not infrequently proved difficult in the analysis of spectra to decide which of two or more sets of constants refer to the deepest-lying energy states : an example of this arose in my experience in the interpretation of Gale and Monk's work on the fluorine di-atom FF. Empirical methods of obtaining these numbers for ground states may therefore be useful. It is already possible on the basis of the periodic classification of di-atoms[1] to form estimates of such numbers in many cases. The fundamental nuclear vibration frequency ω_e is one of the most important of these constants, since it enters into the expressions for other numbers. Methods by which the equilibrium internuclear distance r_e may be obtained from ω_e have been recently improved[2].

It has so far proved practicable to derive an empirical formula for ω_e's of di-atoms XX, XY and YY, so that if any two are known the third may be derived, but *only so long as X and Y contribute equal numbers of valency electrons to the shared group of XY*, or, in other words, so long as X and Y belong to the same atomic periodic group. In terms of the proposed classification, the di-atoms XY must be chosen from the *symmetrical* molecular groups designated II, IVs, VIs, VIIIs, Xs, XIIs and XIV[1]. For such cases, Howell[3] and I[1] independently observed that $a = \omega_e(XY)$ is approximately the arithmetic mean of $b = \omega_e(XX)$ and $c = \omega_e(YY)$, so that—

$$a = 0 \cdot 500(b + c) \quad . \quad . \quad . \quad . \quad (1)$$

As it turned out that the errors in a using (1) were always positive, I suggested[1] a reduction of 1·8 per cent in a, giving—

$$a = 0{\cdot}491(b+c) \quad . \quad . \quad . \quad . \quad . \quad (2)$$

It seemed probable that a more accurate formula could be reached by assuming that the contributions made by b and c to a might be unsymmetrical, the larger frequency c having a greater influence than the lower frequency b. Proceeding by empirical methods, I have searched for a better relationship on this basis, and have derived the following:

$$a^3 = 0{\cdot}800bc^2, \quad . \quad . \quad . \quad . \quad . \quad (3)$$

which appears to give remarkably reliable results.

Calculation from the available data on 36 di-atoms of the specified type, where a, b and c are known, shows that the average difference errors, neglecting sign, between a(calc.) and a(expt.) are 15·0, 9·8 and 3·8 wave-numbers by the three formulæ (1), (2) and (3) respectively. The corresponding percentage difference errors are 4·6, 3·3 and 1·6 per cent respectively. Judged either way, (3) gives the best results; moreover, the errors are no longer wholly positive. It may be added that in some cases the experimental uncertainty in a may amount to 1 or 2 per cent. If we may therefore trust this formula, it becomes possible to estimate a's for a score of di-atoms for which no definite experimental data are available.

The results seem to support Howell's view[3], that it is not very probable that a(PN), assigned by Curry, Herzberg and Herzberg, refers to the ground state. If, as may appear, the true value lies in the region 1,500 wave-numbers, my earlier arguments[4] about PN are in no way invalidated. In the case of AsN, the run of the numbers suggests that neither the assigned a(AsN) nor a(AsAs) belong to the unexcited condition. I cannot concur, however, in the suggestion[5] that the bond (force) constants k_0 of a triad of di-atoms of the specified kind are equal. In the course of calculations involving a considerable number of these constants, I found, for example, that the k_0's of OO, SO and SS were 117·7, 78·8 and $49{\cdot}7 \times 10^4$ dynes per cm. respectively[6].

The limitation observed in this note to symmetrical di-atoms appears to emphasize the suggested periodic group classification of molecules, as of considerable assistance in the discussion of band spectral data. For di-atoms other than those of the chosen groups, the errors are usually large, and equations of the present type useless. (A possible exception may be CP, where I am inclined to regard the coincidence as accidental). It seems probable that the 'reduced' mass will enter into suitable expressions for di-atoms of unsymmetrical groups, and efforts will be made to find a suitable formula of more general application on these lines.

I would be pleased to be of any possible assistance to workers who are interested in a particular estimate.

Details of the calculations here reported will be published in another place.

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Feb. 3.

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[1] Clark, C H Douglas, *Trans. Faraday Soc.*, **31**, 1017 (1935).

[2] Clark, C. H. Douglas, and Stoves, J. L., *Phil. Mag.*, (vii), **22**, 1137 (1936).

[3] Howell, H. G., NATURE, **138**, 36 (1936).

[4] Clark, C. H Douglas, NATURE, **135**, 544 (1935).

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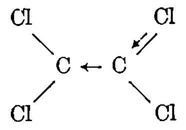
[6] Clark, C. H. Douglas, *Proc Leeds Phil. Soc.*, **3**, 26 (1935).

Force Constants and Structure

IN a recent letter in NATURE[1], Duchesne has discussed the values of the 'force constants' of the potential energy function of the molecules ethylene and tetrachlorethylene, and has attempted to draw inferences from the calculated data about structural properties. In a paper at present in the press[2], we have examined the values of the force constants of the linkages in different molecules of a given series, such as the methyl and ethyl derivatives of a metal, in so far as these are given by the values of their normal vibration frequencies. The results suggested that in different molecules of a particular type variation in the force constant of a given link or of the 'bending constant' of a given angle might throw light on the electronic arrangements in the different linkages. We have accordingly now calculated the force constants of linkages in a very large number of molecules from the known vibration frequencies. It becomes clear that in some cases, structural problems, such as the phenomenon of resonance, may be studied by this procedure. The detailed results will appear shortly elsewhere, but since our conclusions with the two molecules mentioned above appear to go further than those given by Duchesne, it may be fitting to summarize them here.

For ethylene we find: $k_{\mathrm{C-C}} = 9{\cdot}0 \times 10^5$, and $k_{\mathrm{C-H}} = 4{\cdot}85 \times 10^5$. For tetrachlorethylene: $k_{\mathrm{C-C}} = 5{\cdot}8 \times 10^5$ and $k_{\mathrm{C-Cl}} = 5{\cdot}2 \times 10^5$. Now for methane, we have $k_{\mathrm{C-H}} = 4{\cdot}98 \times 10^5$, and for carbon tetrachloride $k_{\mathrm{C-Cl}} = 4{\cdot}38 \times 10^5$ dynes per cm. Thus in passing from ethylene to tetrachlorethylene the constant of the C–C link is markedly diminished. This suggests the possibility of structure



agreeing with the idea of Duchesne. On this basis we should perhaps expect an increase in the C–Cl constant, as compared with that in carbon tetrachloride. This increase is noticed. The C–H constant, however, does not appreciably change in passing from methane to ethylene, since the hydrogen atoms have no electron donating capacity.

In the same way, cyanogen chloride might be written

$$\mathrm{Cl} \rightleftarrows \mathrm{C} \rightleftarrows \mathrm{N},$$

and the C–Cl constant ought to exceed the value in carbon tetrachloride. This is again found, the values being 5·15 and $4{\cdot}38 \times 10^5$. The C–N link constant, on the other hand, should be lower in cyanogen chloride than in hydrogen cyanide, as it is in fact, the values being 16·65 and $17{\cdot}8 \times 10^5$. Precisely similar results are found with cyanogen bromide and carbon tetrabromide.

Thus it is clear that calculations of this kind may well be instructive in connexion with structural problems. Some anomalies are found, however, which may arise from defects in the potential energy functions used. These will be discussed fully elsewhere, but it should be noticed that in the case given above (ethylene and tetrachlorethylene), regardless of the type of potential function used (valency force system, central force system, Delfosse[3] function), the C–C constant has approximately the same value, and changes in the same way and to approximately the same extent. This is strong indication of the reality of the effect suggested.

The corresponding variations of the bending constants of the angles is also interesting, as well as translation of the deduced force constants into distances by the method of Badger[4], but these will be fully given later.

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H. W. THOMPSON.

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[1] NATURE, **139**, 288 (1936).

[2] Thompson, H. W., and Linnett, J. W., *Proc Roy Soc* (in the Press)

[3] *Ann. Soc. Sci. Brux.*, **55**, 114 (1935).

[4] *J Chem. Phys* 3, 710 (1935)

Dipole Moments of some Aliphatic Aldehydes

SEVERAL determinations of the moments of aliphatic aldehydes have been made, but some uncertainty in the values exists.

The results previously published are given below.

Compound	Moment	Temperature	Solvent	Reference
Acetaldehyde	2·72	16°C.	(vapour)	1
	2·69	27°–182°	(vapour)	2
Propionaldehyde	2 4	—	benzene	3
n-Butyraldehyde	2·46	18°	benzene	4
n-Heptylaldehyde	2·56	22°	benzene	5

The values of the moments are given throughout in Debye units

The ease with which these compounds are oxidized and also the volatility of the lower members makes solution measurements difficult, and an accurate comparison of the moments cannot be made, as the results are incomplete. We are therefore reinvestigating these compounds, and preliminary measurements in benzene solution have been completed.

The moments of acetaldehyde, propionaldehyde, valeraldehyde and isovaleraldehyde are, we find, 2·49, 2·54, 2·57 and 2·60 respectively in benzene solution. The compounds were fractionated and measured in an atmosphere of nitrogen and the dielectric constants of the solutions determined by the apparatus described by Martin and Partington[6].

The physical constants of the materials, and the values of the polarizations and moments determined in benzene solution at 20°, are given below.

Compound	b p	d_4^{20}	n_D^{20}	P_E	$P_{2\infty}$	μ
Acetaldehyde	20 6° C./764 mm	0 8058 (0°)	1 3437 (0°)	11 5 c c.	143 c.c	2 49
Propionaldehyde	48 2° /764	0 8058	1·3639	16 0	153	2 54
n-Valeraldehyde	102 5° /766	0 8105	1·3947	25 5	165	2·57
iso-Valeraldehyde	92 5° /754	0·8004	1·3904	25 5	169	2 60

Further work on other aldehydes is in progress, and the results will be discussed when completed.

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D. I. COOMBER.

Queen Mary College,
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Feb. 13.

[1] Højendahl, Thesis, Copenhagen, 1928; calculated from experimental results of Pohrt, *Ann. Phys.*, **42**, 569 (1913).

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[3] Herold and Wolf, *Z. phys. Chem.*, B, **12**, 165 (1930) (result corrected for P_A).

[4] Hassel and Naeshagen, *Z. phys. Chem.*, B, **6**, 152 (1929).

[5] Errera and Sherrill, *J. Amer. Chem. Soc.*, **52**, 1993 (1930).

[6] Martin and Partington, *J. Chem Soc.*, 602 (1935); 158 (1936).

Insect Drift over the North Sea

FROM August 5 until August 13 last year, one of us (A. C. H.) was kindly permitted to accompany the Ministry of Agriculture and Fisheries research ship *George Bligh* during one of her routine cruises over the North Sea and, by flying collecting nets either from the mast-head or from kites flown from the ship, to study the drift of insects over the sea. It is hoped that further surveys will be made this year. Whilst a full discussion of the data will be reserved until further evidence is available, the results of this first survey were so unexpected that a preliminary note may be of interest.

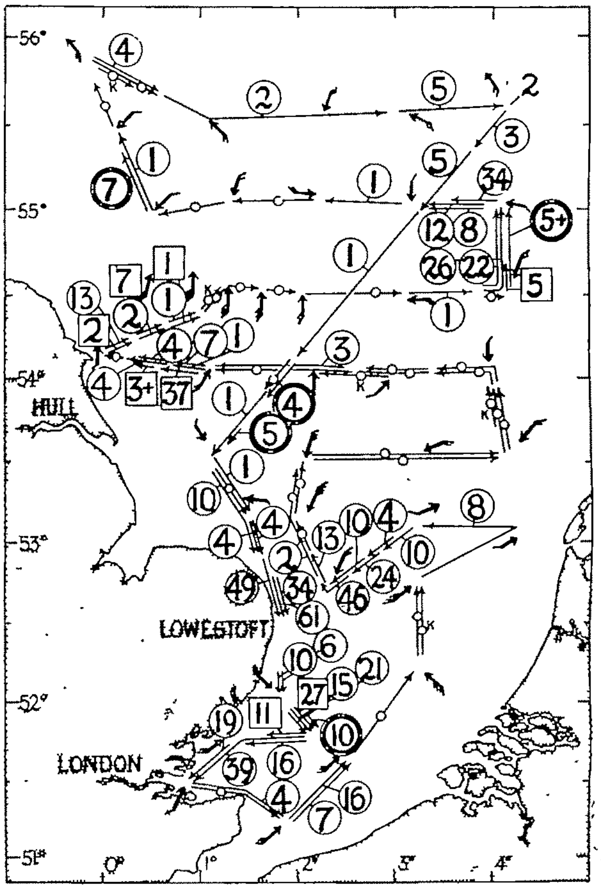

Fig. 1.

CHART SHOWING INSECT CAPTURES OVER THE NORTH SEA.

Fig. 1 is a chart of the area covered. Each of the fine arrows shows the direction and distance over which a net was collecting. The nets were flown almost continuously, so that by following the arrows one may follow the track of the ship starting from Lowestoft in a southerly direction. A small circle on an arrow indicates a blank haul. Arrows side by side indicate nets collecting at the same time. The enclosed figures against the arrows show the total number of insects taken in each net. Those in circles were from nets flown from the mast-head, about 40 ft. above sea-level, those in squares from nets flown from kites at heights between 200 ft. and 400 ft. Blank kite hauls are marked with a 'K.'

The nets were of muslin with an opening of 3 ft. diameter, except when occasionally a larger net, 6 ft. diameter, was used (shown by a double circle). A glass collecting tube was fitted to the end of each net; twice these broke, presumably losing most of the catch (indicated by + sign on chart).

Altogether 730 insects were collected, distributed amongst the following families thus:

HEMIPTERA		DIPTERA	
Aphididæ	171	Cecidomyidæ	21
Psyllidæ	1	Chironomidæ	54
NEUROPTERA		Culicidæ	1
Chrysopidæ	1	Mycetophilidæ	53
Hemerobiidæ	2	Psychodidæ	20
TRICHOPTERA	1	Phoridæ	3
LEPIDOPTERA		Syrphidæ	7
(Noctuidæ	1)	Acalypteræ	355
Micro-lepidoptera	5	Spiders	6
HYMENOPTERA			
Chalcidoidea	5	Unrecognizable	
Ichneumonoidea	7	(damaged in net)	16

The broad arrows on the chart indicate the direction of the wind at points where the ship stopped for marine work, and the number of 'feathers' on the arrows indicate the strength of the wind by the Beaufort scale: 1, 2, 3 or 4. The speed of the ship was approximately 8 knots.

The insects taken in the north-eastern area, mostly Aphididæ and small Diptera but also lacewing flies and micro-lepidoptera, were 120–150 miles from the nearest land.

There is, on the whole, no apparent difference between the number of insects taken at the mast-head and at heights of 200–400 ft. in the kite nets. Considering the small size of the nets used, the number of insects collected indicates a very large population of 'aerial plankton' drifting across the sea. All were taken in the nets except the Noctuid *Plusia gamma* and one Hemerobiid, which flew on board ('2' at north-east corner of chart), and all except the Noctuid must be regarded as too small and weak in flight to be true migrants. All observed in the collecting tubes (the majority) were alive and active; a few were crushed in handling the nets, especially when wet through fog. They were taken both during the day and night, and some in rain or fog.

Distinct areas can be seen in the chart: richer, poorer or apparently devoid of insect life. The barren areas perhaps represent blocks of air which have moved off the land during the night when convection currents are at a minimum.

It appears likely that the study of insect drift over the sea, in giving definite evidence of the distances (minimum when measured from nearest land) travelled by insects, may be of value in understanding the spread of insect pests over the land, in addition to indicating the infection of Great Britain from the Continent and throwing light on the origin of the insect faunas of islands. It is hoped that with the co-operation of steamship lines across the North Sea and Channel, a regular survey may be inaugurated.

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Feb. 15.

A Comparison of Certain Properties of Timbers from Tropical and North Temperate Regions

EXAMINATION of the results of standard mechanical tests on more than three hundred species of timber reveals a striking difference in the properties of timbers from tropical and north temperate regions respectively. The results were taken from tests carried out in the Timber Mechanics Section of this Laboratory, together with those published by the Forest Research Institute, Dehra Dun, India[1], and the United States Forest Products Laboratories, Madison[2].

Two strength properties of the timbers were considered, namely, the strength in impact bending as measured by the maximum drop of a 50 lb. hammer, and the strength under compression parallel to the grain. When the species-averages of these two properties were plotted separately against specific gravity, it was observed that for both of them the values for tropical and north temperate zone timbers have quite distinct distributions. Although these distributions overlap, it is clear that, for any given specific gravity, tropical timbers are, on the whole, weaker in impact bending though stronger under compression parallel to the grain than north temperate zone timbers.

There appear to be no constant differences in gross anatomical structure between temperate and tropical timbers such as might account for the observed differences in their strength properties, and it would seem that the causes must lie in the composition of the cell walls. A comparative study of thin transverse sections of species from each group indicated that, on the average, the fibres of the temperate zone timbers show a greater affinity for the so-called cellulose-stains (for example, Light Green in a Safranin-Light Green combination), particularly after the sections have been subjected to prolonged boiling in distilled water, whereas the tropical timbers usually show a stronger reaction with so-called lignin reagents (for example, Phloroglucin). Furthermore, a comparison of six English-grown timbers with material of the same or closely related species grown in the tropics revealed a somewhat greater affinity for so-called cellulose stains on the part of the English-grown specimens.

Although the reactions of these microstaining reagents are not closely related to the results of standard chemical analyses of woody tissues, it may be inferred that variations in the concentration of some substance or in the physical condition of the cell walls affect the two strength properties in different directions. It is interesting to note that the positive relation between strength in impact bending and under compression parallel to the grain is an indirect one, since both strength properties are positively related to specific gravity. Mr. E. D. van Rest, of this Laboratory, has demonstrated statistically that the indirect positive relation masks a significant negative relation between the two types of strength.

The investigation so far has been of a preliminary nature and it is hoped to publish the complete results later; the evidence already obtained, however, strongly suggests that the influence of tropical conditions of growth on the composition of wood cell walls is such that, where weight is the primary consideration, timbers of outstanding toughness must be sought in the temperate regions, as they are not likely to be produced under tropical conditions.

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Forest Products Research Laboratory,
Princes Risborough.
Feb. 15.

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[1] Limaye, V. D., *Ind. For. Rec.*, 18 (Part X) (1933).

[2] Markwardt, L. J., and Wilson, T. R. C., *U.S. Dept. Agr.*, *Tech. Bull.*, No. 479 (1935).

Urea as a Hygroscopic Substance

WHILE pure urea shows no tendency to absorb moisture when exposed to air under ordinary conditions, it becomes a remarkably hygroscopic substance if the humidity of the air is at a relatively high level. It is only recently that American chemists from the Bureau of Chemistry and Soils, Washington, D.C., have directed attention to this phenomenon in connexion with the behaviour of urea when present as a constituent of various mixed fertilizers.

Adams and Merz[1] have shown that while pure urea becomes hygroscopic only when the relative humidity of the air is at 72·4 per cent (at 30° C.), mixtures with various salts give rise to products which become hygroscopic when the relative humidity of the air is at a much lower level. They found, for example, that a mixture of equimolecular proportions of urea and ammonium nitrate became hygroscopic at a relative humidity of 18·1 per cent, whereas pure ammonium nitrate itself only becomes hygroscopic at a relative humidity of 59·4 per cent.

While the American investigators[2,3] have been mainly concerned in determining the effect of urea on the hygroscopicity of mixtures with various salts used as fertilizers, no results have been hitherto recorded as regards the maximum amount of water which urea can absorb when exposed to an atmosphere at its maximum hygrometric state. In order to obtain information upon this point, the following experiments were made: A small quantity (0·6 gm.) of pure dry urea in fine powder was spread over the surface of a watch-glass, which was supported over a dish containing 30 c.c. of water. The whole was covered with a beaker so that the connexion with the outer air was confined to a small opening due to the lip of the beaker. The temperature during the experiments averaged 16° C.

The results, which are of a remarkable nature, were as follows:

Time (hours)	Water absorbed (per cent)	Time (hours)	Water absorbed (per cent)
1	4·23	96	111·48
24	31·70	144	145·40
48	49·73	168	166·60
72	77·70	192	176·06

Thus after a period of eight days, after which there was no further increase in weight, urea had absorbed slightly more than one and three-quarter times its own weight of water. At the end of three days, the urea had completely dissolved in the absorbed water, yet the solution continued to absorb considerably more water than occurred up to this time. This is remarkable for a substance that separates from aqueous solution in the anhydrous form. Repetition of the experiment with urea in coarse powder and as crystals gave 174·8 per cent and 173·9 per cent absorption respectively, when equilibrium had been established with the surrounding atmosphere.

It is very remarkable that urea, which is non-hygroscopic until the relative humidity of the air reaches 80 per cent at 15° C. (Adams and Merz), should show such a great avidity for water when placed in a saturated atmosphere. In this connexion the contrast in the behaviour of (*a*) urea, (*b*) urea hydrochloride, and (*c*) urea nitrate is of interest. Equal weights of the three well-dried substances were exposed on watch-glasses on the laboratory bench, and whereas (*a*) and (*c*) showed no increase in weight after exposure for six days, (*b*) absorbed 53·5 per cent of water after only 24 hours exposure. Furthermore, (*c*) showed no increase in weight when exposed for six days in a saturated atmosphere under the conditions of the experiment with urea. Thus we have urea hydrochloride very hygroscopic even at a low relative humidity, urea itself hygroscopic only when the relative humidity is very high, and urea nitrate non-hygroscopic even when exposed to air saturated with water vapour. Can the physical chemist offer any explanation to account for these phenomena?

The subject is one which seems to be well worthy of a more extensive investigation, and this is the chief reason for bringing the foregoing results to the notice of those who may be interested in the matter.

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Dublin.

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[1] Adams and Merz, *Ind. and Eng Chem.*, 21, 305 (1929).

[2] Whittaker, Lundstrom and Skimp, *Ind. and Eng. Chem*, 26, 1307 (1934).

[3] Davis, Scholl and Miller, *Ind. and Eng. Chem*, 27, 69 (1935)

Structure of Agar-Agar

WE now communicate some preliminary results of the investigation on methylated agar prepared from the acetate previously described in NATURE[1]. By the simultaneous deacetylation and methylation of acetylated agar ($[\alpha]_D^{15°} = -32°$ in chloroform; $CH_3CO = 38·5$ per cent), an apparently homogeneous methylated agar was obtained ($[\alpha]_D^{15°} = -78°$ in chloroform; $OCH_3 = 31$ per cent), the methoxyl content of which remained constant despite repeated methylations.

This derivative on hydrolysis yielded a mixture of methylated sugars (yield *c.* 75 per cent), together with an acid. The sugars on conversion into the glycosides yielded a new crystalline trimethyl α-methylgalactoside (yield, *c.* 70 per cent) from which on complete methylation and suitable treatment crystalline tetramethyl *d*-galactopyranose anilide was obtained in excellent yield, indicating the absence of substitution in position 5 of the trimethyl galactose molecule. This sugar gave a crystalline dimethyl galactose phenylosazone indicating substitution in position 2, and oxidation with bromine under conditions favourable to the formation of a γ-lactone yielded a trimethyl galactonolactone of high positive rotation ($[\alpha]_D^{18°} = +150°$ in water), which fell rapidly on standing to an equilibrium value of + 50° in less than 24 hours, this behaviour being characteristic of a δ-galactonolactone. Furthermore, galactoside formation at room temperature regenerated exclusively the galactopyranoside, so that there appears to be no doubt of the fact that position 4 is occupied by a methoxyl residue, and the trimethyl galactose cannot therefore be the 2 : 3 : 6-trimethyl galactose isolated from varianose by Haworth, Raistrick and Stacey[2]. There thus exists the possibility that the methylated sugar in question is 2 : 3 : 4- or 2 : 4 : 6-trimethyl galactopyranose. The former has been previously described [3,4]; but both the properties of the lactone and its derivatives and the results of oxidation with nitric acid indicate that the latter formulation is correct in this case.

In view of these facts therefore, and the strong negative rotations of acetylated and methylated agar, we consider it probable that the 'main carbohydrate portion' of agar-agar consists of β-galactopyranose units linked at positions 1 and 3, an arrangement unique so far in polysaccharide chemistry. From an inspection of models it appears either that the galactopyranose units are present in the form of a six-membered ring, or alternatively as a zigzag chain terminated by residues as yet undetermined. It is not yet possible to form an opinion on the 'fine structure' of the agar macro-molecule, whether for example the supposed sulphuric ester residues exist as cross-linkages, or indeed their approximate location. Further work will also be necessary to decide the constitution and mode of union of the acid portion of the hydrolysed product.

These investigations will be discussed elsewhere.

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[1] Percival and Sim, NATURE, **137**, 997 (1936).

[2] Haworth, Raistrick and Stacey, *Biochem. J.*, **29**, 2068 (1935).

[3] Challinor, Haworth and Hirst, *J. Chem. Soc*, 258 (1931).

[4] Onuki, *Chem. Zentr.*, II, 307 (1933).

The Theory of Dimensions

IN reviewing Dr. F. W. Lanchester's book "The Theory of Dimensions and its Application for Engineers" in NATURE of January 9, I stated with regard to Appendix VI that "in my opinion the author was unwise to include this section in a book the avowed object of which is to help the young engineer". Dr. Lanchester has written to me pointing out that although this was the primary object of writing the book, it is stated in the preface that the author hopes that it "may be found of service to others besides those to whom it is primarily addressed. As a book of reference for workers in the physical laboratory, auxiliary to existing works on the same subject, it may prove of service as conveying its message in a simple and direct manner".

I should be sorry if the book were prejudiced in any way by my reference to what was only the primary object as the avowed object. In an editorial reference to the book in the *Wireless Engineer*, I remarked that "like many another book written avowedly for the young, it will be read with enjoyment and profit by many who are no longer young; in fact, the latter class of reader will be better able to appreciate the vigorous attempts to extirpate dimensional heresy—that is, anything with which the author does not agree".

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Glasgow.

Points from Foregoing Letters

THE effect of substituting deuterium for hydrogen on the intermolecular bonds of oxalic acid has been examined by Dr. J. Monteath Robertson and A. R. Ubbelohde using X-ray methods. A small expansion of the lattice occurs, mainly in the direction of the deuterium bonds, an effect which throws light on the mechanism of the hydrogen bond, and promises to be of value in locating certain types of hydrogen linkage in complex structures.

In order to predict the shape of the curve expressing the energy distribution of the electrons emitted in radioactive transformations, several formulæ have been proposed, based on the theory that (unobservable) neutrinos are simultaneously emitted. Dr. H. O. W. Richardson points out that the equation of Fermi fits low-energy transformations, whilst that of Konopinski-Uhlenbeck applies in the case of high-energy electrons.

Diagrams of the rate of sedimentation of ovalbumin in water solution (buffered at pH 6·0) and in 50 per cent urea solution, are given by Prof. J. W. Williams and Dr. C. C. Watson. The data indicate that, in urea solution, the ovalbumin is dissociated into a product of approximately half the molecular weight in water solution. This dissociation appears to be reversible.

The presence of an absorption band in the region of 2·7 μ in various organic compounds containing O—H groups is discussed by Dr. J. J Fox and Dr. A. E. Martin. A curve showing the infra-red absorption of benzyl alcohol in carbon tetrachloride, showing both the O—H absorption band and the 'association' band is submitted. The authors state that replacement of hydrogen by phenyl groups suppresses intermolecular association.

Dr. J. S. Anderson, N. L. Spoor and Prof. H. V. A. Briscoe report that the rate of interchange between water and hexammine cobaltic chloride containing deuterium is independent of the heaviness of the salt at any given concentration, and for salt of given heaviness varies inversely as the hydrogen ion concentration and inversely as the square root of salt concentration. These facts suggest the explanation (independently reached by F. J. Garrick) that co-ordinated ammonia can undergo an acid dissociation of the type

$$[Co(NH_3)_6]^{3+} \rightleftarrows [Co(NH_3)_5NH_2]^{2+} + H^+.$$

Dr. C. H. Douglas Clark has reviewed methods available for the calculation of the band spectral constants of di-atoms, and has introduced a formula connecting the fundamental vibration frequencies a, b and c of members of a diatomic triad XY, XX and YY, respectively, which belong to 'symmetrical' molecular groups, as follows: $a^3 = 0{\cdot}8bc^2$.

Tropical timbers show on the whole less resistance to impact, though greater strength under compression parallel to the grain, than north temperate zone timbers of the same specific gravity. S. H. Clarke suggests that the differences in strength properties are caused by growth conditions acting through the medium of the cell wall composition.

Prof. E. A. Werner directs attention to the fact that urea, a non-hygroscopic substance under ordinary conditions, can absorb one and three-quarter times its weight of water when exposed to air saturated with moisture. This rather remarkable result for a substance which separates from aqueous solution in an anhydrous form is discussed in connexion with the marked contrast in the behaviour of urea, urea hydrochloride and urea nitrate towards water absorption under similar conditions.

The hydrolysis of completely methylated agar-agar yields as the main product a trimethyl galactose which appears to be 2 : 4 : 6-trimethyl galactose. Dr. E. G. V. Percival, Dr. J. Munro and J. C. Somerville consider it probable therefore that portion of the polysaccharide which is derived from galactose is composed of β-galactopyranose units linked at positions 1 and 3.

Research Items

Malay Magic

THE various classes of the magical dance performed in the Malay Peninsula, notwithstanding innumerable variations in character and underlying principle, present a general uniformity of type, while the associated traditions conform to certain common patterns. Details of the dance and the magical beliefs connected with it in the State of Kelantan studied by Jeanne Cuisinier (*Inst. d'Ethnol. Trav. et Mém.*, 22) were corroborated by the author in Perak, Pahang and Trengannu, as well as in Patani, Siam. In these dances, the spirits, especially the ancestral spirits, are invoked for a variety of purposes, mostly connected with the treatment of disease, especially epidemics. The performers fall into the possessive trance characteristic of this type of dance. In order to understand the character of the dances, it was found necessary to study the whole nexus of magical belief, on which they rest. Observations of the unbalanced mentality characteristic of those subject to supernatural influence were recorded, though without any attempt at psychological diagnosis, owing to the author's lack of medical training. The essential conditions in the 'make up' of the medicine-man belief in Malaya are: revelation, heredity and secrecy; while symbolism plays a large part in magical practice. Revelation may be either voluntary and induced, or involuntary. The voluntary revelation is sought by going into retreat, fasting, prayer, etc. Involuntary revelation is most commonly found in members of families in which sorcery is hereditary, going back to remote ancestors—a matter in which it links up with totemism. Secrecy is maintained, even when incantations have to be uttered aloud, by speaking in a peculiar and incomprehensible voice or by omitting part of the charm, until it is reduced to perhaps no more than one or two words.

A Peruvian Manuscript

IN 1908 Richard Pietschmann, director of the Gottingen Library, when attending as German delegate the xvth International Congress of Orientalists at Copenhagen, discovered in the Royal Library the manuscript, hitherto unnoted, of a chronicle written by a Peruvian, Don Felipe Guaman Pomo de Ayala. This manuscript, consisting of 1,174 pages quarto, it was Pietschmann's intention to publish with commentary; but he died before his work was complete. It is now published in facsimile by the Institut d'Ethnologie of Paris (*Trav. et Mém.*, 23). The chronicle, which is in corrupt Spanish interspersed with many Quichua words, was written in the early years of the seventeenth century—it embodies a letter by the author's father, which is dated 1587. Guaman claimed to be a descendant of the rulers of the powerful northern State, which long resisted the power of Cuzco. Whatever his descent, his circumstances were abject, a condition which he attributes to his devotion to the cause of his fellow countrymen. About one quarter of the manuscript is devoted to a description of the country and its inhabitants before the conquest by Francisco Pizarro, in which the historic period is preceded by four legendary epochs, beginning with that of the divine, or semi-divine Viracocha, followed by those of the authochthones or "giants", the men of the desert, and the warriors. Historical and biographical sketches and an account of the Inca constitution and social orders follow. The story of the acts of the conquistadores and the rule of the viceroys, Indian risings and sufferings, is rounded off by an idealistic sketch of Indian Christendom, and the Indian calendar of agricultural operations. The remarkable and most valuable feature of the manuscript, overshadowing the text, is the very large number of full page drawings, illustrating the narrative, which convey much information throwing light on Indian appearance, vocabulary, dress, custom and belief.

Birds of the South Orkney Islands

THERE are no truly resident birds in the South Orkney Islands, and very few are to be seen in winter, although one or two sheathbills, thanks to their omnivorous diet, find it possible to live through the winter months upon the refuse of human habitations in the neighbourhood of the meteorological station, as they did about the winter quarters of the *Scotia* expedition. In the "Discovery Reports" (12, 349; 1936) R. A. B. Ardley gives an account, illustrated by eight photographic reproductions, of the members of this oceanic bird fauna, supplementing the description of plumage and breeding given by Dr. Eagle Clarke in his account of the *Scotia* material, and adding records of the presence of several species from islands in the group not investigated by the Scottish National Antarctic Expedition.

Marine Research at Millport

THE annual report of the Scottish Marine Biological Association for 1935–1936 shows that a large amount of good work has been accomplished. Research on herring by Drs. Orr, Marshall and Nicholls is progressing, but, as is usually the case with trying to rear herring from artificial fertilizations, the young only lived about three weeks. Various growth stages, however, were obtained from the plankton, and both larval and metamorphosed fish studied. From hatching to metamorphosis they grew rapidly and fairly regularly, increasing in length 2–3 mm. weekly. Metamorphosis began at a little over 40 mm. At hatching, a single larva weighed about a fifth of a milligram, at a length of 20 mm., reached when the fish was about five weeks old, it weighed 1¼ mgm.: and at 40 mm. when about twelve weeks old, 35 mgm. Estimations of fat and protein were made, the fat content increasing rapidly as the fish approached metamorphosis. Vertical hauls for plankton were taken whenever the young herring were caught. The food eaten by the fish corresponded in size with the size of the fish, as is usually found. The smallest were eating small *Pseudocalanus*, *Microcalanis*, etc., and the larger were eating adult *Pseudocalanus*, *Centropages*, *Temora*, etc. Dr. Marshall is continuing her work on the biology of the small copepods and Dr. Orr his work on the composition of the food of fish by making analyses of the chemical composition of numerous species of crustaceans, molluscs, echinoderms, worms, etc.; Dr. Nicholls his study of the copepod genera *Leptosyllis* and *Paramesochra*, and Dr. A. C. Stephen has paid special attention to the spat-falls of *Tellina tenuis*, continuous observations having been made since the autumn of 1926. Dr. D. C. Gibb has carried out an ecological survey of marine algæ of an area of coast at the north end of Cumbrae.

Boll-worms of Cotton in South Gujerat

MESSRS. B. P. DESHPANDE and N. T. Nadkarny have examined methods for controlling the two species of spotted boll-worms, *Earias faba* and *E. insulana* in south Gujerat, Bombay Presidency. The results of their investigations have been published as Scientific Monograph No. 10 (1936) of the Imperial Council of Agricultural Research, India. Various methods of controlling the larvæ of these two moths are discussed, and the results of experiments recorded. It appears that no advantage is likely to be derived from biological methods of control since all the known parasites of *Earias* are found to be present locally. A study of the most important parasite, *Microbracon lefroyi*, also showed that it was not possible to increase the incidence of this species by artificial methods. Advantage has been taken of the fact that the larvæ of *Earias* get their supply of food, between the two cotton-growing seasons, from the fresh shoots sprouting from standing plants of cotton or their stumps, and from stray malvaceous weeds. The authors claim that it will be possible to prevent the carry over of the *Earias* from one season to another by the destruction of cotton plants and weeds at the appropriate time and by withholding the cultivation of 'bhindi' during that period since it is also used as a food plant by the larvæ. A clean-up scheme has, therefore, been started in order to determine the efficacy of the proposed measures, and is still in progress. The scheme, it may be added, is being financed by the Indian Central Cotton Committee.

Hæmostatic Action of Ayapin and Ayapanin

P. K. BOSE and B. B. Sarkar, writing from the University College of Science, Calcutta, report preliminary observations on the hæmostatic action of two substances isolated from the leaves of *Eupatorium ayapana* Vent., a decoction of which has long been a popular remedy against various kinds of hæmorrhage in Hindu medicine. The substances are termed ayapanin, identical with 7-methoxycoumarin, and ayapin, identical with 6 : 7-methylenedioxycoumarin; in each case similar hæmostatic effects were found with the synthetic and natural compound; no effects on heart, respiration or blood pressure were observed. The coagulation time of rabbits' blood was diminished when traces of finely divided ayapanin or ayapin were added *in vitro*, when saturated solutions of the compounds in physiological saline were injected subcutaneously, and when the substances were given by mouth, the effect in the latter instance lasting approximately one hour. The closely related substances coumarin, 7-hydroxycoumarin and sodium *p*-methoxycinnamate had no effect on clotting time.

Hot-water Treatment of Bulbs

HOT-water treatment is now the standard method for dealing with Narcissus bulbs infected by eelworm, but although it has given a considerable measure of success, its efficiency has not reached the standard which was to be expected on theoretical grounds, or could be usually obtained with small-scale trials. The question has been under investigation during the past few years by Messrs. Staniland and Barber of Seale-Hayne Agricultural College, and the results of their inquiry have been issued by the Ministry of Agriculture as Bulletin 105, "The Efficiency of Baths used for the Hot-Water Treatment of Narcissus Bulbs" (H.M. Stationery Office, price 1*s*.). Unsatisfactory results could be traced to a number of different causes, but the factor which seems to have led most frequently to the survival of eelworm during treatment is the use of sacks to hold the bulbs, for penetration and circulation of the water within a sack is slow, and the majority of the bulbs fail to reach the requisite temperature under these conditions. Practical suggestions are given for improvements, such as the use of rigid containers in place of sacks and the introduction of a circulatory system where rectangular tanks are employed. Attention is also directed to the fact that inaccurate thermometers or incorrect steam pressures are frequently the cause of apparent inefficiency of the method. It is hoped that the practical recommendations provided in the bulletin will result in the hot-water treatment giving even greater satisfaction than it has in the past, for there is no doubt that such treatment has been the saving of the bulb industry.

Transfusion of Quartzite

DORIS L. REYNOLDS has described (*Min. Mag.*, 24, 367; 1936) in great detail the most convincing example which has yet been recorded of the transformation of quartzite into rocks that are indistinguishable from common igneous types. The hornblendite of three small composite intrusions in Colonsay is thickly sprinkled with blocks of white quartzite, most of which exhibit various stages of replacement by micropegmatite, syenite and appinite. Completely replaced xenoliths are represented by felspathic patches and schlieren. Finally, the process of transfusion gave rise to syntectic magma, of syenitic and appinitic composition, now represented by veins which emerge from metasomatized quartzite. By study of successive replacement zones and chemical analyses, it is found that differential migration into the quartzite of various magmatic constituents took place. The paper is followed by one in which A. Holmes describes the augite-rimmed xenoliths of transfused quartz which occur in many of the alkali basic and ultrabasic lavas of south-west Uganda (*Min. Mag.*, 24, 408; 1936). Transfusion begins with the development of intergranular channels of glass and continues until only isolated relics of quartz remain. Microchemical analyses (by F. Hecht) of three samples of glass from pure quartzite or vein-quartz show that the glass has the composition of silica-rich potassic obsidian. The constituents which migrated into the quartz were mainly those of alumina, potash and water. Comparison is made with the Colonsay phenomena, and in both papers references to many comparable but less well-authenticated examples are given.

Effect of a Magnetic Field on Adsorption

THE effect of a magnetic field on the rate of crystallization and some physical properties of substances is well-known. S. S. Bhatnagar, P. L. Kapur, and A. N. Kapur have recently reported the results of the effect of a magnetic field on the extent of adsorption (*Phil. Mag.*, (7), 23, 256; 1937) The systems studied were the adsorption of potassium permanganate, potassium dichromate, potassium ferrocyanide, and ferric chloride on sugar charcoal, and that of potassium permanganate and potassium ferrocyanide on barium sulphate. In the case of potassium permanganate, potassium dichromate, and potassium ferrocyanide, there was a small but definite increase in the adsorption by sugar charcoal in the magnetic field. With ferric chloride on sugar charcoal there was a decrease, whilst for adsorption of potassium permanganate and potassium ferrocyanide on barium sulphate there was no effect. The authors discuss the effects with sugar charcoal in the light of the view put forward by a number of workers, but particularly by Burrage, that active charcoal is covered with a film of active oxide which cannot be removed even by prolonged heating in a vacuum. The filtrate from the potassium permanganate experiments with charcoal was found to contain a suspension of manganese dioxide, the presence of which may be ascribed to the interaction of the permanganate with the active oxide. Similarly, chromic ions were found in the filtrate from the dichromate adsorptions. In the adsorption of ferric chloride it is probable that the active oxide forms iron carbonyl and is thus removed. Potassium ferrocyanide was found to be partly oxidized to the ferricyanide during the process of adsorption. These facts favour the existence of an active oxide of carbon, and a chemical theory of adsorption. The authors go on to show that the effect of a magnetic field on the adsorption which was found by experiment is in agreement with the rule put forward by them in 1929, that a reaction would be accelerated, retarded, or remain unaffected according as whether the sum of the molecular susceptibilities of the products is greater than, less than, or equal to the sum of the molecular susceptibilities of the initial substances.

Protein Films

IN *Science* of January 15, Drs. Irving Langmuir and V. J. Schaefer of Schenectady collaborate with Dr. Dorothy M. Wrinch of Oxford in a very interesting study of films of protein transferred to solids from water surfaces. In order to facilitate optical study of these films, they were deposited on a polished chromium-plated surface. The method of deposition was similar to that already worked out by Langmuir and Miss Blodgett, dipping the slide into water covered by a film; and two different types of protein film were obtained according to whether the slide was dipped into water already covered by a film, or dipped first into clean water, a film then put on, and the protein afterwards spread before withdrawing the plate. The two types of film probably differ in that one is applied the opposite way up to the other, and their outer layers are hydrophilic or slightly hydrophobic according to the manner in which they have been applied. Many successive layers can be built up, and any even number of layers of protein can be inserted between layers of stearate molecules, thus giving a close approach to possible structures for the surfaces of living cells. Studies of the penetration of liquids into these films have been commenced, and it appears that hydrocarbon liquids can easily penetrate into the holes (of molecular dimensions) left by the removal of the stearic acid molecules from a mixed barium stearate – stearic acid film. The water-retaining properties of these films depend on the orientation of the protein molecules.

Encounters between Pluto and the Neptunian System

MR. RAYMOND A. LYTTLETON, who has already contributed an interesting paper (*Mon. Not. Roy. Astro. Soc.*, 96, 566) on the origin of the solar system, prompted by Russell's severe criticism of the theory of Jeans, has a paper on this subject in the same journal (97, 2; Dec. 1936). The high eccentricity of Pluto, exceeding 0·25, implies that it may be nearer to the sun at times than Neptune, and for this reason encounters of Pluto have an important bearing on certain problems relating to the past history, as well as to the future, of the solar system. A rigid mathematical investigation leads to several interesting conclusions, amongst which the following may be noticed. Encounters between Pluto and the Neptunian system may have occurred in the past and may occur again. It is even possible that the orbit of Pluto may come within that of Saturn, and an encounter with Saturn could eject Pluto from the solar system, but as such an encounter is most improbable, the matter is of little interest. The action of Neptune, on the other hand, may cause great alterations in the orbit of Pluto, though it cannot eject it. The considerations in the paper lead to the conclusion that Pluto may originally have been a direct satellite of Neptune, and that an encounter which gave it an existence as an independent planet also reversed the general direction of motion of Triton. It is admitted, however, that this explanation of the retrograde motion of a true satellite is rather speculative.

The Gas Impregnated Cable

DURING the last few years, the development of cables suitable for high-tension currents has proceeded rapidly. In a paper read to the Institution of Electrical Engineers on March 10 by A. W. Arman, various types of these cables are described. The earliest type consisted of a copper core for carrying the current, separated by impregnated paper from a co-axial hollow copper cylinder which formed the return path. It was found that a limiting factor in this type of cable was due to the vacuous spaces (voids) which formed in the dielectric and caused ionization to occur at high electric pressures. The next type of cable was the oil-filled cable, in which low viscosity oil was introduced under moderate pressure from the hollow conductor and filled up the voids, thus avoiding ionization. It has been successfully applied to 132 kV. systems. The main drawbacks are that the cable and the associated apparatus are expensive. Another and more recent method of preventing the formation of voids in three-core cables is to use an impregnated dielectric of the usual type for the three cores and encase them in a thin flexible sheath. The cable is then drawn into a steel pipe, and the latter is filled with gas at high pressure. As the compound in the cable expands and contracts as the current it carries varies, the sheath 'breathes' to accommodate the varying volume and the high external pressure prevents the formation of voids. This type of cable is called the 'pressure cable'. The 'gas impregnated' cable, which the author describes, is intended to produce a 132 kV. cable based on sound principles. The insulation consists merely of high-pressure gas and dry paper. It is unaffected by heat cycles and so the dielectric can be run at a higher temperature than in other cables. Nitrogen at a pressure of 200 lb. per sq. in. was first employed but later on it was found that carbon dioxide gave a better performance.

Fuel Research

THE report of the Fuel Research Board* for the year ending March 31, 1935, differs from its predecessors in the emphasis given to problems arising from the preparation of coal for sale. This follows naturally on the changes taking place at British collieries, where increasing proportions of coal are obtained by mechanical methods, and are also subjected to various cleaning processes. Again, consumers become more reluctant to pay a premium for size. Apart from the open fire, there are few uses for large lump coal. It is the modern tendency to employ automatic mechanical methods of firing boilers, furnaces and producers, and for such uses coal must be small in size and uniformly graded. Formerly, small coal was often deliberately rejected by the use of forks for loading underground. To-day collieries are increasingly finding it necessary to break lump coal to supply the demand for small fuel, and this has brought into prominence many chemical and physical problems previously unknown. The best methods of breaking to preserve sizes and avoid the production of dust have been investigated. Coals broken and graded suitably at the colliery were found to suffer little further degradation in normal transport to the consumer.

The development of schemes for coal marketing has disclosed the need and opportunity to reduce the number of sizes of marketable coal. The Board is collaborating with the Midland Institute of Mining Engineers and the South and West Yorkshire Coal Owners in an attempt to do this. It was found, in this area, that no less than 106 different size grades of coal below 3 in. size were being marketed; and yet seventy per cent of the coal fell within 15 size grades. With slight adjustment of the size mesh, these 15 grades would cover ninety-five per cent of the tonnage. It is difficult to see any technical reason for marketing coal in so many sizes, and there must be advantage in selling to reduce the number.

Considerable attention has been given to the question of mixing or blending coal from different seams. It is often forgotten that the supply of good coking coal is limited. The problem of blending coals, which though unsuitable alone, give good coke when carbonized after blending with others, is receiving increasing attention.

The supply of active carbon suitable for respirators and gas masks is obviously a very important matter. Some materials on carbonization yield an active residue, but it is known that less active carbon can be activated by gasification with steam. The report records that it has been found possible at the Fuel Research Station to carbonize selected coals, of the durain type, and treat the coke with steam at a high temperature to obtain an active carbon nearly as good as the best obtainable and at a considerably lower cost. The importance of this observation needs no emphasis. The cost of active carbon is a limiting factor in processes for recovery of vapours.

Systematic work on the hydrogenation of coal and tar oils has been continued. Attempts to prepare first-class lubricants from coal tar oils have not been successful—possibly because the molecular structure of these hydrocarbons is unsuitable. It now appears that the most hopeful line is to synthesize hydrocarbons from carbon monoxide and hydrogen, and experiments in this direction have been initiated.

The report touches most aspects of national fuel problems and may be commended to those who seek a conspectus of the current position. H. J. H.

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* Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March, 1936; with Report of the Director of Fuel Research. Pp. x+217. (London. H.M. Stationery Office, 1936.) 4s. net.

Twenty-fifth Anniversary of Laue's Diagrams

IT has been a pleasure to men of science in Great Britain to see the growing interest taken and progress made in science in India. The rapidly increasing list of original investigators, and the importance of many of their papers, contributed not only to their own institutions but also to learned societies in Great Britain, are a source of sincere gratification. Forty years ago (1896) I was present at the opening of the completed Indian Institute in Oxford, by the ex-Viceroy, Lord Dufferin, accompanied by Mr. Asquith (afterwards Prime Minister and Lord Oxford), who made a remarkable speech in welcoming our Indian co-subjects of the British Crown to partake of the best of our educational facilities. The fraternal lead then given has borne such wonderful fruit that India itself is now providing all that is needful, without any longer feeling the necessity of expatriating its sons to Europe for their higher education.

These facts are remarkably illustrated at the moment by the appearance of a special number of *Current Science*, a monthly journal devoted to science published at Bangalore, with the aid of thirty natives of India. This special number is devoted entirely to marking the twenty-fifth anniversary of the discovery by Laue of the diffraction of X-rays by crystals, and to the review of the years of intense research into crystal structure which have followed. It contains a dozen articles by the leaders in this work, the first being by Prof. Max von Laue himself, with his portrait as frontispiece. Succeeding articles are by Sir William and Prof. W. L. Bragg, Prof. P. P. Ewald, Prof. M. Siegbahn, Prof. A. Sommerfeld, Dr. L. Pauling, Prof. C. G. Darwin, Prof. H. Mark, Prof. J. A. Prins, Dr. S. K. Allison, Prof. H. A. Kramers, and Dr. S. Rama Swamy; an introduction is also contributed by Sir C. V. Raman. The mere fact that such a remarkable jubilee 'Festschrift', celebrating Laue's epoch-making discovery, should be organized by our Indian scientific brethren, speaks volumes for the advance of science in India.

There is every reason why I should feel specially warm towards this interesting brochure. For, twenty-five years ago (1912) I was the guest for a week of Prof. P. von Groth, the veteran crystallographer, at Munich almost immediately after the discovery made in the adjacent laboratory, and was shown the first negatives taken by Laue and Sommerfeld's assistants, Friedrich and Knipping, of copper sulphate and zinc blende. I was, indeed, by Dr. Laue's kindness, provided with duplicates of these and of the negatives of the apparatus used, and lantern slides from them were shown in a Friday evening discourse given by me at the Royal Institution shortly after my return to England. It was only in the preceding year, 1911, that my treatise on "Crystallography and Practical Crystal Measurement" was published by Messrs. Macmillan and Co. Ltd., representing the state of crystallography at the moment of Laue's discovery; and the twenty-five years of X-ray analyses of crystals which have followed, have confirmed and substantiated the contents of that work, which was expanded to two volumes in 1922, including a full account of X-ray work. No structure has been revealed by X-rays which does not conform to one or other of the 230 types of possible crystal structure clearly defined by the independently corroborating work of Schoenflies, Fedorow, and Barlow. The relative dimensions of the crystal unit cells, containing one or more molecules of the substance, which were given by me for the members of the several series of isomorphous substances which I had investigated in sufficient detail, were not only confirmed but also—and this was the greatest achievement of X-ray analysis—converted into absolute measure, in Ångstrom units.

Moreover, the generality of the law that the whole of the crystallographical and physical constants of the members of isomorphous series showed a regular progression with the atomic number of the interchangeable elements forming the series, was at this moment being somewhat criticized (but only as to the generality of its application), on account of an apparent important exception in the case of the haloid salts of the alkali metals. I had been careful to stipulate that the law only applied so long as the type of structure (one of the possible 230 types) remained rigorously the same throughout the whole series. X-ray analysis at once cleared up the mystery, for it indicated that there was a change of type between rubidium and cæsium chlorides; for while potassium and rubidium chlorides resemble sodium chloride in belonging to the face-centred cubic type of space-lattice, cæsium chloride belongs to the body-centred type, so that the law is totally inapplicable, the members of the series not being all strictly comparable with each other.

Many other instances of the assistance afforded by X-ray analysis to the clearing up of doubtful cases could be quoted. It should further be pointed out that in obtaining the results, which led to the law of progression, extreme refinement in angular and other fine measurement was essential, and the use of only the most perfect small crystals, grown with the greatest care free from either mechanical or thermal disturbance, such, in fact, that those crystal-angles which were of equal value with respect to the symmetry would not vary more than two minutes of arc. The so-called 'mosaic' crystals, which appear to give better reflection results in X-ray analysis, owing to the use of the rotating integrating method of using the X-ray spectrometer, are merely imperfect hastily grown crystals, which I would have ruthlessly rejected as being useless for the purpose in view.

It is thus obvious that it is the combination of the most refined of the older (pre-1912) crystallographic methods, with the newer X-ray analysis, that will give us the fullest knowledge of crystal phenomena and structure, one being complementary to the other, and the two together giving us the truth in full. The fascination of X-ray analysis has caused almost a cessation of crystal-angle and optical and other physical constants measurement, and one must hope that now so many structures have been unravelled by X-rays, of both inorganic and organic substances, more attention will be paid to goniometrical, optical, elastic, magnetic and electrical measurements with crystals. The purely structural X-ray work will then occupy its proper important position in the complete research.

In his personal article, Prof. von Laue throws a little further light on the circumstances in which in February 1912 his discovery was made. One evening in that month, P. P. Ewald went to him for advice as Privatdozent as to a difficulty which had arisen in preparing his (Ewald's) thesis for the Munich doctorate, on a subject which he had undertaken at the instance of Prof. Sommerfeld. During the discussion, the fact became prominent that a crystal is essentially a three-dimensioned lattice, and the question suddenly dawned in Laue's mind, as to what would happen if such a lattice were approached by a radiation of which the wave-length was short compared with the lattice-constant (unit cell dimension). The analogy of light waves and gratings suggested that diffraction must ensue. Remembering that Wien and Sommerfeld had only recently found Rontgen rays to possess a wave-length of the order 10^{-9}cm., and that the lattice constant must be somewhere about 10^{-8}cm., Laue came at once to the inspiring conclusion that the conditions for diffraction were highly favourable. Just at that moment entered W. Friedrich, Sommerfeld's assistant, and hearing the conclusion of the discussion, at once expressed a wish to put the matter to an immediate experimental test. Now Laue was obviously accepting Sommerfeld's view that the X-rays were a wave-motion, electromagnetic waves of excessively short wave-length, and not corpuscular, as was at that time supposed by Prof. W. H. (now Sir William) Bragg.

Friedrich obtained the help of a specially able experimental colleague, P. Knipping, and the apparatus was soon rigged up for passing a beam of X-rays through a crystal, and interposing a photographic plate in the path of any transmitted or diffracted rays. But unfortunately the crystal chosen, from being so easy to obtain well developed, was copper sulphate, which crystallises in the triclinic system of lowest symmetry. The effect on the photographic plate after development, although very promising, was confused, owing to the lack of symmetry. But on substituting a crystal of zinc blende, as advised by Prof. von Groth who lent the crystal, which is of cubic symmetry, the now well-known excellent pattern of cubically symmetrically arranged spots was obtained. After repeated confirmations and discussions of the meaning of the results, Prof. Sommerfeld was able to present the epoch-making paper of Laue, Friedrich and Knipping, on June 8, 1912, to the Munich Academy.

It would appear that the subsequent entrance of Sir William Bragg, and of his son W. L. Bragg, into the field was due to an attempt to discover whether Laue's effects were caused by the X-rays themselves (as corpuscular) or by electromagnetic wave-radiation associated with corpuscular rays. W. L. Bragg, then a student at Cambridge, was soon able to show that the zinc blende pattern of spots was due to the symmetry of the crystal, and not to the character of an X-ray spectrum; and he followed it up by determining the actual arrangement of the atoms in the still simpler cubic crystals of potassium and sodium chlorides. Sir William Bragg then found that the reflected X-rays, when analysed by an ionization spectrometer, consisted both of a general (continuous) spectrum and of rays of characteristic wave-lengths (Barkla's K and L rays), and that indeed Laue's explanation of the effect as a diffraction of electromagnetic waves must be accepted.

Moseley's brilliant measurement of the wave-lengths or frequencies of the characteristic X-radiations of the various elements immediately followed, and their relations were shown to offer a complete explanation of the Periodic Law of the elements; and the sequence number (atomic number) of the element suddenly developed a wonderful and unanticipated meaning, in expressing the positive charge on the nucleus of the atom, and the number of the surrounding planetary negative electrons. By a combination of the use of the Laue photographic method and the Bragg ionization spectrometer, together with the Debye powder method when good crystals are not available, and the rotating methods more lately introduced, all the important subsequent progress in unravelling the internal structure of crystals, not only of very simple substances but also of many complicated ones, including organic substances containing a large number of atoms in the molecule, has been achieved.

In their article Sir William and Prof. Bragg scarcely do justice to the really great progress which had been made in crystallography previous to 1912. They state that "at that time crystallography was so much a science apart, and played so little part in physics and chemistry, that the idea of a crystal pattern had never presented itself to the majority of scientists". If this were really the case it was the fault of workers in other scientific fields; for a small band of devoted crystallographers were insistently, in season and out of season, directing attention to the subject, and to its immense importance to physicists and chemists.

My own "Crystallography and Practical Crystal Measurement" set it forth clearly in the year 1911. The Laue discovery came at the most psychologically appropriate moment, to clinch the facts, to arouse universal interest in the subject, to reveal the 230 types of crystal structure already specified and defined by the genius of Barlow in Great Britain and simultaneously and independently by Schoenflies and Fedorow on the Continent, as real entities and not merely the natural deductions from all the accumulated experimental work on crystals, and to add that to crystallographic knowledge which rendered it assured and incontrovertible.

Sufficient will have been said to indicate the value of this Laue special number of *Current science*, and it is with all sincerity that we congratulate our Indian scientific colleagues in so admirable a production. In the preface, it is foreshadowed that other special numbers are being prepared, on canal rays, genetics, and on animal development, and among the articles in the first mentioned we are promised contributions by Sir J. J. Thomson, Dr. F. W. Aston, and Dr. J. D. Cockcroft. We shall look forward to these further special numbers with all the greater interest, from the pleasure which the perusal of the present issue commemorating the initiation of Laue diagrams has afforded us. A. E. H. TUTTON.

The Chemical Research Institute, Warsaw

THE Chemical Research Institute of Warsaw (Chemiczny Instytut Badawczy w Warszawie) was founded by Prof. Ignacy Mościcki, who is now President of Poland. Firm in his conviction that the independence of Poland would be restored and that the country would then need the services of such an institute, Prof. Mościcki took the first steps to realize this aim during the Great War, in 1916. He founded the Metan Company in Lwów, the object of which was to carry out chemical research for industry. The shareholders of the Metan Company voluntarily resigned from their material interests in this organization in 1922, and transformed it into the Chemical Research Institute Association, which pays out no dividends, in accordance with its by-laws, and expends all revenue and earnings on the prosecution of new research work. Having thus arisen without the help of the Government or of industry, the Institute was in 1925 transferred to Warsaw, where it has since 1927 occupied its own commodious, modern building, erected thanks to the donations of Poles, both at home and abroad. The building was officially declared open in 1928 by Prof. Mościcki, who had in the meantime been elected President of the Republic. The Institute contains a Department of Inorganic Industry, a Coal Research Department, an Analytical Department, an Alcohol Research Department, a Department of Rubber Synthesis, etc.

The personnel of the Institute at present numbers 161. The director is Prof. Kazimierz Kling, one of the co-founders of the Metan Company. The other members of the executive board are: Prof. Wojciech Świętosławski (at present Minister of Education), Prof. Jan Czochralski, Prof. Wacław Leśniański, Mr. Jerzy Pfanhauser, Miss Halina Starczewska and Mr. Zdzisław Zaleski. The chairman of the Board of Curators is Mr. Eugeniusz Kwiatkowski, the present vice-premier and Minister of Finance.

The Institute is engaged in tracing out the lines of the technical progress of the chemical industry of Poland, with special reference to the possibilities of extending the use of and improving Polish raw materials on one hand and of substituting imported raw materials by home-produced ones on the other.

The research work conducted by the Institute is chiefly concerned with petroleum, natural gas, sulphuric acid, aluminium, the analysis and standardization of coal, metallurgical coke and rubber. The twentieth anniversary of the foundation of the Institute was celebrated in the Warsaw Polytechnic on December 9, the president of the Republic of Poland being present.

University Events

BIRMINGHAM.—At the recent annual meeting of the Court of Governors, the pro-chancellor, Mr. Walter Barrow, announced a bequest of £5,000 by the late Lady Scott-Moncrieff, who was one of the original students of Mason College. The late Prof. R. F. C. Leith, emeritus professor of pathology, bequeathed a sum of £15,000 to the Department of Pathology and £15,000 to be used for scholarships to promote the study of pathology and bacteriology. The late emeritus Prof. Lewis and Sir John Robertson also bequeathed their libraries to the new Medical School. An anonymous donor has given £2,000 to enable an investigation to be carried out under the personal direction of Prof. W. N. Haworth with the view of producing an improved form of insulin for use in the treatment of diabetes, and two research fellows are already at work on the subject.

Part of the new Hills Chemistry Block is already in occupation, and it is expected that the whole will be ready for use in the summer term. A further sum of £6,050 has been received in donations towards the equipment of the building.

The fund for the Medical School, which received £50,000 as its share of the proceeds of the Hospitals Centre general appeal, has received further donations to the amount of £12,000, including £10,000 from Sir Charles Hyde for a Chamberlain Memorial Museum, £500 from the Dean of the Faculty of Medicine (Dr. Stanley Barnes) and £101 from the Guild of Graduates. It is hoped that the school will be ready for occupation in 1938, but a considerable increase in available funds is required.

The Department of Industrial Hygiene and Medicine has received donations to the amount of nearly £1,670 from various industrial firms and has been actively engaged, evidently meeting a widely felt want. Arrangements have been completed for the establishment, under the joint auspices of the Birmingham United Hospital and the University, of consultation centres in industrial hygiene and medicine at the Queen's and General Hospitals.

As a consequence of the death of Prof. J. S. Haldane, the Mining Research Laboratory is being transferred to the Imperial College of Science and Technology, London, on April 1.

CAMBRIDGE.—R. G. Hawtrey, formerly of Trinity College, has been appointed to the Alfred Marshall lectureship for the year 1937–38.

The following grants from the Worts Fund have been made: £25 to J. K. S. St. Joseph, towards the expenses of a visit to certain Continental museums for the purpose of studying the palæontological collections there; £40 to W. V. Lewis, towards the expenses of an expedition to East Iceland to study the geography and natural history of this region; £50 to J. W. Wright, towards the expenses of an expedition to Ellesmere Land to study the geology and the birds of that country; £10 to Miss W. Lamb, towards the expenses of a visit to Turkey for archæological purposes; £40 to J. R. B. Stewart, towards the expenses of a visit to Cyprus for archæological purposes; £40 to Miss M. Fearnsides, towards the expenses of a journey across Scandinavia for the purpose of studying the ecology of certain areas; £40 to H. E. Hinton, towards the expenses of a journey to Lake Titicaca, Peru, to study the aquatic insects there; £12 to Miss E. M. McIndoe, towards the expenses of a visit to the Stazione Zoologica at Naples for the purpose of studying the acclimatization of animals to temperature; £40 to J. L. Mason, towards the expenses of a visit to Algeria to study the fauna of the hot springs there.

The General Board recommends that the following additional teaching offices be established on October 1: a university demonstratorship in the Department of Geology; a part-time University lectureship in the faculty of Mathematics; two University lectureships in the Department of Chemistry (temporarily replacing two demonstratorships); a university lectureship in the Department of Physics, replacing an assistant directorship of research; two University demonstratorships in the Department of Botany (replacing a University lectureship); a university lectureship in the Department of Parasitology. The General Board recommends that a readership in plant morphology be established for one tenure only, and that it be authorized to appoint Dr. H. H. Thomas to this post from October 1.

OXFORD.—H. M. Sinclair, University College, has been elected to the Radcliffe travelling fellowship in medicine for 1937.

H. S. Brodribb, University College, and Miss J. Wright, Somerville College, have been granted the degree of M.D.

SHEFFIELD.—J. A. Wragg has been appointed assistant to Dr. W. A. Timperley, research fellow in the Department of Physiology.

R. Ibbotson has resigned his post of demonstrator in non-ferrous metallurgy.

Science News a Century Ago

Karl Himly (1772–1837)

MARCH 22 marks the centenary of the death of the eminent German eye specialist Karl Gustav Himly, to whom scientific nomenclature is indebted for the words 'ophthalmology' and 'mydriatics'. He was born on April 30, 1772, at Brunswick, where he attended the medico-chirurgical college from 1790 until 1792, and then continued his medical education at Göttingen under Richter. In 1795 he was appointed professor at the College at Brunswick, where he remained until 1801, when he was elected to the chair of medicine at Jena. Two years later he was made director of the Academy Hospital at Göttingen, where he inaugurated a course of theoretical and practical instruction in ophthalmology and gained a well-merited reputation both as lecturer and as operator, so that in 1816 he was made an honorary professor of the University of Pisa.

Himly's importance in the history of ophthalmology lies not only in his systematic use of mydriatics, but also in his having founded the first journal devoted to his speciality. In conjunction with Johann A. Schmidt, between 1802 and 1806, he brought out three volumes of a journal entitled *Ophthalmologische Bibliothek*, which was continued by himself alone under the name of *Bibliothek für Ophthalmologie* in the period 1816–19 during which two volumes appeared. He was also the author of a text-book on practical therapeutics (1807), and from 1809 until 1814 was co-editor with Hufeland of the *Journal für praktische Heilkunde*. His posthumous work on diseases and malformations of the human eye and their treatment, with additions by his son, E. A. W. Himly, appeared in 1843.

The Surface of the North American Continent

ON March 22, 1837, the Geological Society listened to a paper by Mr. Roy entitled "On the supposed ancient state of the North American continent, especially on the extent of an inland sea, by which a great portion of its surface is conjectured to have been covered". The author, who had been employed on extensive surveys in the Lake District of North America, found on drawing sections for professional purposes that the country everywhere exhibited successive ridges which encircled the lakes; and upon comparing sections to the north of Lake Ontario with others to the south, that the ridges exactly corresponded in elevation. The highest of these ridges is 996 ft. above sea-level or 762 ft. above that of Lake Ontario. Connecting this elevation with the physical features of the valleys of the Mississippi and Missouri, Mr. Roy supposed that the whole area from the Rocky Mountains to just below Quebec down to the Gulf of Mexico formed one vast inland sea 960,000 square miles in area.

British Railways

IN a notice in the *Athenæum* of March 25, 1837, of F. Whishaw's "Analysis of Railways", the following quotation from the book was given: "The number of proposed Railways, including Diversions, Extensions and Branches in England and Wales, for which plans have been lodged in the Private Bill Office in the present Session, is seventy-five, of which only forty-eight are under the consideration of Parliament; these amount in length to 1233 miles, and are estimated at the sum of £19,352,726 or £15,625 per mile. The whole length of tunnelling is twenty-five miles and the number of bridges, exclusive of viaducts and culverts, 2,825 or nearly two and a third per mile. The weight of iron required for the rails is 193,500 [illegible]d of stone for the blocks 2,670,000 tons. The [illegible]of the land is upwards of 1,500 acres; and of [illegible] for the chairs 130 acres. These Railways, if [illegible]rried into execution, would employ at least 5,000 men and 1,500 horses for three years for the earthworks alone."

Dumont D'Urville's Voyage in the *Astrolabe*

IN the *Nautical Magazine* of 1837, it is stated: "The king of the French has by a decision of the 26th March approved of a proposal for a new voyage round the world, the conducting of which is to be confided to M. Dumont D'Urville. Two vessels will be employed in this expedition; the *Astrolabe*, commanded by Captain D'Urville and the *Zelee* by Captain Jacquinot. Leaving Toulon about the middle of September, they will proceed due south to the polar sea to pursue Weddel's track, who it will be remembered reached the latitude of 74° 15′. The vessels will penetrate as far south as possible and return to the Magellan Straits. In the spring of 1838 they will leave Valparaiso for the Polynesian Archipelago, and in June will be at Vavoo, where M. D'Urville will finish the work left undone by the *Astrolabe* in 1827. They would then visit in turn Banks Island, the Solomon Islands, the Dutch Settlements in Aroo and Key Islands, Amboina, New Holland, Tasmania, New Zealand, Borneo, Sumatra and return home by the Cape. Commenting on the announcement the *Nautical Magazine* said: "We look on this as a most interesting expedition and one that will yield important results. We cannot, however, but regret to see so extensive and important an island as New Guinea, left year after year, in its original neglected condition and with but little addition to its coasts since the time of Dampier."

Jean Sebastian Cesar Dumont D'Urville, who was born on May 23, 1790, had circumnavigated the globe under Captain Duperrey (1756–1865) in the *Coquille* in 1822–25. Promoted to captain, in this ship, renamed the *Astrolabe*, he left Toulon in April 1826 and proceeded to the Pacific, returning in March 1829. His third voyage began on September 7, 1837. After his return home he began the publication of the results of his voyage and had completed the second volume, when on May 8, 1842, with his wife and son, he was killed in a railway accident on the line from Paris to Versailles.

Societies and Academies

Dublin

Royal Dublin Society, February 23

J. BREEN, G. M. KENNEDY, J. KEANE and T. J. NOLAN: Chemical constituents of lichens found in Ireland—*Lecanora sordida*. *Lecanora sordida* was found to contain atranorin, chloratanorin, roccellic acid, and, in minor amount, a product similar to thiophanic acid and containing fourteen per cent chlorine. Roccellic acid, $C_{17}H_{32}O_4$, was established by synthesis as α methyl α' dodecyl succinic acid.

J. W. PARKES, W. S. HAMILTON, E. J. SHEEHY, P. A. MURPHY, G. SHERRARD, M. J. GORMAN, D. MELLON and T. O'CONNELL: A symposium on fertilizers.

Paris

Academy of Sciences, February 15 (*C.R.*, 204, 457–532).

JACQUES HADAMARD: Observations on notes by Destouches and by Appert. These authors have arrived independently at the same results. The present note raises a question of nomenclature.

ARMAND DE GRAMONT and DANIEL BERETZKI: The determination of the surface of a piezo-electric plate as a function of its frequency.

MARCEL LINSMAN: Real left arcs and curves of the fourth order.

L. KANTOROVITCH and E. LIVENSON: Some theorems concerning the theory of projective ensembles.

JEAN DELSARTE: A generalization of Taylor's formula.

LAURENCE C. YOUNG: A generalization of the idea of variation of the *p*th power in the sense of Wiener, and on the convergence of Fourier's series.

JOSEPH BARTA: The fundamental vibration of a membrane.

F. GRUSON: The representation of the ground in aerodynamic trials of vehicles.

SVETOPOLK PIVKO: A rational definition of the quality of supporting helices.

LÉOPOLD ESCANDE and GEORGES SABATHE: Remarks on the calibration of hydrometric velocity meters by displacement in a confined medium. Study of the effects of the transversal dimensions of the channel in which the instrument is moved.

DIMITRY PANOFF and PAUL RIZ: An apparatus for recording the deformations and vibrations of an aerial screw during flight.

MLLE. PAULETTE FÉVRIER: The uncertainty relations of Heisenberg and logic.

JEAN ROUBAUD-VALETTE: The relations between the polarisation of a photon and the spins of constituent corpuscles.

J. J. PLACINTEANU: The properties of the electronic photon.

R. BERNARD: The influence of pressure on the function of stimulation of bands of the ionized nitrogen molecule.

MARCUS BRUTZCUS: The intrinsic values of the linkages (C—O) and (C—H) in hydrocarbons.

RENÉ DELAPLACE: The vapour pressure of saturated and unsaturated hydrocarbons at low temperatures. The method is based on previous work on the conductivity of gases under low pressures. Vapour pressures of nine gases are given over a temperature range of from − 120° C. to − 196° C.

PIERRE VALLET: A tetrahydrate of zinc sulphate.

MARCEL PATRY: The action of alcohol on aqueous solutions of potassium tellurate.

JEAN MARIE MERCIER: A double bromide of iron and ammonium. The double bromide $NH_4FeBr_3.6H_2O$ was isolated: it gave a characteristic X-ray diagram, differing from those of its constituents.

PANOS GRAMMATICAKIS: The action of mixed organo-magnesium compounds on the phenylhydrazones of ketones. A new mode of action of mixed organo-magnesium compounds.

MAURICE MARIE JANOT and THÉODOR TOMESCO: The hydrogenation of some glucosides by active nickel. Details of the hydrogenation in the presence of Raney nickel of eleven glucosides.

GEORGES DARZENS: A new contribution to the synthesis of glycerol. The starting point is ethoxyacetic ester, and the series of reactions proposed give good yields throughout.

MAXENCE MEYER: Two new ethylenic aldehydes.

RENÉ PERRIN: Non-metallic meteorites can give no information on the nature of stony rocks.

MLLE. FERNANDE FLOUS: The evolutive characters of the cone of the Abietineæ.

MME. H. HOCQUETTE: Considerations on the Anabœniolum of the guinea pig and the rabbit.

MARIUS CHADEFAUD: Intranuclear cyclosis in the basidium of certain Hymenomycetes.

ALBERT BERTHELOT and MLLE. GERMAINE AMOUREUX: The sensibility of some aseptic seedlings to some carcinogenic substances.

CONSTANTIN DAWYDOFF: The supposed metamerization of the larvæ of the Hexacorallæ.

CHARLES LAPICQUE: The coloration of retinal images and chromatism in general.

RENÉ SALGUES: The elements of normal phosphatæmia in amphibians and reptiles.

ALEXANDRE GOURÉVITCH: The distribution of flavin in the tissues of mammals, in relation with their residual respiration in the presence of cyanides.

MME. VÉRA DANTCHAKOFF: The effects produced by a dose of 0·05 mgm. of testerone on the histogenesis of the female in the guinea pig.

Moscow

Academy of Sciences (*C.R.*, 4, No. 8; 1936).

S. SOBOLEV: A direct method for the solution of polyharmonic equations.

P. L. KALANTAROV: Fundamental values in the study of electromagnetic phenomena.

I. A. KHVOSTIKOV and A. N. SEVČENKO: Application of the polarimetric method to the study of the upper layers of the atmosphere.

A. E. FAVORSKIJ and P. A. TIKHOMOLOV: The problem of mutual influence of radicals on their migration. (2) Dehydration of tertiary phenylhexylcarbinol.

F. M. ŠEMIAKIN and A. I. LAZAREVA: Investigation of the reaction in which magnesium hydroxide is produced in gelatine.

A. V. FROST, D. M. RUDKOVSKIJ and E. K. SEREBRJAKOVA: Reversible catalytic conversion of *n*-butylenes into isobutylene.

B. L. ISAČENKO and N. N. MALČEVSKAJA: Biogenic spontaneous heating of peat.

I. A. GOLJANIZKIJ and K. A. BRJUŠKOVA: Vitamin C (*l*-ascorbic acid) in tea.

V. GLIVENKO: Mendelian algebra.

L. V. POLEŽAEV: Determination of initial stages in the development of extremities in amphibians.

Sydney

Royal Society of New South Wales, October 7.

M. D. GARRETTY: Some notes on the physiography of the Lake George region, with special reference to the origin of Lake George. Following the work of Taylor in 1907, Lake George, New South Wales, has long been held to have had its origin in recent normal faulting along its western shore. The streams to the east were betrunked, deprived by the fault scarp of their connexion with the Murrumbidgee System, and impounded to form the lake. In the present paper the pertinent physiography of the region is described, and the tectonic origin of the western escarpment questioned. An alternative explanation for the lake based on normal stream development and gentle warping is submitted.

November 4.

D. P. MELLOR and H. MULHALL: The el[illegible] potential of thin films of zinc on platinum. [illegible] attempt is made to determine the minimum thick[illegible] of zinc when plated on platinum to produce the sam[illegible] electrode potential as the massive metal. Experimental results indicate that it is impracticable to answer this question definitely.

R. LEMBERG and R. A. WYNDHAM: Some observations on the occurrence of bile pigment hæmochromogens in Nature and on their formation from hæmatin and hæmoglobin. Observations are dealt with on the formation of bile pigment hæmochromogens by autoxidation of hæmatin in presence of nitrogenous compounds and reducing substances, on their occurrence in Nature, and on the removal of iron from them. Verdohæmochromogens are found in catalase preparations from horse liver, in preparations of cytochrome *c* from yeast and (in traces) in extracts from blood of horse and pig. Verdohæmochromogens have to be considered as intermediate products of physiological bile pigment formation. Cytochrome a_3 is probably a biliviolin hæmochromogen.

ALMA G. CULEY and GERMAINE A. JOPLIN: Evidence of magmatic stoping in a dyke at Hartley, N.S.W. Field evidence is based on the facts (1) that the dolerite of the dyke follows prominent joint planes in the granite which it intrudes, (2) that inclusions of granite occur in the dolerite, and (3) that a small tongue or vein of dolerite surrounds a block of granite which is incompletely rifted off. This is probably the only recorded example of stoping in a small dyke. It is of interest, as emplacement of small intrusions is usually attributed to the lateral displacement of wall-rock.

A. Bolliger: Chemistry of Jaffe's reaction for creatinine. Jaffe's reaction, that is, the interaction of creatinine and picric acid in an alkaline medium, was studied. If this reaction is executed in alcohol, an orange-red crystalline compound can be obtained which consists of one molecule of creatinine, one of picric acid, and two of sodium. This substance may be responsible for the red colour obtained in Jaffe's reaction. The chemical constitution of this compound has been considered to be that of an organic molecular complex between sodium picrate and 'sodium creatinine'. On treatment with acid it furnishes a red isomer of creatinine picrate.

E. H. Booth: Some observations of zonal discordance in diurnal magnetic variations. Sets of readings have been (and are being) taken at the station "Hills and Dales", Mittagong, a district where the magnetic variations from point to point are small, for comparison with concurrent readings at the magnetic station of the Victorian Government at Toolangi. "Hills and Dales" is on the side of the magnetic mass of the "Gib", a syenite hill rising 800 feet above the surrounding country; so that it is both on a magnetized body and on a prominence. The results, after full correction, show that though there is generally fair co-ordination with Toolangi readings, the "Hills and Dales" readings are often swinging in a direction opposite to those of the Victorian station, and sometimes show magnetic fluctuations twice as great as those occurring at the same time at Toolangi even when atmospheric conditions are not abnormal. The conclusion is drawn that it is not safe to accept the variations at an established magnetic station to apply as corrections to a survey over magnetic prominences.

M. D. Garretty: Geological notes on the country between the Yass and Shoalhaven Rivers. The regional geology of about 1,600 square miles of country on the southern tablelands of New South Wales is briefly described. Probable representatives of the Upper Ordovician, Lower and Upper Silurian, Middle and Upper Devonian, Kamilaroi and Tertiary systems occur. Granites of epi-Silurian and epi-Devonian age cover considerable areas, and associated with them e examples of differentiated and hybrid rocks. T ral structure of the region is discussed.

Vienna

of Sciences, December 3.

d A. Hofmann: Substitution of
y (LiAl) in magnesium silicates.
: Local current theory of metal
tal potentials in oxidizing solutions.
W. Wirth and B. Zaunbauer:
phosphine and its suitability for
s of water.
. Giacomello: Crystal structure
ic choleic acid.
ndamentals of the kinetics of
ns.
: Upper Silurian graptolites of
Alps).
ich: Mineralization of the Nock

Red fluorescence band of di-
he red fluorescence, observed in
rradiation with radium. is shown
of samarium.

Leonore Brecher: Coloration of the chrysalides of the cabbage white butterfly, *Pieris brassicæ* L., and of the vanessæ, *Vanessa io* L. and *V. urticæ* L. The effect of severing various nerves on the adaptation of the colour of the chrysalis to its surroundings is studied.

Martha Geiringer: Adrenalin as a synergist of thyroxin in the metamorphosis of toads (*Bufo vulgaris* Laur.).

Josef Glaser: Innervation of one or two legs grafted on *Dixippus morosus* Br. and Redt.

December 10.

Erwin Kamptner: Coccolites of the south-west coast of Istria.

F. Bukatsch: Influence of salts on the production of light by bacteria. Addition of salts increases the production of light, not by increasing the number of cells, but by increasing the light production of the individual cell.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, March 22

Victoria Institute, at 4.30.—Rev. T. E. R. Phillips: "Some Recent Views of the Universe and their Reactions on present-day Thought".

Engineers' Study Group, at 7.30—(at 23, Grosvenor Place, S.W.1).—Prof. R. A. Fisher, F.R.S.: "Family Allowances".*

Tuesday, March 23

House of Industry League, at 8.15—(Essex Hall, Essex Street, Strand, W.C.1).—Dr. V. Cofman: 'The Scientist's Task in the New Order".*

Wednesday, March 24

Institution of Chemical Engineers, at 6—(at the Chemical Society, Burlington House, W.1).—Dr. D. Hunter: "Prevention of Disease in Industry".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Scientific Officers (radio and line communication), Junior Scientific Officers (radio and line communication) and Assistants (Grades II and III—physics or electrical engineering) at the Bawdsey Research Station, Bawdsey Manor, Woodbridge, Suffolk—The Superintendent, Bawdsey Research Station, Bawdsey Manor, Woodbridge, Suffolk (March 22).

Junior Assistant Entomologist (sugar beet pests) in the School of Agriculture, Cambridge—The Secretary (March 30).

Principal of the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield (March 31).

Lecturer in Mathematics in the Sir John Cass Technical Institute, Jewry Street, Aldgate, E C.3—The Principal (April 3).

Head of the Mechanical Engineering Department in the Rutherford Technical College—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne (April 7).

Lecturer in Charge of the Department of Botany in University College, Leicester—The Registrar (April 10)

Principal and Headmaster of the Gravesend Technical Institute and Junior Technical School—W. A. Clench, Bank Chambers, Windmill Street, Gravesend (April 10).

Lecturer in Geology in the University of Birmingham—The Secretary (April 10).

Curator of the Nottingham Natural History Museum—The Town Clerk, The Guildhall, Nottingham (April 12).

Assistant Keepers of Zoology and Mineralogy in the British Museum (National History), S.W.7—The Secretary (May 1).

Assistant Chemist for the Colne Valley Water Company—The Chief Engineer, Colne Valley Water Co., Aldenham Road, Watford, Herts

Official Publications Received

Great Britain and Ireland

National Health Insurance. Insurance Committees Regulations, 1937. Draft dated February 5, 1937, of Regulations proposed to be made by the Minister of Health under the National Health Insurance Act, 1936. Pp. 29. (London: H.M. Stationery Office.) 8*d*. net. [62

Physical Training and Recreation: Memorandum explaining the Government's Proposals for the Development and Extension of the Facilities Available. (Cmd. 5364.) Pp 12. (London: H.M. Stationery Office.) 2*d*. net [62

Department of Scientific and Industrial Research. Report for the Year 1935–36. (Cmd 5350.) Pp. iv+195. (London: H.M. Stationery Office.) 3*s*. net. [82

The Hastings Natural History Society. Report and Balance Sheet for the Session 1935–36, Council, and List of Members. Pp. 15. (St. Leonards: Hon. Sec., 23 Charles Road.) [82

War Office. Report of the Air Survey Committee. No. 2, 1935. Pp. 183+12 plates. (London: H.M Stationery Office.) 4*s*. net. [92

Imperial Institute. Annual Report, 1936. Pp. 64. (London: Imperial Institute.) [112

Empire Cotton Growing Corporation The Work of the Experiment Stations, Season 1935–36; an Explanatory Review. By W. Nowell. Pp. 21. (London: Empire Cotton Growing Corporation.) 1*s*. 6*d*. [112

Carnegie Trust for the Universities of Scotland. Thirty-fifth Annual Report (for the Year 1935–36) submitted by the Executive Committee to the Trustees on 10th February 1937. Pp. iv+84. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [152

A Programme of Priorities. Pp. 12. (Oxford. Next Five Years' Group.) 3*d*. [152

University of Leeds: Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livesey Professor (John W. Cobb) for the Session 1935–36. Pp. 12. (Leeds: The University.) [152

Poverty and Over-Taxation: The Way Out. By the Most Hon. the Marquis of Tavistock. Pp. 56. (Coventry: *Prosperity* Office.) 6*d*. [182

University of Leeds. Thirty-second Report, 1935–36. Pp. 168. (Leeds: The University.) [182

Our Money. By Dr. W. H. Coates. Pp. 24. (London: Institute of Chemistry.) [222

International Tin Research and Development Council. Bulletin No. 5: Le fer-blanc et les conserves en France. Pp. 96. (London: International Tin Research and Development Council.) Free. [222

Department of Scientific and Industrial Research. Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea-Water. Sixteenth (Interim) Report of the Committee of the Institution of Civil Engineers. Edited by A. H. Naylor and H. J. Grose. Pp. iv+22. (London H.M. Stationery Office.) 6*d*. net. [222

S.P. Tract No. 48: Linguistic Self-Criticism, by Otto Jespersen; Terminology in Physics, by C. G. Darwin; The Irregularities of English, by Sir W. A. Craigie. Pp. 267–292. (Oxford: Clarendon Press; London: Oxford University Press.) 2*s*. 6*d* net. [222

University of Leeds. Publications and Abstracts of Theses by Members of the University during Session 1935–36. Pp. 29. (Leeds: The University.) [222

Development Commission. Twenty-sixth Report of the Development Commissioners being for the Year ended the 31st March 1936 Pp. 184. (London: H.M. Stationery Office.) 3*s*. net. [222

Proceedings of the Royal Society of Edinburgh, Session 1936–1937. Vol. 57, Part 1, No. 5: Microphthalmia and other Eye-defects throughout Fourteen Generations of Albino Rats. By Dr. A. M. Hain Pp. 64–77. 1*s*. 6*d*. Vol. 57, Part 1, No. 6: Ovarian Rhythm in *Drosophila*. By Dr. H. P. Donald and Rowena Lamy. Pp. 78–96. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [222

The Imperial Forestry Institute. University of Oxford. Twelfth Annual Report, 1935–36, and Prospectus. Pp 38. (Oxford. Imperial Forestry Institute.) [222

Other Countries

Field Museum of Natural History. Geological Series, Vol 6, No 16: A New Genus, Barylambda, for *Titanoides faberi*, Paleocene Amblypod. By Bryan Patterson. Pp. 229-231. (Chicago: Field Museum of Natural History.) 10 cents. [122

Indian Lac Research Institute. Bulletin No. 24: The Use of *Schleichera trijuga* (Kusum) in Lac Cultivation By Dorothy Norris. Pp. 5. (Namkum: Indian Lac Research Institute.) 9 pies. [122

Imperial Council of Agricultural Research, India. A Handbook of Statistics for use in Plant Breeding and Agricultural Problems. By Dr. F. J. T. Shaw. Pp. iv+182 (Delhi: Manager of Publications.) 4.6 rupees; 7*s*. 3*d*. [152

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Science, Industry and Society

ALTHOUGH the recent annual report of the Department of Scientific and Industrial Research, an article on which appears elsewhere in this issue, contains much evidence of the increasing readiness of industry in Great Britain to make use of scientific method and scientific knowledge, particularly in the progress of the Research Association movement, the Advisory Council does not regard the position of the Research Associations as a whole as satisfactory, and points out that adequate advantage is not yet being taken of the grant offered. This warning has since been reiterated from the industrial side in respect of the woollen industry by Mr. D. R. H. Wilkins, a leading Huddersfield worsted manufacturer, in proposing a vote of thanks to Dr. J. B. Speakman for a lecture to the Huddersfield Textile Society on "The Chemist and the Mill" on February 22. Mr. Wilkins referred strongly to the short-sightedness of those textile firms which justified reluctance to finance research by arguing either that they were doing well enough without it or that they are not doing well enough to afford it.

The woollen industry is one of the two specially mentioned by the Advisory Council as having failed to provide the initial subscription to their Research Associations to qualify for the substantial block grant offered by the Department. The reluctance of this industry to finance research on an adequate scale is the more surprising in view of the admirable work that is already being carried out by its Research Association at Torridon with limited resources, and of the important fundamental discoveries on the chemical and physical structure of wool which have been made at the neighbouring University of Leeds in recent years. Such reluctance, however, gives further point to the emphasis which the Advisory Council lays on organizing the conduct of research so as to promote contact with industry.

From the point of view of industry, the report urges, research is only a means to an end—the application of scientific knowledge to all the stages of production, and the development of new processes. The application and development of scientific ideas in industry depend upon a complete understanding of the way in which industry can make use of science and scientific method, and this can only be achieved if the problem of co-operation is studied by the man of science as well as by the industrialist. The differences of experience, training and outlook between men of scientific education and many others engaged in productive industry are not always considered by those who are anxious to secure the potential benefits which science, wisely used, can bring to the community. The scientific worker has to meet the industrialist half way, and an important task of the Department of Scientific and Industrial Research is to assist the organization of such contact.

This question of co-operation, in one or other of its aspects, is probably the most important confronting industry and science to-day. It is not merely a matter of promoting contact between industry and science in such a way as to stimulate research in industries where it is at present comparatively neglected. The problem of promoting the application of science varies from industry to industry, partly by reason of the nature of the industry, partly by reason of its traditions and of the extent to which it has engaged the services of men of scientific training in its direction and its productive effort. The first step is, however, that of getting the industrialist to state his problems to the man of science, and to determine the order of priority, in terms of their economic importance, of the objectives of particular proposals for research.

The contribution which science can make to the solution of industrial problems depends on persevering effort on the part of industry and close co-operation between the industry and science. In this sphere, the staff of a research association can often make an invaluable contribution through their knowledge alike of the day-to-day problems of the industry and of science.

The statement of the problems concerned is important if the best method of attack is to be selected, because for industrial purposes to-day that may involve consideration not merely in terms of a particular science but also of a combination of sciences. Moreover, it may even involve consideration and attack from the point of view of several industries, if the fullest resources are to be utilized and the best results obtained. This, as the Advisory Council points out, is probably the most significant development in the industrial outlook in Great Britain in recent years.

The last five years have witnessed the fruition of the policy adopted by several large industrial undertakings of setting well-balanced teams of research workers including chemists, physicists, engineers, biologists or entomologists, and others to solve a particular problem or to develop a new product. To this method of attack are due the steady improvement in the efficiency of electric lamps, the position Great Britain has won in high-definition television, the commercial development of the conversion of coal into oil by hydrogenation, the growth of the plastics industry, etc. Great Britain has never been lacking in men of genius whose inventive capacity can give birth to the ideas which bring about industrial advances. What is new in the country is the way in which industry has taken up these new ideas, and brought them to the stage of industrial development by team work in which all the departments comprising a great business have worked side by side in the practical attainment of an objective.

For economic reasons, as well as because of the high degree of specialization which the advance of knowledge has made inevitable in scientific fields, the future no longer lies with industries that are content to make advances at the call of the brilliant investigator. Co-operation, team work and an extensive organization are essential for success. Further, the exploration of the borderland of different sciences which is facilitated and stimulated by such team work has proved, as so often happens in the history of science, provocative of new ideas and fundamental advances in knowledge. For this reason we need not fear that team work in research, if wisely organized and directed, need stifle individuality or cramp initiative or creative thought, as has been suggested in some quarters. Such dangers undoubtedly exist, but can easily be avoided by prudent management. Moreover, there is yet a third aspect of co-operation to which attention is directed, not merely by the report of the Department of Scientific and Industrial Research, but also by the recent appeal on behalf of the University of Oxford.

Among the examples of co-operative research to which the Advisory Council directs particular attention are the developments in building research and the formation of consultative groups in food investigation. The new Fire Testing Station which has been opened at Elstree represents the outcome of co-operation between the Building Research Station and the Fire Offices' Committee and indirectly the British Standards Institution, while similarly the Heating Laboratory which has been erected at the Building Research Station represents the outcome of substantial contributions from industry through the Institution of Heating and Ventilating Engineers. Again, the consultative groups which are being established by the Food Investigation Board are intended to assist in establishing a community of interest in the increase of scientific and technical knowledge through the whole range of industries concerned, whether production, transport, storage, marketing and retail distribution. The first of these groups has been established for the shipping industry and has proved highly successful, greatly facilitating discussions between the staff of the Department and representatives of the shipping companies on the many problems connected with the carriage of foodstuffs overseas and also arrangements for full-scale trials of modifications in existing practice.

It would be easy, however, to multiply examples of the way in which co-ordination of the research activities of different industries is required in the attack on problems of common interest, or of the way in which only by some measures of co-operative research between different industries or Departments of State can effective attack be made on problems of general national welfare and interest. What is, however, now emerging is the desirability of co-ordi n even wider field if the l ped from available resource

This factor a pertinence in this connexion to the r appeal on behalf of the University of Oxford for £500,000 for each of two research funds. Advances in scientific knowledge make ever more onerous the task of schools of science, medicine and social studies in keeping abreast of the needs of an age of rapid material and technical development, and in making adequate provision for advanced studies and post-graduate research. Moreover, the very advances in natural sciences, with the concomitant calls for funds for erecting new laboratories or extending existing ones, equipping and staffing them, and for improving the facilities for research in the various science departments including the provision of research posts, only strengthen the claims for further funds for the better organization and extension of research in the humane subjects, particularly provision for the study of human society and allied subjects such as anthropology.

What is clear is that we have reached a stage when it is imperative to take stock of the nation's resources and facilities for research, both academic and industrial. To neglect or starve research is to invite national peril, but the danger of unbalanced development in certain fields while others remain scarcely explored is too great to be ignored. Some means of securing a better distribution of the national effort in research is indeed long overdue, and such distribution must take due account of all research activities and facilities, whether by the Departments of State, at the universities or within industry. To such a national stocktaking the Department of Scientific and Industrial Research might well make a decisive and indispensable contribution. Few organizations are in a better position to encourage the prosecution within industry itself of intensive research in the applied and physical sciences, with all the important reactions which such research continually has on the technique and outlook of the underlying sciences themselves. The relations between academic and industrial research in the physical sciences at the present time, the extent to which progress depends on team work, independent of whether the investigation is prosecuted within the university or within industry, the inspiration and assistance which academic and industrial research in these fields are continually bringing to one another, give fundamental research in the physical sciences special claims upon the support of industry, apart from the rapidity with which discoveries in this field are applied to industrial purposes. If the main burden of research in such fields were accepted by industrial resources, it should be possible to redistribute research facilities at the universities so as to endow much more liberally that research in the social sciences which is so urgently needed if we are to attain an understanding of the problems of society, its organization and adaptation to the forces playing upon it to-day, whether within industry or outside it. Without such understanding there is dire peril that the riches with which scientific knowledge could endow us even now may never be enjoyed.

Urgent as is this problem, it is not one to be solved in a few months or perhaps even a few years. A wide vision and a generous spirit are demanded of all who seek to co-ordinate research resources and endowments in any such way, and if we are to attain to wise direction of research it will come first through the bringing together of many authorities concerned, in much the same way as the Food Investigation Board has brought together the scattered interests concerned in its problems in the consultative groups to which we have referred. To restrain research in a narrow or partisan spirit is to endanger its finest quality and inspiration. Neither to natural science nor to the science of civilization can money be wisely grudged, and the distribution between the two can only be determined safely by minds inspired by the same vision of what may be achieved by skilled workers, governed only by the truth that makes them free, and in their turn the guardians of the intellectual integrity and freedom that have prompted famous donations to learning in the past.

No degree of co-operation, no excellence of team work will avail us if such direction does aught to impair the power of the university to promote and maintain true liberty of thought, which to-day is so seriously threatened in many quarters. It is only when, in that sense, the university not merely inspires the progress of civilization but also defends it, that we can expect free play for the creative thought upon which progress everywhere depends, alike in the study of the urgent practical problems of government and social life, human and international relations and in the fundamental problems continually brought before the scientific worker by industry.

Mme. Curie's Swan Song

Radioactivité
Par Madame Pierre Curie. Pp. iii +564 +26 plates. (Paris: Hermann et Cie., 1935.) 150 francs.

THE fundamental new property of radioactivity, discovered by M. Henri Becquerel in 1896 in the course of a re-examination of the fluorescence of uranium salts, a subject in which both his father and his grandfather before him had been pioneers, was in itself a remarkable example of scientific genius running in families. It was followed two years later by the discovery of radium and other new naturally radioactive elements, a million-fold more active than uranium, by Mme. Curie and her husband, which has made her one of the most famous women of the age, if not of all time. She died in July 1934, in the same year as, though happily not before, her daughter, Mme. Joliot-Curie, and son-in-law, M. Joliot, had made another fundamental step forward by the discovery of artificial radioactivity, the more notable as until then the aloofness of radioactivity from all external influences and the impossibility either of altering it in the natural radio-elements or imitating it in the inactive elements had been easily its most outstanding characteristic.

Under bombardment by suitable high-speed atomic projectiles many, if not most, of the common inactive elements can be made to give an evanescent radioactivity. This had often been tried before, without success, and the advance was entirely due to the almost incredible delicacy of modern single-atom methods coupled with the power of the valve to magnify these infinitesimal effects almost without limit. But since for this purpose, though the original discovery was made with the natural α-rays of polonium, artificially generated projectiles serve, they again may be multiplied by suitable electric generators almost without limit. So that already the monopoly of radium in its main practical use in therapy is threatened; radio-sodium obtained by bombarding common salt with heavy hydrogen atoms, which has a half-period of 15·5 hours, has already been prepared comparable in activity to the naturally radioactive elements, and the price of radium has in consequence notably diminished.

Thus Mme. Curie died just as her daughter and son-in-law, in turn, had broken through the barrier which guards the future, and this handing on of the torch of discovery from father to son and from mother to daughter, which it would be difficult to parallel in the history of science, is peculiarly appropriate in the science that first showed that even the chemical elements are not immune from the processes of birth and death.

At the time of her death, Mme. Curie had just finished a new book on radioactivity, and this now appears posthumously after having been prepared for the press by her daughter and son-in-law—a little tardily, perhaps, as the date 1935 appears on the title-page. It is in one volume, about half the length of her much-esteemed "Traité de Radioactivité" of 1910, and is expressly intended for the student rather than the specialist, covering the lecture courses she had given at the Sorbonne. Part 1, occupying about one fourth the whole, deals with ionization of gases, cathode-, X- and positive rays, and it is not until Chapter vii that radioactivity is commenced. The disadvantages of this are, in my view, very serious. For the student is taken in detail through, for example, all the work subsequent to the Great War on isotopes by the positive-ray method and a great number of other topics inspired by and often arising directly out of the progress of radioactivity before the War, before any mention even is made of the parent subject. To make matters worse, when he does arrive at the second part, he is plunged into all the details of radioactive *families*, the formulæ governing the accumulation of radioactive matter, the isotopic constitution of the radio-elements, without any preliminary account of atomic disintegration, the evolution of the chemistry of the radio-elements and the idea of isotopes, or, indeed, any general conspectus of what radioactivity is, except what he already knows from popular hearsay or the study of earlier works.

Chacun à son goût. The beginner to-day has little enough time or breath for what is never going to be the subject of an examination question. He gets here in five hundred pages a careful and clear description of a many-sided subject, copiously illustrated with a large number of striking radiographs both of the earlier and later single-atom methods of examining these new radiations. Rarely can those to whom the task of writing such books usually falls claim to be as intimately versed in the subject. It is a monument to the indefatigability of modern scientists, to whom nothing is too trivial for elaboration, nothing so infinitesimal that it cannot be magnified into investigability. But from another point of view it is also a tombstone of what was once a living subject, erected as a guide to the budding licentiate to satisfy the examination system. It sacrifices historical to logical order and the convenience of treating each section as it arises comprehensively so that it need not be reverted to. It is somewhat disconcerting to find that a subject so new and upsetting has already arrived at the stage of being just one more burden on an overloaded curriculum, all the more so as it is one in which the general principles only are essential, and these belong to the fundamentals of all physical science. It is the ideas, their evolution and the form in which they first appear to the human consciousness that it is most important to preserve; the rest is technics.

If we go back forty years to when Mme. Curie began her work, though chemists at least had a clear idea of the difference between atoms and molecules, the very existence of such energy as will keep her radium alight undimmed for centuries after she has gone was not even suspected, transmutation was universally shunned as an ancient chimera, prominently connected with fraud, and the chemical elements in all seriousness were regarded as homogeneous. It may be convenient to derive everything from the theories that grow up afterwards concerning the constitution of the atom, whatever these may happen at the moment to be, but these are the consequences of new knowledge, whereas it is the origins which should have the first attention of the would-be discoverer. Admittedly it is more difficult to convey to the student the general idea of fog, uncertainty and incomplete knowledge out of which discoveries take their rise. The modern theory has it all so pat and glib, though the truth is stranger than fiction.

If in the space of a lifetime the history of discovery can be so completely inverted or forgotten, one wonders sometimes whether there is any truth at all in what passes for the history of more remote events. It is fortunate that in this field the subject has entered on a new lease of life with the discovery of artificial radioactivity, and that Mme. Curie's last book may prove to be not merely the end of an epoch but also the beginning of a new one, so felicitously begun by her own daughter. *La reine est morte. Vive la reine!*

FREDERICK SODDY.

Earthquakes

Earthquakes
By N. H. Heck. Pp. xi+222. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1936.) 16*s*. net.

ON the concluding page, the author gives the titles of some text-books on general seismology that have been published in the United States, England and Germany. As the last of them dates from 1923, there is clearly room for a new book in which the more recent advances in our knowledge are described. The author is the chief of the Division of Terrestrial Magnetism and Seismology of the United States Coast and Geodectic Survey, and he is therefore in constant touch with the important work that is being carried on in the United States and especially in the State of California.

As the book is designed for the general reader in the United States, the examples and illustrations of the various phenomena are naturally drawn from the earthquakes in that country, especially from such great earthquakes as those of New Madrid in 1811 and 1812, the Owens Valley in 1872, Alaska in 1899, and California in 1906. While this, to a certain extent, increases the usefulness of the book for the European student of seismology, in another sense it somewhat narrows its scope, for, even in these great earthquakes, certain phenomena were inconspicuous, such as the seismic seawaves and the long trains of after-shocks that are connected with the earthquakes of other lands. These subjects are referred to indeed, but too briefly to be of much service.

With these exceptions, the ground is well and carefully covered, the phenomena are clearly described and most of the illustrations are excellent. Among the chapters of greatest interest are those on the causes of earthquakes, including what are known in the United States as 'trigger forces'—a term that it is to be hoped will never become current in Great Britain—on earthquake study with instruments, with good descriptions and illustrations of recently made seismographs, on earthquake records and their interpretation, the location of earthquake epicentres and foci, and on regional investigations in the United States, a chapter that occupies nearly one fifth of the book.

Two other chapters are welcome innovations in the usual text-book course. In that headed "Descriptions of Great Earthquakes", are given brief accounts of seventeen disastrous shocks since

1755, accounts that in most cases furnish the main facts, though omitting the remarkable seiches of the Lisbon earthquake of 1755 that were observed in the lakes of Scandinavia and the north of Scotland. Again, the last chapter contains a brief summary of the "History of Seismology", beginning with the work of John Michell—a most useful feature. In a new edition, the names of seven workers that are wrongly spelled should be corrected. C. D.

A Colour Code for Biology

Code universel des couleurs
Par E. Séguy. (Encyclopédie pratique du naturaliste, Vol. 30.) Pp. lxviii+55 plates. (Paris: Paul Lechevalier, 1936.) 60 francs.

WE have many times collected flowers and animals for our scientific friends. They have always been insistent that we should note their colours. For this purpose we have lately used a colour chart sold by a well-known philatelic shop, but, in resulting publications, we have observed that our colour terms are seldom accepted. Now a French entomologist presents us with a seriously thought out colour-code, founded on the three basic colours, blue, red and yellow, which, when mixed as on a rotating disk, may be made to yield all the colours of the spectrum.

This code covers 48 plates with 15 tints on each, numbered 1 to 720, and the colours may be conveniently quoted by number which, if desired, can be preceded by the spectral terminology for the series. Cover-slip sheets with a suitable aperture through which to view the colours are provided, and it is advised to use the same, choosing a slip of a colour complementary to that of the shade isolated. An example is given, a coloured plate showing three kinds of water-lilies: "Feuilles: vert 388—Fleur supérieure: blanche—Au milieu à gauche: *Nuphar luteus*, fleur, jaune 257—A droite et en bas: *Nymphæa hortorum*, fleur, face supérieure des pétales, rouge 154, face inférieure, rouge 181."

The reviewer's determinations work out better by daylight than by artificial light, and with a white slip rather than with those of the complementary colours. Tested with *Chrysanthemum* petals and some butterflies, our results were distinctly good, each object being laid on the coverlip alongside the shades of colour in rotation. As a practical example, consider a few of the various blues which may be mentioned by artists and scientific men—and let the reader decide whether he is capable of determining all these with accuracy from isolated specimens: turquoise, jade, Antwerp, Gentian, sky, marine, flax, peacock, cyanine, swallow, steel, ultramarine, lavender, royal and Prussian. All are fairly clear on the charts, but the last four are blue-violets.

Great credit is due to the publisher in the production of these charts, and, if necessary, they can obviously be repeated. The physicist has his own methods of enumerating colours, but the naturalist demands something simpler. If he requires the greatest accuracy, would it not be worth his while, whether botanist or zoologist, to test out this code—and if approved ask for its official adoption wherever possible? Any normal individual of reasonable intelligence can very quickly master its use, and thus save himself and his correspondents worry and doubt.

Sea Dayak Textiles

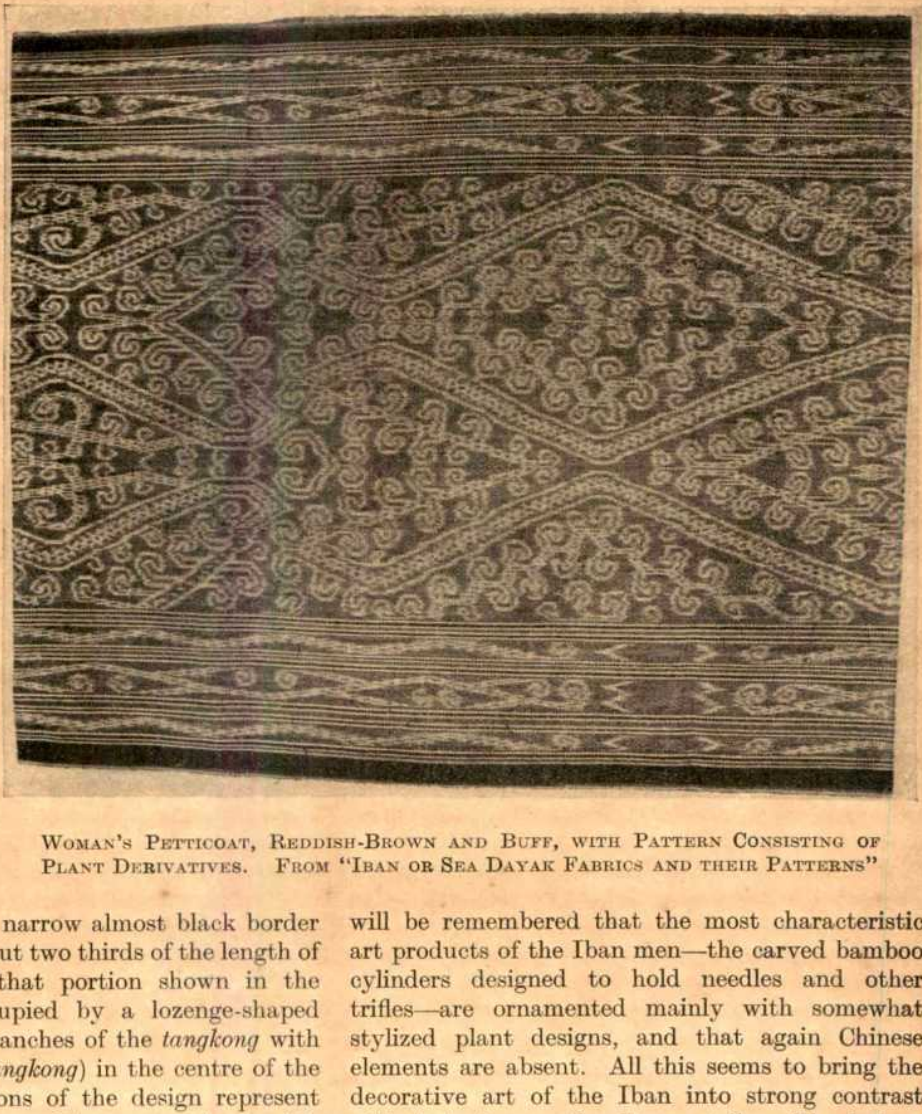
Iban or Sea Dayak Fabrics and their Patterns: a Descriptive Catalogue of the Iban Fabrics in the Museum of Archaeology and Ethnology, Cambridge. By Alfred C. Haddon and Laura E. Start. Pp. xv+157+36 plates. (Cambridge: At the University Press, 1936.) 25*s*. net.

IN this volume Dr. Haddon has returned to one of his early interests, the decorative art of a less advanced community. We are given a study of the designs and patterns on the specimens forming the Cambridge and British Museum collections of Iban (Sea Dayak) cloths, of which the best known and most numerous are the petticoats worn by women. These are always highly patterned, the designs being for the most part so conventionalized that it is impossible to tell what they represent by mere examination. The identification, that is, naming, of the elements of design on the cloths of both collections is due to the late Charles Hose. These are taken as authoritative, and it is upon them that the work is based.

The Iban are a smart, rather dressy people, and both sexes are fond of ornament; the women are expert weavers, producing their complicated and admirably spaced patterns with no other guide than knowledge of conventional design and appreciation of the space to be covered. They have rather a full palette of colours, red, yellow, blue, black, brown and white all being included.

As to the designs themselves, these represent men, crocodiles, deer, shrews, birds, spiders, centipedes, leeches, scorpions, various insects, and plant designs, besides natural phenomena such as clouds. To these must be added a minority of patterns derived from objects of everyday life. All, with the exception of the anthropomorphs (which include a few designs called frogs) and the crocodiles, are so conventionalized as to be unrecognizable without expert instruction.

An example rather simpler than most is reproduced herewith. This cloth is just over 4 feet long and 21 inches broad. Most of the patterns are derived from plants. The background is reddish brown and the patterns upon it are in buff. The main pattern is edged on each side with three longitudinal stripes in varied colours, with a narrow almost black border at the outer edge. About two thirds of the length of the cloth, including that portion shown in the figure, is mainly occupied by a lozenge-shaped arrangement of the branches of the *tangkong* with its "flowers" (*bunga tangkong*) in the centre of the lozenge. Other portions of the design represent *pating betula*, "branches pushing one another back", and *daun tangkong mulai*, "leaf of the *tangkong* twisted back", as well as other plant derivatives. About one third of the cloth (not shown in the figure) has a somewhat degenerate deer pattern, with strikingly developed antler derivatives. The borders consist of two stripes of *daun wi*, "tendrils of ratan", with between them one line of *entibap* (*Arenga saccharifera*).



WOMAN'S PETTICOAT, REDDISH-BROWN AND BUFF, WITH PATTERN CONSISTING OF PLANT DERIVATIVES. FROM "IBAN OR SEA DAYAK FABRICS AND THEIR PATTERNS"

Thirty-six plates are devoted to illustrating the designs, as well as a number of the cloths themselves. Turning these over, the reader is immediately struck by the absence of obvious foreign influence. Apart from a few deer designs, which probably are not dragon derivatives, though it might be possible to construe them as such, there is nothing that can be ascribed to foreign intrusion, a rather remarkable fact considering the Chinese influence that has been exerted in Sarawak. It will be remembered that the most characteristic art products of the Iban men—the carved bamboo cylinders designed to hold needles and other trifles—are ornamented mainly with somewhat stylized plant designs, and that again Chinese elements are absent. All this seems to bring the decorative art of the Iban into strong contrast with that of some other Borneo tribes. The designs must then be regarded as definitely Iban in origin, and a consideration of the objects represented will convince the reader that the authors are right in tracing many of them to the omen animals which play so large a part in Iban religion.

C. G. SELIGMAN.

The Hero:

a Study in Tradition, Myth and Drama. By Lord Raglan. Pp. xi+311. (London: Methuen and Co., Ltd., 1936.) 10*s*. 6*d*. net.

IN this volume, Lord Raglan extends to a wider field the application of certain critical principles which he formulated in his presidential address to Section H (Anthropology) of the British Association. He denies the validity of the methods by which tradition is made the ground of inference as to events in the past, of which documentary evidence, literary or archæological, has not survived. He maintains that tradition, still less the elusive "folk memory", does not endure for more than at most one hundred and fifty years, and that anything claiming to transcend that period is fictitious.

Lord Raglan is not content to rest in destructive criticism. He passes on to show how the 'standardized' heroic traditions came into being. They are, he holds, the concrete part of a ritual, which in most instances can be seen to underlie them, and when regarded at this angle, conforms to the pattern of fertility and cognate rites of an early form of community.

Lord Raglan argues his case ably and well. At the same time, there is something to be said in favour of tradition. Lord Nelson and Napoleon did exist, even though they may appear side by side with the entirely imaginary characters of the folk-drama. Lord Raglan, presumably, would feel constrained to deny their existence, if documentary evidence were absent. That the argument from tradition has sometimes been carried to absurd lengths does not alter the fact that it has served as a useful pointer in archæological argument, as, for example, in the instance of Crete, Troy and other sites of Greek heroic legend. Often such legends must be taken as doing no more than provide the archæologist with a *memoria technica* for cultural movements, contacts and development revealed by archæological research. The argument from tradition, like many other useful things, including Lord Raglan's counter, must be employed with discretion.

Wave Mechanics:

Elementary Theory. By Prof. J. Frenkel. (The International Series of Monographs on Physics.) Second edition. Pp. x+312. (London: The Oxford University Press, 1936.) 20*s*. net.

THIS new edition needs little introduction to readers of NATURE. For the benefit of those who have not studied it, it may be said at once that it is one of the best introductions to wave mechanics extant—complete in itself, clear in development, and not overburdened with mathematical symbolism. The seven sections into which the book is divided deal respectively with light, matter, wave mechanics of a particle, wave mechanics of a system of particles, statistical mechanics, applications to metal theory, heat motion and radiation, and the last section, which is new, is concerned with the theory of chemical forces. Small errors and misprints have been eliminated. The word 'elementary' must not be misunderstood, as, although mathematical developments are not over-emphasized, the work cannot be read with profit by a student who does not possess that knowledge of mathematics necessary to a student of physics of honours grade.

"A little philosophy inclineth Man's mind to atheism; but depth in philosophy bringeth men's minds about to religion." So far Bacon; and some of the enthusiasts who have made far-reaching, and possibly hurried, deductions from Heisenberg's uncertainty principle, might profitably consider the brief, but important section in which Prof. Frenkel deals with Heisenberg's theory of the uncertainty relation to the role of the observer.

Neuroembryology:

Neuroembryology: an Experimental Study. By Prof. S. R. Detwiler. (Experimental Biology Series.) Pp. x+218. (New York: The Macmillan Co., 1936.) 16*s*. net.

A BOOK which gives the exact position of a research subject is always valuable, provided it is accompanied as here by a full literature list. It discusses the factors influencing the growth of nerves, the proliferation of nerve cells and the capacity of the nervous system to adapt itself in response to changed conditions. By experimentation, imposed upon a knowledge of the morphological changes, the dynamics of the developing organism are studied. The data are collected by the examination of the effects in regeneration, by surgical means and by grafting, these leading to hypotheses of the agencies underlying the normal architecture; here the work of Ross Harrison in the last forty years is highly distinguished. Then later there is the study of the growth of nerves *in vitro*, which favours mechanical factors rather than those dependent on hormones, chemotaxis or electrical agents. The whole story of the use and present position of the subject is here told in a pleasant and easy manner, such as will undoubtedly encourage new workers to enter this difficult field.

Ebulliometry

By Prof. Wojciech Świętosławski. Pp. x+196. (Krakow: Jagellonian University Press, 1936.)

THIS is an account of the method of precise boiling point measurements based on the Cottrell principle which has been developed by Prof. Świętosławski and his students since 1925 and applied to a number of physico-chemical problems. Numerous forms of apparatus are described with full experimental details, and this monograph should be useful in directing attention to an experimental technique which has perhaps not yet been recognized in Great Britain at its true worth.

It is a little unfortunate that the translator appears to be more familiar with the idiom of the French language than with English; thus it requires a moment's thought to reveal the significance of "dosing vessels". In general, however, the meaning is clear, and this monograph will be valued not only for its detailed exposition of the experimental methods but also for the discussion of a wide range of scientific and technical problems in which boiling point methods can be used. S. S.

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Progressive Science in Public Welfare and Modern Industry*

THE Department of Scientific and Industrial Research now occupies such an essential place in the scientific and industrial structure of the country that it is already hard to realize that it is little more than twenty years since it first came into existence. The recently issued twenty-first annual report of the Department indicates the remarkable success of the Department in stimulating a new outlook in British industry, and can point to welcome evidence of increased support for research from a considerable number of industries in the last year. The most admirable feature of the report, however, is the lucid and comprehensive picture it gives of the contribution of science to the service of the needs, not merely of industry but also of every aspect of our daily lives, whether as a nation or as private citizens. From the requirements of the defence forces and other Departments of State, to the primary needs of the humblest citizen in respect of water supply, food, transport, clothing and recreation there is scarcely a question to which some contribution is not made by the Department. Moreover, the growing complexity of many of the issues involved in some questions, as food supply, national defence, roads and road safety, render the more valuable such a comprehensive picture as is regularly afforded by the annual report of the Department.

The present report, which covers the period October 1, 1935–September 20, 1936, contains the brief report of the Committee of the Privy Council, signed by the Right Hon. J. Ramsay MacDonald, Lord President of the Council, the report of the Advisory Council, over Lord Rutherford's signature and summaries of the work of the National Physical Laboratory, the Chemical Research Laboratory, and of the various research associations, and research boards or committees.

The gross expenditure of the Department in 1935–36 was £787,186, or £571,831 net as against £549,751 net in 1934–35. The largest single item of expenditure was £109,038 on the National Physical Laboratory, the gross expenditure of £234,383 covering, however, the cost of work carried out at the Laboratory for the Food Investigation Board, the Radio Research Board, and other Research Boards of the Department. Against this gross total, receipts amounted to £125,345, of which £65,950 represents fees from industry for paid work. Other receipts against the gross expenditure of the Department include £63,878 in payments by other Government departments for services rendered, £32,623 from the Road Fund and £9,800 from the Empire overseas for food investigation. Expenditure on the Chemical Research Laboratory was £21,697, on food investigation £43,296 net, on building and road research £78,218 gross, or £33,655 net, on forest products research £38,983 net, on fuel research £87,501 net and on water pollution research £13,968 gross or £4,354 net. Expenditure on the Geological Survey and Museum amounted to £66,641 net, while grants to Research Associations amounted to £108,951 as against £85,384 in 1934–35 and £58,992 in 1933–34.

Special stress is laid in the report on the progress of the Research Associations, and encouraging evidence of development in this field is the increased contribution of the industries concerned to the support of these associations. In the three years since the Million Fund came to an end in 1932–33, this figure has grown from £167,370 to £232,468, and the erection of further buildings and the extension of equipment which have marked the past year indicate the growing faith of industry in the value of research. New laboratories of the Electrical Research Association costing more than £29,000 were opened at Perivale. The Research and Standardisation Committee of the Institution of Automobile Engineers—the co-operative research organization of the motor industry—has acquired and equipped new laboratories costing £20,000 on the Great West Road. The laboratory accommodation of the Paint Research Association has been considerably enlarged. Extensions involving expenditure of £41,000 have been opened at the Shirley Institute (cotton research), where the buildings now cover an area of more than three acres and the total cost of laboratories and equipments has passed £200,000. The income of the Cotton Research Association, the largest of the research associations, has now reached £84,000 and its staff last year numbered 270.

The position of the research association movement as a whole is not, however, regarded as entirely satisfactory. The Department is prepared to provide a further £66,000 for the support of the Research Associations, and would have found that sum in each of the last two years had industry been ready to provide an equivalent contribution. In fact, had full advantage been taken of the offer of the Department, the income of the associations would have been increased by a further £150,000 a year. In some cases only two years now remain in which the industry can earn the balance of additional grant still available. A new development in the year has been the conversion of the Printing Research Association from merely an efficient information bureau, serving the printing industry, the paper-making industry and the printing ink manufacturers, into an organization which adds to knowledge by research. Additional staff has been engaged, and laboratory premises, opened by H.R.H. the Duke of Gloucester on March 9 of this year, have been equipped.

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* Department of Scientific and Industrial Research. Report for the Year 1935–36. (Cmd. 5350.) Pp. iv+195. (London: H.M. Stationery Office, 1937.) 3s. net.

To turn from the prosaic survey of ways and means to results achieved, it is almost startling that industry anywhere should be so backward in supporting the work of the Research Associations, which makes such important contributions not only to industrial welfare but also to social amenities and well-being. The examination by the Iron and Steel Industrial Research Council of data of works operation, for example, has led to a rapid improvement in productive efficiency and reduction of fuel consumption even in works which were regarded as highly efficient. Moreover, the greatly increased control by scientific instruments in steel making has led to robust apparatus of high precision for such work being made by British firms at prices competitive with foreign apparatus. A comprehensive investigation on steel sheet has been initiated in co-operation with the research organization of the automobile industry. The British Non-Ferrous Metals Research Association has continued its work on the corrosion of copper with particular reference to water service pipes as well as that on the corrosion of lead.

Mainly as a result of the work of the British Refractories Research Association, the life of the silica brick linings of gas retorts is now 25 per cent longer than ten years ago, and the economies resulting to the gas industry are very large. The Electrical Research Association has developed a new type of fuse for radio receivers or electrical clocks which combines a close degree of protection with a greatly increased time lag. Other of its work has been concerned with interference with broadcasting from electric appliances in common use, and with earthing conditions for overhead lines which will protect cattle grazing under them from shock if faults develop on the lines. An interesting investigation carried out by the Paint Research Association of particular interest to the householder is that of painting in winter and in wet weather, and of methods of overcoming the difficulties or ill-effects due to such conditions by simple modification in the composition of the paint.

The close bearing of the work of the Research Associations on everyday life is indeed remarkably illustrated in the present report. A community which is making ever greater use of the motor-car, whether for private or for public transport, can scarcely fail to appreciate the importance of the co-operative research which has made cylinder wear in automobiles no longer the serious problem it presented a few years ago. Gas masks are unfortunately now presenting a civilian interest as well as an industrial interest or one confined to the defence forces of the Crown, but the importance of the work of the Rubber Research Association in developing durable rubber components for such masks and in devising tests to ensure that supplies of reliable articles are available is obvious. Equally of interest, in view of the increasing use which is made of rubber as a constructional material in buildings, is work on the development of rubbers resistant to fire and heat.

Work on rubber is related to comfort as well as to safety, however, and the Association has also been investigating methods of measuring the hardness of rubber which will enable its cushioning properties in reducing noise and vibration to be evaluated more accurately. A particularly interesting piece of work of the Association has been concerned with the resistance to wear of rubber soles and heels, which has enabled the durability of rubber footwear to be increased. The Leather Manufacturers' Research Association has also been concerned with footwear, and has undertaken an important investigation on the quality of sole bands for shoe manufacturers with special reference to the suitability of the leather for light stuck-on soles. The boot, shoe and allied trades have their own Research Association, however, and this has been responsible for an outstanding development in what may be called the initiation of research on walking. To assist manufacturers to design better fitting shoes, the Association has devised a means of making very careful records of the way in which various people walk. A cinematograph record is taken by means of a moving platform or treadmill of the movements of the foot, and is afterwards carefully analysed. The gaits of individuals and the effect of different kinds of shoe upon them are being investigated, and the results already obtained suggest that some shoes are much more likely than others to interfere with the usual gait. The significance of such a contribution from the point of health is difficult to assess, but may well be of great importance.

Equally significant is the work of the Flour Millers' Research Association on the keeping qualities of bread. What the housewife calls 'staling' is usually due to poor keeping qualities in the bread. Bread made in the best possible way from the best possible flour will retain its edibility for ten or twelve days, whereas bread improperly made from poor flour may become unappetizing and almost uneatable in two or three days. The work already carried out suggests that if more attention were paid to commercially controllable factors which promote the good keeping quality of bread, the question of stale bread would be much less serious.

This aspect of bread staling is not, however, true staling, which is caused by a change in the nature of the starch in the bread from its natural form at high temperatures to the natural form stable at low temperatures. If true staling could be prevented, the bread would probably always keep well, but, in practice, methods which would prevent the transformation are liable to accelerate the growth of moulds. Other work of the Association has been concerned with the storage of flour and the fats of flour, while the Research Association for the Cocoa, Chocolate, Sugar, Confectionery and Jam Trades has been investigating the problem of the attack of starch products by insect pests and has already been of much assistance in the suppression of such pests. Other work of this Association on the jellifying properties of various pectins has led to the improvement of conditions for the manufacture of marmalade from oranges.

Many other investigations on food problems, particularly those relating to the storage and transport of food, for which the Food Investigation Board is responsible, are referred to in the report. At the Low Temperature Research Station at Cambridge the lethal effect of X-rays on bacteria has been studied in connexion with the storage of meat. Methods of storing eggs in different concentrations of carbon dioxide are being tried out on a large scale. Another investigation is concerned with the relation between the quality of pork and bacon and the growth and diet of the pig ; and the advantage in dry salt cures of resting the pig adequately before slaughter has been established. The storage and salt curing of herrings, the gas storage of apples, pears and other fruits and vegetables, and canning questions, are other examples of the way in which the work of the Department is tending to improve food supplies and assist in questions of adequate and balanced diet.

Nor are boots and shoes the only point at which the work of the Department touches the clothing of the citizen. The work of all the textile research associations bears closely upon many such matters. The new silk section of the Cotton Research Association, for example, is contributing materially to the solution of problems involved in the use of mixed fabrics of cotton, silk and rayon. The Linen Research Association has been concerned with the laundering of linen fabrics and their resistance to weathering and to fading when dyed, while besides its important work on the resistance of wool to shrinking the Woollen Industries Research Association has been responsible for fundamental research now widely exploited in the 'permanent waving' of ladies' hair. The housewife should be equally appreciative of the work of the Launderers' Research Association on the washing of woollens, on the development of fastness standards for coloured goods and on the properties of detergent solutions.

Reference has already been made to contributions made by the Department in matters of safety. No aspect of the work of the Colliery Users' Research Association is more important than this, whether in respect of dust suppression and the prevention of silicosis, underground illumination or the control of atmospheric conditions in mines. An important investigation has been commenced at the National Physical Laboratory on the production of static electrification in operating theatres of hospitals, which should enable the risks of ignition of anæsthetics by sparking to be considerably reduced. A preliminary investigation on the similar risk in dry-cleaning works has been undertaken at the request of the Home Office.

Among other work bearing directly on health and safety may be mentioned that on industrial respirators and the detection of toxic gases in industry, research on the composition of dental amalgams, their manufacture and use, the radium treatment of disease, atmospheric pollution, in which field a survey on a large scale of the pollution in and round the City of Leicester is to be undertaken, and the investigations in chemotherapy at the Chemical Research Laboratory. Moreover, at the present time, the significance of much of the work of the Road Research Board, whether in road construction or road usage, such as questions of skidding and its prevention, needs no emphasis in this connexion. Work on water pollution, too, has yielded results as important from the health point of view as from that of the considerable savings which have been achieved, for example, for the dairy and milk industry, through the improved disposal of their effluents.

The Building Research Station is scarcely of less importance to the householder than to industry, and besides the improvement of bricks and cements, the durability of building stone and the structure and strength of materials, has covered questions of fire prevention, for which purpose a Fire Testing Station has been opened, and the efficacy of buildings from the point of view of users as regards heating, ventilation, lighting, or the transmission of noise.

The Illumination Research Board has been concerned not only with lighting, or such problems as the effect of glare on vision, but also with problems in connexion with automobile headlights. Space does not permit even mention of other investigations carried out at the National Physical Laboratory or at the Chemical Research Laboratory, by the Forest Products Research Station, the Fuel Research Station, the Lubrication Research Board, in metallurgical matters, furnace design, aircraft design and other fields which have yielded equally significant results for industry or the general advantage of the community. A final reference can only be made to the discovery in radio research, which is one of the most interesting of the year, of the existence of three new electrified regions in the atmosphere between 4 and 40 miles above the earth. These regions are thus well below the well-known Heaviside and Appleton regions, which play such an important part in broadcasting to great distances and in making Empire communication on short waves possible.

Enough has been said, however, to demonstrate the value of the work of the Department alike in the latest fields of scientific activity and investigation and in the very oldest on which industrial prosperity and civic welfare alike depend. No document could in fact be better calculated to show the contribution which scientific research can make to human welfare and progress if it is applied to constructive and social ends, and not prostituted for destructive purposes as in preparations for war.

Boron and the Control of Plant Disease

By Dr. Winifred E. Brenchley

THE value of boron in improving plant growth was indicated in the early part of this century by various workers, notably Agulhon[1], but it was not until 1923 that its essential nature was definitely proved by Warington[2] in her work on the broad bean. Since then, research workers and practical men have taken up the matter all over the world, and various obscure physiological diseases of crops have been traced to a deficiency of boron in the soil. Crown rot of sugar beet, raan in swedes, topsiekte of tobacco and certain leaf-roll diseases of potato all respond favourably to the application of small dressings of borax, usually ranging from 10 lb. to 20 lb. per acre for these relatively short-lived plants. Heavy dressings of boron compounds are unfavourable as they produce toxic symptoms which may cause grave damage.

During the last few years, active experimental work has been carried out in widely separated centres on the control of cork disease, corky core, or internal cork of apples, all apparently representing the same trouble. The surface of the fruit becomes uneven, and brown areas of diseased tissue are distributed throughout the apple, particularly around the core, greatly reducing the market value of the crop.

Acting on a suspicion that the disease was due to the deficiency of some essential element, McLarty[3] tested thirty chemicals by injecting them into the trunks of affected trees. Of these, boric acid and manganese borate proved effective in controlling corky core, as with injections above a minimum of 1·83 gm. per 100 sq. cm. of the cross-sectional area of the trunks no disease occurred, and the total crop was greatly increased. Heavier doses up to 5·92 gm. did not cause any damage to the foliage, though there was slight injury to the bark and cambium at the point of injection. In these experiments the test material was nearly always packed into the trunks in the dry form, because of the greater convenience in handling and also because larger amounts could be used without injury to the foliage.

At the same time, Askew and his collaborators in New Zealand[4] and Jamalainen[5] in Finland were also investigating the problem. In New Zealand boron again proved to be the effective controlling agent out of a large number of elements tested, and the method of getting it into the tree seems to be largely a matter of convenience. Borax spread broadcast at the rate of ½–1 lb. per tree or 50–100 lb. per acre rapidly penetrates the soil to the absorbing zone of the roots in a favourably moist season, and is taken up and passed into the leaves and fruit, giving good control of internal cork. The penetration might not be so good or rapid in a dry season, but there is a considerable safety margin, as the normal annual requirement per acre for leaf and fruit growth has been found by analysis to be only about 14 oz. of borax. Injections of solution containing 0·25 per cent of hydrated borax were equally effective in increasing the boron content of leaves and fruit, and internal cork was prevented by so little as 2·5 gm. borax per tree. Where the injections were made into a branch, a certain amount of migration of boron took place into untreated branches, even when the point of injection was some way above the crotch. Similar control was obtained by applying borax sprays at the rate of one gallon per tree, and the suggestion is made that two applications of a 0·25 per cent solution in spring at an interval of three weeks would prove useful in commercial practice.

In the Finnish experiments[5], boric acid was used as well as borax, and smaller quantities were also tested and proved effective in the control of cork disease. This may be due to a combination of factors, including the type of soil, the different climatic conditions and the fact that the boron compound was watered into the soil. The size of the trees is not indicated, and it is possible that the Finnish trees were younger and smaller than those in New Zealand and so responded to a lower dressing.

Boron deficiency not only damages the tissue of the fruit but also affects the chemical composition, as Jamalainen found that diseased apples contain more glucose and fructose than saccharose, and that the carbohydrates of the actual diseased tissues remain in the starch stage and are not converted. The striking similarity in the results obtained in different parts of the world afford conclusive proof of the value of boron in the control of corky core in apples, and gives rise to the hope that other obscure diseases of fruit trees may also prove to be due to deficiency of some essential minor element, which can be supplied at a relatively low cost and without undue difficulty.

[1] Agulhon, H., "Recherches sur la présence et le rôle du bore chez les végetaux", Thèse, Paris (1910).

[2] Warington, K., "The Effect of Boric Acid on the Broad Bean and certain other Plants", *Ann. Bot.*, **37**, 629–72 (1923).

[3] McLarty, H. R., "Tree Injections with Boron and other Materials as a Control for Drought spot and Corky Core of Apple", *Sci. Agric.*, 16, 12, 625 (Aug. 1936).

[4] Askew, H. O., Chittenden, E., Thomson, R. H. K., and Atkinson, J. D., "The Use of Borax in the Control of 'Internal Cork' of Apples". *New Zealand J. Sci. Tech.*, **18**, 365 (1936).

[5] Jamalainen, E. A., "On Cork Disease of the Apple and on its Appearance in Finland". *J. Sci. Agric. Soc. Finland*, **8**, 24–35 (1936). "The Effect of Boron on the Occurrence of Cork Disease in Apples", *Agric. Expt. Activities of the State*, Pub. 89, pp. 11 (1936) (English summaries).

Obituary Notices

Mr. William Taylor, O.B.E., F.R.S.

WILLIAM TAYLOR, who died at the age of seventy-one years on February 27, showed a bent towards engineering early in life, making his own lathe at an age when most children are playing with toys. He learnt from the village blacksmith and the local wheelwright. His first schoolmaster was Dr. Richard Wormald of London, a pioneer in the teaching of science, at whose lectures he assisted as demonstrator. The school was so far advanced in its methods as to have a workshop for metal and wood work. At this time, William and his brother made in their workshop at home, which they had themselves built, a pair of the first telephones ever made in England, and one of the first copies of Edison's recently invented tinfoil phonograph. Later, William Taylor was one of the first students at the Finsbury Technical College, his teachers being Profs. H. E. Armstrong, Ayrton and Perry. He made for Ayrton and Perry the model of their ammeter which is now in the Science Museum. Some of the instruments made in his student days are still in use at the factory he started in conjunction with his brother. The firm thus founded in 1886 was known at first as T. S. and W. Taylor, and afterwards as Taylor, Taylor and Hobson. The founders had the unusual experience of celebrating last year the jubilee of the business they had established.

The firm started by manufacturing photographic lenses, and William Taylor soon saw that accurate lens manufacture depended on accurate screws, so he invented methods of measuring the essential dimensions of screws with a micrometer, using cylinders placed between the threads; he then found it necessary to make his own screw-cutting lathes to produce threads of the necessary accuracy. He also invented the abrupt thread to facilitate the engagement of the lens in its flange. The Royal Photographic Society had proposed standard flange screws, but at first the manufacturers were antagonistic and the Taylor firm was the only one with the necessary equipment to conform to these standards. This experience in exact workmanship was invaluable in the manufacture of the anastigmat, when, in consequence of the reputation of the brothers, they were offered the manufacture of the Cooke lens, the first anastigmat of English design. The inventor of this lens, H. Dennis Taylor, was not related to William Taylor.

In the manufacture of photographic lenses, the need was felt for speedier and neater methods of engraving the mounts than was possible by hand; this led to the design of the engraving machine which, originally intended only for use in Taylor's own works, quickly found a market outside and greatly enhanced the reputation of the firm.

William Taylor next turned his attention to improving the methods of glass working, and practically revolutionized the process of making lenses, so that it became possible to manufacture them in quantity and of high quality. Machines were made for sawing the glass, cutting out disks, roughing to shape, smoothing and polishing, and finally edging. In the design of the automatic grinder, Taylor's work was fundamental. The iron tool fed with loose abrasive, as previously used, quickly lost its shape. He saw that by using a cup-shaped abrasive wheel—he secured one of the first to arrive in Great Britain—any curvature could be produced on the glass by varying the angle between the axes of the revolving work and that of the wheel; wear would not alter the curvature, and could be compensated by moving the wheel forward along its axis.

Great Britain reaped the harvest of these improvements during the Great War, but William Taylor's services did not end there; he made precision tools for munition making (one of the screw thread measuring machines is now in the Science Museum) and redesigned, entirely on his own responsibility, the Army clinometer, so that it was possible to make two hundred weekly of the new design against twenty of the old. In 1919, Taylor, Taylor and Hobson's was one of two Leicester factories which were visited by Their Majesties King George V and Queen Mary.

Mr. Taylor's chief hobby was golf, and he was accustomed to think over and sometimes solve his engineering problems while on the links. He soon became interested in the manufacture of golf balls, adapting his engraving machine to the engraving of golf ball moulds. He himself invented several patterns of markings, and with characteristic thoroughness made a golf ball driving machine to test balls scientifically. A further extension of the engraving machine was the recently invented electric etcher to make possible the marking of hardened steel surfaces quickly and neatly.

Mr. Taylor served on many standardization committees, and obtained a patent for a system of screw thread gauges which he gave to the British Standards Institution for the benefit of the public. This was the foundation of the well-known Wickman gauge. He was also interested in the training of the young engineer and did much, by offering prizes, to encourage a high standard of craftsmanship among apprentices. He gave freely of his time and advice also to Leicester and Loughborough Colleges.

Mr. Taylor took a patriarchal interest in the welfare of his workers and maintained close personal contact with them. His essential kindliness was perhaps masked by a certain dignity, but the employee who might at first feel rather like a schoolboy before the headmaster would soon see the twinkle in his eye as a humorous sally was made, or one of his large store of apt anecdotes was related. It is worth while recording that 'daylight saving' was in operation at his factory years before the Daylight Saving Act. After the War, he introduced a scheme of co-partnership. In his earlier years he had been a Liberal and Free Trader, but modified his views after the War and became a firm supporter of the League of Industry, one of the first branches being started in his works.

Among the honours that fell to William Taylor—all too few in view of his achievements—were the award of the O.B.E., the presidency of the Institution of Mechanical Engineers (in the year of the Ottawa Conference, at which he represented the Institution), and the fellowship of the Royal Society. He was a member of the general board and of the executive committee of the National Physical Laboratory. He was a clear thinker, a good speaker, most thorough in his work, with a passion for accuracy, good design and good craftsmanship. He had a firm belief in the mechanization of industry as ultimately good for the craftsman and craftsmanship, relieving the operator of monotonous physical labour, setting him a higher standard of accuracy, and leaving him more time for the work that calls for the exercise of his higher faculties in the art and science of his craft; the time saved entailing further work in furnishing the instruments of education and recreation, thus providing unlimited progressive development. H. W. L.

Mr. A. R. Horwood

BY the death of Arthur Reginald Horwood, on February 21, British botanists have lost a valued colleague and friend.

Horwood was born at Leicester on May 29, 1879, and was trained for the Indian Civil Service. He failed, however, to pass the medical examination and in 1902 he obtained a post at the Leicester Museum; he was afterwards appointed sub-curator and resigned this post in 1922. Two years later he was appointed temporary botanist at the Royal Botanic Gardens, Kew, and remained at the Herbarium until his death.

Horwood's chief botanical work was concerned with fossil plants and the flora of Europe and the Near East. He published many papers and books, and his popular works on the British flora obtained a wide circulation. The best-known of these were "Plant Life in the British Isles" (3 vols. 1914–16), and "The Outdoor Botanist" (1920). His most important publication was "The Flora of Leicester and Rutland" (1933), written in collaboration with the late (third) Earl of Gainsborough. This contains a large amount of ecological information based on the extensive surveys that Horwood carried out with a band of helpers while at the Leicester Museum. At Kew, Horwood worked in the European and Oriental Department and was chiefly engaged in naming collections of plants from Persia, Iraq and other countries in the Near East.

Horwood was always willing to give the benefit of his advice and help to his many botanical friends and correspondents. He was twice married and leaves a widow and four sons.

WE regret to announce the following deaths:

Sir James Currie, K.C.M.G., K.B.E., chairman of the governing body of the Imperial College of Tropical Agriculture, Trinidad, and director of the Empire Cotton Growing Corporation, on March 17, aged sixty-eight years.

Prof. E. C. Franklin, emeritus professor of organic chemistry in Stanford University, known for his work on ammonia compounds, on February 4, aged seventy-four years.

Prof. J. A. Gilruth, formerly professor of veterinary pathology in the University of Melbourne, lately chief of the Division of Animal Health of the Commonwealth Council for Scientific and Industrial Research, on March 4, aged sixty-six years.

Prof. Duncan S. Johnson, professor of botany in the Johns Hopkins University, on February 16, aged sixty-nine years.

News and Views

Dr. H. L. Eason, C.B., C.M.G.

DR. HERBERT LIGHTFOOT EASON, who has been appointed principal of the University of London, in succession to the late Sir Edwin Deller, was educated at University College, London, and at Guy's Hospital. He has been superintendent of Guy's Hospital since 1920, having previously held the post of dean of the Medical School from 1904 until 1912. He has been a member of the Senate since 1911 and has been vice-chancellor since 1935. He was chairman of the Library Committee in 1929–33, of the Finance Committee in 1923–25, and of the Academic Council for two periods (1922–23 and 1933–35). He served during the Great War as consulting ophthalmic surgeon to the Forces in the Mediterranean, Egypt and Palestine, was mentioned in dispatches, and was awarded the C.M.G. in 1917 and the C.B. in 1919. He has been the representative of the University on the General Medical Council since 1925, and is now junior treasurer of the Council. From 1924 until 1926 he was a member of the Departmental Committee of the Board of Education on the re-constitution of the University, and from 1925 until 1930 a member of the Departmental Committee of the Ministry of Health on Postgraduate Medical Education.

Prof. J. A. Douglas

DR. J. A. DOUGLAS, of Keble College, for many years senior lecturer and demonstrator in the Department of Geology at Oxford, has been appointed to the chair in succession to the late Prof. W. J. Sollas. The professorship carries with it a fellowship at University College. Prof. Douglas's most important work is his classical contribution to the geology of the Andes. He has also done important work on Persian palæontology and stratigraphy, especially the Permo-Carboniferous fauna of south-west Persia. He had published many papers on local geology, especially on the cornbrash sequence of the British Isles, and on other subjects. He has served both as secretary and vice-president of the Geological Society. Generations of students of geology at Oxford have known him as a good teacher—both as tutor and lecturer—and an expert in field geology. The appointment is a popular one, and one that augurs well for the future of geology in the University.

The Flooding in East Anglia

ALTHOUGH on a much smaller scale than the tragic experiences along the valleys of the Rivers Ohio and Mississippi in the United States, and happily, so far, unattended by any loss of life, though the damage to property has been considerable, the flooding of the Fen District in East Anglia has been a source of great anxiety and distress to the unfortunate inhabitants and a matter of grave concern to the responsible authorities. The situation, continuously critical, has changed its aspect but little from day to day during the past week or ten days, except to demonstrate fresh localities of weakness in the over-strained banks of the rivers. Cracks and breaches have occurred at various points and, at the time of writing, some 15,000 acres of good cornland lie under water, while another 150,000–180,000 acres are threatened with a similar fate. The district lies in the South Level area of the Great Ouse Catchment Board, which includes Ely, Soham and Burwell on the east and Earith on the west, forming a basin drained by the Cam, the Lark and the Little Ouse and minor streams. At the moment, the chief source of anxiety is transferred to two main watercourses, the Old and the New Bedford Rivers, artificial channels of the Great Ouse from Earith to the estuary, constructed by Sir Cornelius Vermuyden in the seventeenth century. The two channels run almost parallel about three quarters of a mile apart for a distance of twenty-one miles, and the intervening space, known as the 'Washes', provides a relief for the channels when overcharged, being flooded regularly in the winter and occasionally in the summer months. The two main, or barrier, banks of the enclosure protect the low-lying land on each side, and the maintenance of these banks is a matter of vital importance. The banks are now being taxed to the limit of their resistance.

The Special Areas Act

THE statement relating to the Special Areas, including the memorandum on the financial resolution proposed in the House of Commons on March 8, reviews the work of the Commissioners and the progress in the Areas in public health, social and other services, trading estates, development of industrial and shipping facilities and of the Special Areas Reconstruction Association (Cmd. 5386. London: H.M. Stationery Office). The paper states that the placing of Government orders and the establishment of Government factories in the Special Areas, together with the prospective improvement in the rate position, have prepared the way for a further advance. To assist the introduction into the Areas of new industrial undertakings of the 'light' type and provide more stable, because more diversified, employment, the financial resolution provides the necessary authority for the introduction of a Bill to continue in operation the Special Areas (Development and Improvement) Act after May 31, 1937, to extend the powers of the Commissioners under that Act, and to make new provisions as regards Special Areas and certain other areas to be certified by the Ministry of Labour.

It is proposed to extend the present Act and additional provisions until March 31, 1939, and the resolution provides for the facilitation of the establishment of industry by authorizing the Commissioners to let factories in the Special Areas. It also authorizes the Commissioners to contribute for periods not exceeding five years, not only towards income tax and rates, but also towards the rent payable in respect of new industrial undertakings. Assistance is also to be given to Site Companies established to provide factories in the Areas, and provision is made for loans not to exceed £2,000,000 in the aggregate to new undertakings for their establishment in the Areas. These proposals and the resolution led to a lively debate in which the Government accepted the Opposition suggestion of a Select Committee. Neither the Statement nor the Minister of Labour's speech indicated any rational extension of the boundaries of the Special Areas or redress of existing anomalies, and they are also silent on the questions of training labour and the improvement of communications in the Special Areas.

Transmutation of the Heavy Elements

AT the Friday evening discourse before the Royal Institution on March 19, Lord Rutherford discussed "The Transmutation of the Heavy Elements". During the last few years, our knowledge of the transmutation of the elements by artificial methods has grown with great rapidity, and practically all the known elements have been found capable of transmutation on a small scale when bombarded by fast particles of suitable type. The bombardment of bismuth by fast deuterons is of particular interest as it leads to the production of a radioactive isotope of that element identical in radioactive and chemical properties with the natural radioactive body, radium E. This important result has been confirmed by showing that this artificially produced radium E gives rise to polonium—the first of the radioactive elements separated by Mme. Curie in 1897 from uranium minerals. In general, the neutron is extraordinarily effective in producing transformations in the majority of the elements. In a number of cases very slow neutrons are far more efficient in this respect than fast ones. A suitable source of neutrons for such experiments can be obtained by bombarding beryllium with α-particles from radium. The fast neutrons can be slowed down by allowing them to pass through material containing hydrogen, for example, water or paraffin. In this way more than eighty new radioactive isotopes have been discovered, most of which break up with the emission of β-particles.

THE action of neutrons on the heaviest known element, uranium, has been the subject of close study by Hahn and Meitner during the past two years. Work with this element presents special difficulties on account of its spontaneous radioactivity. The trans-uranic elements produced by neutrons have chemical properties similar to those to be expected from eka-rhenium, eka-osmium, eka-iridium and eka-platinum, corresponding to elements of atomic numbers 93, 94, 95 and 96 respectively. Three new radioactive series are formed, two of which probably arise from the main isotope of uranium (mass 238) after the capture of a neutron, and the third may be due to a less abundant isotope of uranium (mass 235). It does not appear that the bombardment of uranium by neutrons has any effect in accelerating the natural disintegration of this element. A complex series of transformations also arises when the second heaviest element, thorium, is bombarded by neutrons.

Rusting of a Meteorite

EVER since the largest of the meteoric irons found at Cranbourne, about thirty miles south-east of Melbourne in Australia, was extracted from the sand in which it had lain buried for numberless years, it has shown a pronounced tendency to rust. This large mass, which weighed about 3½ tons, was presented to the Trustees of the British Museum in 1862. When first received, it was mounted on a turntable and was shown uncased. So rapid, however, was the rusting that within a short time it was decided to place it in a glazed case and keep the air within as dry as possible by means of frequently renewed supplies of lime. The effect was to slow up markedly the rate of rusting, but not to stay it altogether. It is estimated that more than 4 cwt. of rust has been removed from the meteorite since it reached the Museum. Arithmetically, therefore, it would appear as if the mass had a very long life before it, but it would have been nothing like so long because the lawrencite (ferric chloride), the cause of the mischief, is disseminated in seams and by expanding during alteration tends to split up the mass. Owing to the size and porous character of the meteorite, treatment by a surface coating which has proved so successful with other meteoric irons was out of the question.

ABOUT a year ago, the Trustees on the advice of the Keeper of Minerals decided to substitute for the ordinary glazed case an airtight one which could be filled with dry nitrogen. At the same time the original turntable was replaced by a stronger rigid structure and the mass provided with a firmer bed. During this process forty pounds weight of rust and scale was removed. The nitrogen supply, which is concealed under the bed by the mahogany panelling, consists of the usual cylinder and oil bubblers at the entrance and egress, an extra one at a higher pressure being provided for safety at the egress side. It is necessary to pass the gas slowly through the case because of the impossibility of assuring so large a one being absolutely airtight. The glass and metal are bound together by a special hard cement. A small panel fitted with a gasket has been provided on one of the short sides to give access to the interior when necessary. The first effect of the new method has been to cover the floor of the case with an unusual amount of dust and fragments, the reason being that they had previously been maintained in the cracks or on the surface by moisture which has now gone.

Standardization of Technique in Physical Anthropology

ONE result of the first International Congress of Anthropological and Ethnological Sciences, held in London in 1934, was the establishment of a permanent International Committee for Standardization of Technique in Physical Anthropology. Miss M. L. Tildesley was elected as chairman, and Prof. H. V. Vallois as secretary, until 1938. The records of the subject have been increasing rapidly in recent years, but it is now generally realized that many of the definitions used are not precise enough to ensure that independent workers will obtain metrical or other descriptions which are truly comparable. The techniques used in measuring living people are the least satisfactory, and in this case the personal equations of observers are large enough to falsify many inter-racial comparisons. Miss Tildesley has been making a grand tour in the interests of her committee, and in January she read a paper, entitled "The Problem of Internationally Standardizing Scientific Method", at the meeting of the Australian and New Zealand Association for the Advancement of Science held in Auckland. This dealt more with organization than with any results as yet achieved. The committee consists of 37 members representing 35 different countries, and it is claimed that the fact that it has no permanent seat is an advantage. Different sections of the work are delegated to small groups, and the members of these will be obliged to collaborate chiefly by correspondence. Resolutions of the committee are to be circulated in French versions, with translations in other languages if this is found necessary. An organization of this kind should bear good fruit, even if its principal achievement should be to persuade those who publish new material to give data which will make it possible to estimate the reliability of their records, such as repeated measurements on the same subjects.

John Buist and the Elementary Bodies of Vaccinia

IN the February issue of the *Edinburgh Medical Journal*, Dr. Mervyn Gordon directs attention to the work of Dr. John Buist of Edinburgh upon the microscopy of variola and vaccine lymph, which appears to have been lost sight of. In recent years evid[illegible] has accumulated that the minute agents of virus diseases such as smallpox, vaccinia and influenza, which are capable of passing through fine filters that stop the passage of ordinary bacteria, are particulate. In fact, it is possible to demonstrate tiny spherical or ovoid bodies in most virus diseases by means of dark-ground illumination, or after suitable staining by ordinary objectives. Their size usually lies between 0·1 μ and 0·2 μ, and they are arranged singly, in pairs, or in groups. These granules have been given the name of 'elementary bodies', and accumulated evidence suggests that they are the causal agent of the virus disease, particularly in vaccinia, in which they are frequently known as "Paschen bodies". In a book published in 1887 ("Vaccinia and Variola: a Study of their Life-History"), Buist describes and figures minute bodies which he observed in films of vaccine lymph after prolonged staining with aniline-water gentian violet. Dr. Gordon remarks that there can be little doubt that these bodies described and figured by John Buist (and regarded by him as being the contagium itself) are identical with those afterwards found by Paschen and others and known to-day as the elementary bodies of vaccinia and its causal agent. John Buist was a native of Fife, born in 1846, and was for a time medical superintendent of the smallpox hospital at Barrow-in-Furness. He died in Edinburgh in 1915.

Natural and Artificial Clouds

THE Symons Memorial Lecture was delivered before the Royal Meteorological Society on March 17, by Prof. D. Brunt, professor of Meteorology in the University of London, on the subject of "Natural and Artificial Clouds". Prof. Brunt pointed out that the motions which occur when an unstable layer of fluid breaks down have been found to be in the form of polygonal prismatic cells, in which the motion at the centre of the cell is upward, when the fluid is a liquid. In air, while the motions in deep layers resemble those in liquids, except that the direction of motion is reversed, the motion in shallow layers made unstable by heating from below consists of a large number of ascending currents, surrounded by much slower descending currents. When the air is bounded at its upper limit by a movable glass plate, the shearing produced by moving this plate will give long rolls extending through the whole length of the chamber, if the upper plate is moved sufficiently rapidly. With slower movements of the upper plate, the chamber is filled with distorted prismatic cells, and with very slow movements of the plate, the chamber is filled with rolls transverse to the direction of motion of the plate. These experimental results can be applied to explain a variety of cloud forms, which are thus presumably in part due to the effects of instability. Among these clouds are those which consist of small cloudlets on a background of blue sky, cloud sheets which show a series of clear holes, and clouds in rolls, which may be analogous to either the longitudinal rolls found in the laboratory with rapid shearing of the top plate, or to the transverse rolls found with slow shearing of the upper plate.

Erosion in the Punjab

A CONFERENCE held at Simla recently affords evidence that the importance of the erosion question in the outer Punjab Hills is now receiving serious attention. It was presided over by Sir Herbert Emerson, the other members consisting of the revenue member, the financial commissioner for development, three commissioners of divisions, two deputy commissioners, a representative of the Finance Department, a chief engineer of irrigation, the chief conservator of forests, the conservator of the Eastern Circle and the forest research officer. The assembly of so influential a body shows the importance now attached to this problem by Government. Yet the problem is not a new one. For the last four decades it has been discussed, and men with wide vision have, years ago, foretold the inevitable waste and ruin which would result if the population were allowed to carry on certain practices, including the almost unrestricted pasturage of flocks, more especially goats. The Governments of the day turned a deaf ear. To-day the position has to be faced. Apart from the loss of valuable agricultural land resulting from serious erosion in the hills, part of the water supplies upon which the great network of canals in the Punjab plains depend will be jeopardized unless the extending erosion in the outer hills can be stayed. In several regions of the British Empire this problem of erosion on the large scale and the man-made desert are probably two of the most complicated and most important of the administrative and economic matters facing several Governments.

Education of Young Children

"YOUNG CHILDREN IN EUROPEAN COUNTRIES" is the title of a report recently issued (Washington, D.C.: Superintendent of Documents. Pp. 108. 15 cents) by the United States Office of Education. Among the *sequelæ* of the economic depression in that country none aroused greater concern than the physical and mental handicaps imposed upon young children, and emergency nursery schools were established in 1933–35 in nearly all the States; mostly in already existing school buildings but also in hospitals, camps, mines, mills, etc. As these schools proved their value, it became generally recognized that they had come to stay, and it was determined to ascertain what other countries were doing in this field. The senior specialist in nursery-kindergarten-primary education of the Office of Education was, accordingly, sent on a mission of inquiry to England, Scotland, Belgium, Holland, Italy, Austria, Hungary, Czechoslovakia, the Soviet Union and Poland. Hence the present report, which describes administrative and financial arrangements, housing and equipment and the training of nursery school teachers. In addition, the report deals with health and nutrition and family housing in relation to young children. In scientific planning for the staffing of nursery schools, the Soviet Union is pre-eminent with a network of institutes preparing the teachers who are to take care of the 3½ million children between three and seven years of age for whom nursery and infant schools are to be ready this year. Statistics of attendance in such schools in fourteen countries for 1934 show a maximum of 66 per cent of the population (ages 3–6) in Belgium. France comes next with 52 per cent.

Statistics concerning Non-manual Workers

THE Advisory Committee on Salaried Employees, set up by the International Labour Office at its meeting on November 18–19, reviewed statistics, compiled by the International Labour Office, relating to non-manual workers in different countries, which show the tendencies for the proportion of salaried employees to workers to rise in recent years, to which attention was recently directed at the British Association meeting by Mr. S. W. Stephen. The proportion of women among salaried workers has also risen markedly since before the Great War. In industrial countries, non-manual workers now represent 20–30 per cent of the occupied population. In noting the general tendencies, the Committee recommends that the International Labour Office should continue its studies in this field. Attention was also given to the question of notice of termination of contracts, and opinion was expressed that formal rules should be introduced in this respect in countries where they are not yet in existence. Such regulations should provide for a minimum period of notice to be given by the employer in accordance with the importance of the work performed or its remuneration. A report on the effects of the use of office machinery on conditions of work for staff was also considered, and measures for improving the standing of office employees and protecting them against some of the effects of mechanization were suggested. These suggestions cover essentially the type of work at present being carried out by the National Institute of Industrial Psychology, so far as its resources permit. The protection of the health of employees was also considered, attention being directed to the unsatisfactory conditions in many shops and offices, including warehouses and the premises of forwarding agents, from the point of view of the health, comfort and safety of the staff.

South African Herbage Crops

THE grasslands and forage crops of the British Dominions and Colonies have been the subject of various issues in the Herbage Publication Series, New Zealand and Australia being dealt with in Bulletins 11 and 14 respectively, while papers on research in India and Canada have appeared in *Herbage Reviews*. The most recent addition to this series published by the Herbage Bureau, Aberystwyth, is Bulletin 18 entitled, "Pastures and Forage Crops in South Africa" (Aberystwyth: Imperial Bureau of Plant Genetics. 3*s*.) in which contributions are made by such recognized authorities as I. B. Pole Evans, A. R. Saunders, J. W. Rowland and S. R. de Villiers. The four distinct types of natural pasture, namely, parkland, grassland, desert shrub and sclerophyllous bush are described in detail so that the special problems associated with each of them are clearly i[illegible]ted. The discovery that the general decline in [illegible]ng capacity of the veld had resulted from faulty grazing management has led to a research programme being developed on national lines to enable the natural pastoral resources to be more efficiently utilized. At the same time, the progressive nature of the livestock policy has brought the question of fodder crops to the fore, and more attention will have to be paid to the production of legumes in the future. The importance of breeding work is also recognized, and as a result of the intensive botanical survey recently undertaken, a large and valuable collection of indigenous grasses has been made. From this it is hoped to build up the types of herbage most suitable for the various districts, introduction of grasses from Europe or America being largely ruled out owing to the differences in climatic conditions.

Research at Apia Observatory

THE annual report for 1933 of the Apia Observatory, an institution which is controlled by the New Zealand Department of Scientific and Industrial Research, contains seismological, meteorological, magnetic and electrical data for Apia (western Samoa), and climatological summaries for a number of islands in the South Pacific. The electrical data refer to atmospheric electricity, and were obtained under the guidance of the Department of Terrestrial Magnetism at Washington, D.C., U.S.A., as in former years. They include observations made with Benndorf electrometers. A tide gauge was maintained, and copies of the tabular records were supplied to the United States Coast and Geodetic Survey at Washington. In the more ordinary meteorological work, seventy soundings were made with pilot balloons, to give information about the upper winds. Another activity in that section was the preparation of daily synoptic weather charts. The material for these was collected by Apia Radio Station. Twenty observing stations from various islands contributed to this, thus forming the nucleus of a synoptic network. Material of the kind included in this report forms the observational basis of text-books of world climatology, but the report keeps to the statistical type of presentation, no attempt being made to relate the results to those obtained in other parts of the world.

Cancer Research at the Franklin Institute

AN illustrated brochure has recently been published by the Biochemical Research Laboratories of the Franklin Institute, Philadelphia, describing the aims of the Foundation, which previously was known as the Cancer Research Laboratories. It is pointed out that research has extended from studies of cancer alone to other phases of life and disease, so that it appeared suitable that past research done on the cancer problem should be made an avenue of approach [illegible] more general area of other diseases. The aims [illegible] ation are the study of the processes of [illegible] emical point of view, the study of [illegible] ical compounds with regard to their [illegible] medicinal and beneficent values and the [illegible] longevity and the diseases of age, with the [illegible] of prolonging the span of life. The booklet points out that the investigators at the Institute work as a team, although grouped in the three departments of chemistry, physics and cytology: the director is Dr. Ellice McDonald. The library is an important feature of the Institute, with more than 16,000 classified reprints with author and subject reference. The brochure concludes with a list of 101 papers published during the past nine years from the Institute or the Cancer Research Laboratories.

Standards of Telephone Transmission

IN the Engineering Supplement to the *Siemens Magazine* of January, W. H. Grinsted discusses the problem of the standards used for the assessment of telephone transmission. The wide range of variation of many of the factors involved makes the problem a very complex one. The factors affecting transmission may be divided into the conditions associated with the users, including their own peculiarities, and the plant provided by the administration. Transmission is said to be satisfactory when two subscribers can converse without misunderstanding or strain. During the last four years, experiments have been made in the Siemens' laboratories on a method of transmission testing for 'satisfactoriness' based on this definition. Measurements of satisfactoriness are often made by sending speech to the limit of intelligibility or using nonsense syllables (logatomes), but neither represents conditions similar to normal operation. The latest American scheme is to use 'judgment observations', that is, personal preference as the criterion. The objection to this method is that different persons give very different reasons for preferring one circuit to another. In the method described by the author, the quality of the transmission is measured by noting the number of times that the listener's attention is diverted by the need for conscious effort to understand a word or phrase. The method is highly subjective, but this is necessary if it is to take into account some important factors. The limitations of the method are also discussed.

Universities and War

IN Great Britain there is some difference of opinion as to the purpose of university education. In Italy the question has been definitely settled. What follows is a translation of the beginning of the preface to "Nozioni di Balistica Esterna", by T. Levi-Civita and U. Amaldi (Zanichelli, Bologna, 1935): "The Supreme Council of Defence has requested that University programmes of studies in every subject shall comprise, as an integral part of the course, the theories that more directly concern Military Science and Technique; and in particular has pointed out the claims of External Ballistics to be included in the Theoretical Mechanics Course. We have accordingly thought it our duty to complete with this appendix our Compendium of Theoretical Mechanics (Zanichelli, Bologna, 1928), which has been drawn up to conform with the programme of a regular course at a University or Higher Engineering College. The Contents of this Appendix faithfully follow the programme suggested by the aforesaid Supreme Council of Defence. . . ." We should like to see the corresponding programmes for other subjects, including theology. Presumably that for literature would include Nietzche's dictum "Man is made for War . . . ; all else is folly".

Literature on Water and its Pollution

A VALUABLE summary of abstracts of current research upon water and its pollution, prepared by the Water Pollution Staff of the Department of Scientific and Industrial Research, is issued monthly. In the January number (**10**, No. 1, 1937. H.M. Stationery Office. Price 2*s.* net) the matter deals with a variety of subjects grouped under "Water Supplies", "Analysis and Examination of Water", "Sewage", "Trade Wastes" and "Pollution of Natural Waters". The abstracts are fair summaries of the original literature.

Telephone Loudspeakers for Group Conversations

WE learn from the Soviet Union Year Book Press Service that a telephone loudspeaker to enable several persons to take part in a telephone conversation has been designed by the radio and telephone workshop of the Moscow Province post office administration. The apparatus consists of a loudspeaker and microphone instead of the ordinary handset. The microphone can be placed at a distance of three feet or more from the persons taking part in the conversation. If desired also, several telephone lines can be connected with the apparatus at the same time. It is operated with 110–120 volts alternating current. Thirty of these new devices have already been made. It is not stated for what purposes they are intended. They might be useful for a teacher or lecturer who wanted to address several small classes simultaneously, although the classes were at considerable distances apart.

Radcliffe Travelling Fellow in Astronomy

FOLLOWING nomination by the University of Oxford, the Radcliffe Trustees have elected Dr. H. Zanstra, of the University of Amsterdam, to the post of Radcliffe travelling fellow in astronomy for the three-year period commencing October 1937. Dr. Zanstra, formerly a National Research Fellow in the United States, has held university posts at Seattle, the Imperial College, and Amsterdam, and has carried out observational work at the Dominion Astrophysical Observatory, Victoria. He is best known for his theory of the origin of nebular luminosity, for his observational determination of the temperatures of the nuclei of planetary nebulæ, and for his investigations of the effects of radiation pressure on the stability of nebulæ.

The Night Sky in April

BETWEEN April 1 and 30, the nights shorten in the latitude of London by nearly two hours. Summer Time comes into operation on April 18. New moon occurs on April 11 at $5{\cdot}2^h$ and full moon on April 25 at $15{\cdot}4^h$. If the evenings are clear, 'earthshine' on the moon may be observed from about April 13 until April 16. The planet Venus, which was conspicuous in the evening skies of last month, draws rapidly towards the sun's position until inferior conjunction takes place on April 18 ; next month it will be seen as a morning star. Mercury, which is usually rather a difficult object in the latitude of Great Britain for naked-eye observation, is at greatest eastern elongation (20° E.) on April 20. The planet is in conjunction with Venus on April 7 at 15^h. On April 12 at 8^h Mercury and Uranus are in conjunction, and at 12^h on the same day there is a conjunction between Mercury and the moon which is then just over a day 'old'. Mars rises before midnight and is placed not far from Antares. Jupiter is a morning star, rising at about $2\frac{1}{4}^h$ in the middle of the month. Saturn, rising in the dawn, is not conspicuous. By 22^h in mid-April, the winter constellations of Taurus, Orion, Canis Major and Canis Minor with their bright assembly of stars have nearly set in their entirety, whilst Vega has risen in the north-east, and Arcturus is about $2\frac{1}{2}$ hours east of the meridian. The constellations on or near the meridian at this time offer several attractive objects for telescopic observation—the bright double stars of γ Leonis (separation about 4″), *Castor* ($4\frac{1}{2}''$), ξ Ursæ Majoris (1″), γ Virginis (6″), and α Canum Venaticorum (20″). Messier 51 at R.A. $13^h\ 28^m$, Dec. $+47{\cdot}4°$ (epoch 1950), which is one of the best known spiral nebulæ, requires of course a large telescope and the photographic plate to resolve its structure. Messier 3 at R.A. $13^h\ 40^m$, Dec. $+28{\cdot}6°$ is a notable globular cluster 18′ in diameter, whilst the "Owl" planetary nebulæ (Messier 97) is at R.A. $11^h\ 12^m$, Dec. $55{\cdot}3°$. The Lyrid meteors may be looked for on and about April 21, their radiant being near the star 104 Herculis. The northern sky should be scanned for appearances of the aurora—more particularly when a large sunspot is crossing the sun's disk.

Announcements

MR. T. E. HARVEY (Independent Progressive) has been elected M.P. for the Combined English Universities in the by-election caused by the death of Sir Reginald Craddock. Mr. Harvey was formerly an assistant in the British Museum and warden of Toynbee Hall.

DR. H. J. MULLER, the distinguished Russian geneticist working with Prof. N. I. Vavilov, informs us that on March 15 he arrived at Valencia and was proceeding to Madrid for work with the Canadian blood transfusion unit. Dr. Muller states that he hopes to resume later the work in genetics which he had been carrying out in the Soviet Union, and which his colleagues there are continuing in his absence.

THE report of the Third Correlation Tour undertaken by the Soil Surveyors' Executive Committee has just been published by the Ministry of Agriculture, for England and Wales, and the Department of Agriculture for Scotland. The w[illegible] committee is to correlate soil series examined [illegible] by soil surveyors in different parts of the [illegible] and its third report refers particularly to the B[illegible] Reading and West Midland Provinces and to Wales. Copies of the publication may be obtained gratis on application to the Ministry of Agriculture, 10 Whitehall Place, London, S.W.1.

THE Laboratory of Industrial Hygiene has been incorporated under the laws of the State of New York as a non-profit organization empowered to carry on scientific and industrial work in chemical, bacteriological and general public health problems, and to accept grants for definite scientific purposes. The president is Dr. William Hallock Park. The laboratory includes at the present time the following units : a certified milk laboratory under the direct supervision of Dr. Park, a vitamin-testing laboratory, a clinical diagnostic laboratory and chemical and bacteriological laboratories.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 553.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

New Knowledge of the Life-Cycle of Malaria Parasites

WE wish to direct attention in this letter to an interesting result of our work at this Institute on the malaria parasite of the domestic fowl, which Prof. Brumpt, of Paris, found and described in 1935 and to which he gave the name *Plasmodium gallinaceum*[1,2].

This parasite, like other members of the family Plasmodiidæ, has a schizogonic cycle of development in the circulating red blood corpuscles of its vertebrate host (the domestic fowl) and a sporogonic cycle of development in its insect host which, as Brumpt has shown, is the yellow fever mosquito *Stegomyia fasciata* (*Aedes aegypti*). But it appears from our work that it has, in addition, a hitherto unrecognized schizogonic cycle of development occurring in reticulo-endothelial cells of the spleen, liver, kidneys and other internal organs and particularly, in certain cases, in the reticulo-endothelial cells which line the capillaries of the brain.

The first step in this finding was that in January this year, one of us (S. P. J.) observed in the cytoplasm of endothelial cells from the spleen and heart blood of a chicken which had died from the malarial infection, unpigmented schizogonic phases of a parasite which bore no resemblance to the pigmented 'sporulating' or 'pre-sporulating' stages of the malaria parasite occurring in red blood corpuscles. Provisionally we called these phases "x bodies". Then a search of the literature showed that in 1935 Clay Huff and Bloom[3], of the University of Chicago had found what seemed to be the same phases in erythroblastic and lymphocytic cells of the bone marrow of birds infected with *Plasmodium elongatum*, and that in 1936 Prof. Raffaele[4] of the Marchiafava Institute for Malariology in Rome had found what are certainly the same phases in the reticulo-endothelial system of birds infected with *Plasmodium relictum*. The interpretations given to their findings by these observers are not at all the same, but this seems to us to be less important than is the fact that observers working independently in three different countries on three different species of avian plasmodia have found that at any rate some malaria parasites have an additional cycle of development in the vertebrate host which was previously unknown.

As regards the life-history of human malaria parasites, the occurrence of such a cycle in tissue cells instead of in red blood corpuscles was postulated by several investigators some years ago in an endeavour to explain why quinine is ineffective in preventing attacks of malaria due to the bites of mosquitoes and in preventing the relapses or recurrences which are such a troublesome feature of the human disease. In this connexion, we have repeated on chickens infected with *P. gallinaceum* some of the prophylactic and curative clinical trials with quinine and the synthetic antimalarial drugs which were made on other avian and on human plasmodia in 1931 and later years, and the results seem to indicate that the discovery of the endothelial cell cycle of the parasite opens up an entirely new field for chemotherapeutic research and may help to explain some of the clinical, therapeutic and epidemiological problems of malaria which hitherto have remained unsolved. We think this conclusion is justifiable despite the fact that as yet the discovery has been made only on bird malaria.

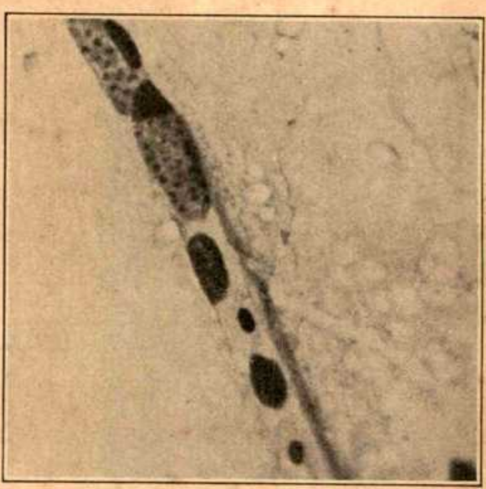

Fig. 1.

At a laboratory meeting of the Royal Society of Tropical Medicine and Hygiene which was held at the Royal Army Medical College on March 18, we showed a series of preparations of various stages of the cycle, including examples from birds which had been temporarily cured of the peripheral blood infection by quinine, but had died later as a result of the uninterrupted development of large schizonts in the endothelial cells lining the capillaries of the brain (Fig. 1).

We should like to add that the discovery, apart from its probable bearing on clinical and therapeutic problems, raises a question of interest to systematists in that it does not seem correct any longer to define the Plasmodiidæ as a family in which the whole of the vertebrate cycle of development occurs in the red blood corpuscles. *P. gallinaceum* is evidently a parasite which, in the vertebrate host, has a cycle of development similar to that of other members of the family Plasmodiidæ but, in addition, it has a cycle of development resembling, in some respects, the schizogonic cycle in endothelial cells which is ordinarily described as being characteristic of members of the family Hæmoproteidæ.

S. P. JAMES.
P. TATE.

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[1] Brumpt, E., *C.R. Acad. Sci.*, **200**, 783 (1935).
[2] Brumpt, E., *Ann. Parasit. Hum. et Comp.*, **14**, 597–620 (1936).
[3] Huff, Clay, G., and Bloom, William, *J. Inf. Dis.*, **57**, 315–336 (1935).
[4] Raffaele, G., *Riv. di Malariol.*, **15**, 309–317 and 318–324 (1936).

Observation of Ultracentrifugal Sedimentation by the Toepler *Schlieren* Method

For the observations of concentration distribution in an ultracentrifuge cell during the process of sedimentation, methods depending on light absorption or refractive index have been used[1,2]. According to the latter procedure, as used in the sedimentation velocity measurements, a scale is photographed through the cell; from the measurements of the displacement of the scale divisions in the distorted image on the photographic plate, the concentration gradient in different parts of the cell is calculated. The resulting gradient diagrams show the number of components present, and their sedimentation velocities and concentrations can be accurately calculated.

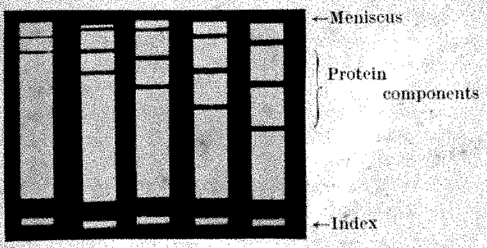

Fig. 1.

Sedimentation pictures of hæmocyanin from *Limulus polyphemus* at *p*H 6·8. 5 min. between exposures. Centrifugal field: 120,000 times gravity. Cell thickness: 12 mm. The black bands represent the three components sedimenting most rapidly.

The well-known Toepler *Schlieren* method, also depending upon the deviation of a beam of light in a concentration gradient, has been used for many similar purposes[3]. Recently, one of us (A. T.) applied this procedure to electrophoresis measurements with quite satisfactory results[4]. The method has now been tried in observations of sedimentation velocities; some examples are given in Figs. 1 and 2. The following optical arrangement is used (Fig. 3): A lens placed as closely as possible behind the centrifuge cell projects an image of a horizontal slit through the cell on to the camera objective. In front of this is a vertically movable screen, having a horizontal edge with which any part of a deviated image of the slit may be cut off. When the screen is properly arranged, any gradients occurring in the cell will give rise to corresponding black bands visible to the eye in the image of the cell and recorded on the plate in the camera, as shown in Figs. 1 and 2. A tungsten ribbon lamp with a condenser lens is used for illumination of the slit.

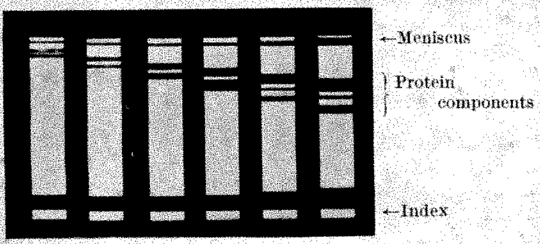

Fig. 2.

Sedimentation picture of a pathological serum (8 parts of serum diluted with 3 parts of a concentrated phosphate buffer). *p*H 6·8. Total salt concentration: 0·25 molar. 10 min. between exposures. Centrifugal field: 350,000 times gravity. Cell thickness: 3 mm. Besides the three components seen in the figure, a fourth slow sedimenting one appeared at the meniscus in later exposures. (Normal serum under the same conditions shows only two components.)

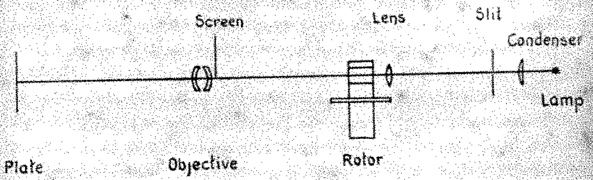

Fig. 3.

The method offers the advantage of rapid and convenient observation of components in mixtures and their sedimentation velocities. It also gives a rough idea of the relative amounts of the differently sedimenting substances. It may be modified also to give a more accurate determination of concentration[5], but for this purpose it does not seem to offer any advantage over the very accurate scale method previously mentioned.

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Feb. 11.

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[1] Svedberg, The, *Z. physik. Chem.*, **121**, 65 (1926).

[2] Lamm, Ole, *Z. physik. Chem.*, A, **138**, 313 (1928); *Z. physik. Chem.*, A, **143**, 177 (1929); NATURE, **132**, 820 (1933).

[3] See for example: F. Kohlrausch, "Lehrbuch der praktischen Physik", and reference 5 below.

[4] Tiselius, A., *Trans. Faraday Soc.* (in the Press).

[5] Schardin, H., "Das Toeplersche Schlierenverfahren" (VDI-Verlag, Berlin, 1934).

Liquid Crystalline Preparations of Cucumber Viruses 3 and 4

In a previous note[1], we showed that liquid crystalline substances infective at high dilutions could be isolated from solanaceous plants infected with three different strains of tobacco mosaic virus. We have been unable to transmit these strains to cucumber plants, and other workers have found cucumber to be immune to tobacco mosaic virus. From cucumber plants infected with cucumber viruses 3 and 4[2], we have now isolated nucleoproteins with a similar chemical composition and similar in many of their properties to those obtained from solanaceous plants infected with tobacco mosaic virus; they are, however, rather less stable and more difficult to isolate.

Of the methods of isolation yet tried, the following has proved most effective: expressed infective cucumber sap is coagulated by heating to 70° C., centrifuged and the supernatant fluid one quarter saturated with ammonium sulphate. A precipitate consisting of small needles or fibres and giving a satin-like sheen is produced, and this is centrifuged off. The precipitate is now dissolved in water and reprecipitated several times with dilute ammonium sulphate solution and with acid at about *p*H 4·8. If this fails to give colourless solutions, further purification can be effected by high-speed centrifugation or by incubation with trypsin. Highly purified preparations of the cucumber viruses, if sufficiently concentrated, separate into two liquid layers; the lower layer is spontaneously birefringent and the upper layer readily shows the phenomenon of anisotropy of flow.

Systemic infections of cucumber plants were obtained by inoculating 1 c.c. of a solution containing 10^{-9} gm. of these nucleoproteins, and specific precipitates with antiserum were obtained with $1/8 \times 10^{-6}$ gm. No infection of tobacco, tomato, *Nicotiana glutinosa* or Golden Cluster beans (all of which are susceptible to tobacco mosaic virus) was obtained, even when they were inoculated with concentrated solutions.

Purified preparations of cucumber viruses 3 and 4 do not differ appreciably from one another in any of the properties yet investigated, but they differ in some respects from those of tobacco mosaic virus. Their precipitation point with acid in dilute salt solutions is about *p*H 4·8, and in the absence of salts about *p*H 5·5, whereas for tobacco mosaic virus preparations these points are *p*H 3·4 and 4·2 respectively. It is tempting to associate the difference in host range of the two groups of viruses with their behaviour with acid, for the *p*H of expressed cucumber sap is about 7·8 whereas that of tobacco sap is about 5·8.

The preparations of cucumber viruses 3 and 4 are very similar to one another antigenically, and they are also serologically related to those of tobacco mosaic virus. They differ antigenically, however, much more from tobacco mosaic virus than from one another, and much more than the recognized strains of tobacco mosaic virus differ from each other. As yet only preparations of viruses serologically related to tobacco mosaic virus have been found to show anisotropy of flow and to form spontaneously birefringent solutions. From plants infected with five distinct viruses not serologically related to tobacco mosaic virus, we have been unable to isolate any substances with these properties by precipitation with acid or strong salt solutions, although highly infective preparations have been obtained.

With these cucumber viruses, as with those previously described, we have been unable to dissociate virus activity from the liquid crystalline nucleoproteins, but there is no proof that our preparations contain only particles capable of infecting susceptible plants.

We wish to thank Dr. G. C. Ainsworth for supplying us with cucumber viruses 3 and 4, and Mr. E. T. C. Spooner for preparing the antisera used.

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[1] Bawden, F. C., Pirie, N. W., Bernal, J. D., and Fankuchen, I., NATURE, 138, 1051 (1936).

[2] Ainsworth, G. C., *Ann. Appl. Biol.*, 22, 55 (1935).

Latent Impurities in Electrodes used for Spectrographic Research

THE recent communication in NATURE by D. A. Webb[1] is of particular interest to me because for the last six years a minor part of my time has been devoted to an attempt to evolve a satisfactory spectrographic method for analysing plant material for the twenty or so elements usually present. Great progress has recently been made as a result of invaluable and much appreciated help given voluntarily by Mr. A. L. Tackley from September to January. The resulting method promises to be satisfactory and it is hoped to standardize it shortly. The great importance of the determination of the minor, as well as the major, elements in plant and animal tissues, in view of the increasing realization of their importance to the organism, seems to justify some mention of the progress made in meeting the difficulties mentioned by Webb.

The method consists in preparing small electrodes from the plant material itself without the addition of any foreign substance, except platinum wire, and comparing its spectrogram with that given by one of known composition prepared by adding pure substances to the purest grade of filter paper.

The plant material is kept at 200° C. for 24 hours, after which it is ground in an agate mortar. 0·0035 gm. of the dark brown powder is compressed in a specially constructed press under a pressure of the order of 500 tons per sq. in. around the end of a short length of platinum wire of diameter 0·005 in. The electrode is transferred by its platinum wire to a small specially designed electric furnace, in which the carbonization is effected by heating for five minutes at a low red heat, following a preliminary heating for the same length of time with half the current flowing. Two such electrodes, each measuring about 2 mm. in diameter and 1 mm. long, are held by the platinum wire and sparked in an atmosphere of nitrogen. Practically the whole of the material may, if desired, be disintegrated. It is fortunate that, under the conditions of excitation so far employed, the platinum spectrum has not appeared on the plate.

As is well known, even the purest filter paper contains minute quantities of impurities, mainly calcium and silicon. This admittedly is a drawback, but it is not a serious one, because these elements occur in comparatively large amount in almost all parts of plants. Filter paper has the great advantage for the purpose of being composed of one of the main organic constituents of the plant, namely, cellulose, so that the resulting electrode should resemble closely in texture the one prepared from plant material. Further, by means of specially designed micropipettes, known volumes of standard solutions may be quickly and accurately added to the paper. The pipette is filled by capillarity when its tip touches the surface of the liquid and is emptied by being allowed to touch the filter paper. The pieces of filter paper with their charges of salts are dried and treated in the same way as plant material.

The method, with slight modifications, should be applicable to a variety of types of material. In view of the promising results so far obtained, it will be developed as rapidly as limited man-power allows.

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Feb. 12.

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[1] Webb, D. A., NATURE, 139, 248 (1937).

Reaction of Nitric Oxide with Hæmoglobin and Methæmoglobin

THAT hæmoglobin reacts with nitric oxide is well known, but there is no agreement in the literature as to the mechanism of this reaction or the nature of the compound thus obtained.

According to Haurowitz[1], nitric oxide combines only with reduced hæmoglobin in complete absence of oxygen or even in the presence of a reducer (sodium hyposulphite, $Na_2S_2O_4$). Methæmoglobin, according to this author, does not combine directly with nitric oxide, but is reduced by it to hæmoglobin which then combines with more nitric oxide. Anson and Mirsky[2], on the other hand, consider that nitric oxide combines normally with methæmoglobin. They believe that hæmoglobin in presence of nitric oxide is oxidized to methæmoglobin, which then forms the nitric oxide compound. However, their experiments, consisting in injection of hæmoglobin by means of a syringe into a tonometer containing a mixture of nitrogen and nitric oxide, do not exclude the possibility of introducing dissolved oxygen, the latter giving rise to nitrogen dioxide, which may be responsible for oxidation of hæmoglobin to methæmoglobin.

Careful study of these reactions has convinced us that both these interpretations are only partly correct. All our experiments have been carried out in modified Thunberg tubes which received 3 c.c. of 0·5 per cent solution of hæmoglobin or methæmoglobin at *p*H 6·5, unless otherwise stated. The tubes were evacuated, washed several times with pure nitrogen, and filled with pure nitric oxide. According to the experiment, the hollow stoppers of the tube may receive various reagents which can be mixed with the contents of the tubes.

I. *Reaction between Nitric Oxide and Hæmoglobin.*

(1) Solutions of oxyhæmoglobin reduced in Thunberg tubes to hæmoglobin by evacuation, when mixed with nitric oxide, turn distinctly red and show two wide and somewhat diffuse bands at 574·5 mμ and 536 mμ.

(2) The same result is obtained in presence of an excess of sodium hyposulphite added at different stages of the reaction.

(3) This compound is very stable and is not decomposed by the addition of a great excess of sodium sulphite or by washing on an ultrafilter membrane.

(4) Potassium ferricyanide added to this compound after removal of excess of nitric oxide only slowly oxidizes it to acid methæmoglobin.

All this confirms Haurowitz's view that the reduced hæmoglobin combines with nitric oxide forming NO–Hb compound.

II. *Reaction between Nitric Oxide and Methæmoglobin.*

(1) An acid solution of methæmoglobin completely free from oxygen mixed in a Thunberg tube with pure nitric oxide rapidly turns red and its absorption spectrum is replaced by two bands at 568 mμ and 531 mμ. These bands are, however, more distinct than those of NO-hæmoglobin and lie 50–60 A. nearer the blue end of the spectrum.

(2) This compound is obtained in the presence of a great excess of potassium ferricyanide.

(3) A solution of acid methæmoglobin, before it is treated as in experiment 1, is mixed with 10 mgm. of sodium sulphite. When this solution is shaken with pure nitric oxide, the bands of methæmoglobin are rapidly replaced by the two bands at 568 and 531 mμ. On standing a minute or two, the colour and the absorption spectrum revert to those of acid methæmoglobin. This reversion can be repeated several times. Sulphite, on combining with dissolved nitric oxide, liberates acid methæmoglobin.

(4) A Thunberg tube with acid methæmoglobin and a little potassium cyanide in the hollow stopper is treated as in experiment 1. When the red compound with two absorption bands is formed, the cyanide is mixed with the solution and the absorption spectrum of NO-methæmoglobin is replaced by that of KCN-methæmoglobin.

(5) A similar experiment carried out with sodium fluoride instead of potassium cyanide gives only a partial formation of fluoride methæmoglobin. The incomplete reaction in this case is due to the comparatively low affinity of fluoride for methæmoglobin.

(6) If methæmoglobin is treated with nitric oxide at *p*H 5·6 and the tube is evacuated immediately the compound is formed, the NO-compound is almost completely reversed to methæmoglobin.

All these experiments clearly demonstrate that methæmoglobin forms with nitric oxide an easily reversible NO-MHb compound. This compound is, however, very unstable. Its absorption bands gradually become diffuse and move towards the red end of the spectrum. The NO-MHb, soon after its formation, is gradually transformed into a compound which is indistinguishable from NO-Hb, and this change is accelerated if the nitric oxide in the tube is replaced by nitrogen. The fact that this transformation is greatly accelerated on addition of a reducer (sodium hyposulphite) shows that NO-MHb in complete absence of oxygen undergoes reduction to NO-Hb.

Nitric oxide combines therefore with hæmoglobin (NO-Hb) and methæmoglobin (NO-MHb). With hæmoglobin it forms a very stable compound from which free hæmoglobin cannot be easily recovered. With methæmoglobin, however, it forms an easily reversible compound which is not stable and which, on standing, undergoes reduction to NO-Hb.

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[1] Haurowitz, F., *Z. physiol. Chem.*, **138**, 68 (1924); **151**, 130 (1926).

[2] Anson, M.L. and Mirsky, A.E., *J. Physiol.*, **60**, 100 (1925).

Aldehyde Mutase

IT is generally believed that aldehyde mutase (the enzyme which catalyses the dismutation of aldehydes in accordance with reaction (1)) is identical with aldehyde oxidase, which oxidizes aldehydes in accordance with reaction (2):

$$(1)\ \mathrm{R{-}CHO + R{-}CHO + H_2O = R{-}COOH + R{-}CH_2OH}$$
$$(2)\ \mathrm{R{-}CHO} + A \qquad \mathrm{+ H_2O = R{-}COOH} + A\mathrm{H_2}$$

where A may be O_2, methylene blue or some other 'hydrogen acceptor'. Wieland[1] suggests that the oxidase normally uses a hydrogen acceptor to produce an oxidation of the aldehyde, but when no other acceptor is present it uses a second molecule of aldehyde as acceptor, reducing it to alcohol and so producing a dismutation of aldehyde (reaction 1).

We find, however, that aldehyde mutase and aldehyde oxidase are two distinct enzymes which can be obtained separately. Oxidase preparations made from milk by the methods of Dixon and Thurlow[2] or Dixon and Kodama[3] are very active in catalysing the oxidation of aldehydes by oxygen or by methylene blue, but we can detect no trace of dismutation of aldehydes by these preparations, even in presence of co-zymase. On the other hand, we have obtained very active mutase preparations by precipitating an aqueous extract of horse liver with alcohol, rejecting the precipitate, and again precipitating the fluid with a mixture of acetone and ether. These mutase preparations are totally unable to oxidize aldehydes either with methylene blue or with oxygen, even after addition of the cytochrome-oxidase system. (Some preparations made by Reichel's[4] method behave similarly, but others contain small amounts of aldehyde oxidase and catalyse both reactions.)

Not only can the two enzymes be prepared free from one another, but also they behave differently in several respects. The mutase is strongly inhibited by iodoacetic acid, which has little or no action on the aldehyde oxidase. The oxidase is completely inactivated by treatment with cyanide, which does not inhibit the mutase. On the whole, the oxidase acts better with aromatic, and the mutase with aliphatic, aldehydes, probably owing to differences of affinity. The mutase is apparently only active in the presence of co-zymase, in agreement with the views of Euler[5], whereas co-zymase is quite unnecessary for the oxidase. (Mutase from dog liver is practically inactive unless co-zymase is added; horse liver preparations appear to contain some co-zymase and are already active, but the activity is greatly increased by adding further co-zymase.)

The mutase preparations produce a rapid dismutation of methyl glyoxal, apparently to pyruvic acid and acetol, about 1 mol of acid being produced from 2 mols of the aldehyde in accordance with equation 1. Boiled mutase preparations of course have no effect. The milk oxidase preparations produce an apparent dismutation of methyl glyoxal, but roughly 2 mols of acid are produced from 2 mols of aldehyde; the product is lactic acid, and the reaction is given equally well by boiled oxidase preparations. This reaction is therefore not enzymatic, but is due to the milk proteins. The same reaction is brought about by glyoxalase, but whereas glyoxalase is inactive without its co-enzyme, glutathione, this system is independent of glutathione.

Most of the mutase experiments were done manometrically by measurement of acid production by the method used by Lohmann[6] and others. The reactions took place in dilute bicarbonate solution in Barcroft manometers, the flasks being filled with a mixture of 95 per cent nitrogen plus 5 per cent carbon dioxide (completely freed from traces of oxygen) before mixing the reactants. The acid then produced was neutralized by the bicarbonate, releasing an equivalent amount of carbon dioxide, which was measured manometrically. Corrections were applied for the 'retention' of carbon dioxide. Serious difficulties were encountered in following the mutase reaction by chemical estimations, but the main points were checked chemically.

The subject is being fully investigated, and the results will be published in detail elsewhere.

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C. Lutwak-Mann.

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Feb. 27.

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[1] Wieland, H., *Ber. deutsch. chem. Ges.*, **47**, 2085 (1914).
[2] Dixon, M., and Thurlow, S., *Biochem. J.*, **18**, 971 (1924).
[3] Dixon, M., and Kodama, K., *Biochem. J.*, **20**, 1104 (1926).
[4] Reichel, L., and Köhle, H., *Z. physiol. Chem.*, **236**, 145 (1935).
[5] Euler, H. v., and Brunius, E., *Z. physiol. Chem.*, **175**, 52 (1928).
[6] Lohmann, K., *Biochem. Z.*, **254**, 332 (1932).

A New Biological Stain for General Purposes

It was accidentally discovered while dissecting small Crustacea under spirit on a background of black velvet, that a dye dissolved very slightly in spirit and stained the chitin a distinct green. This observation was communicated to the Dyestuffs Group of Imperial Chemical Industries, Ltd., who succeeded, after investigation, in supplying a suitable dye in the Chlorazol series, which on further experiment was found to act as a very useful general biological stain.

This Chlorazol Black E *Biological quality* stains nuclei and chromosomes black, rivalling iron hæmatoxylin in its effects. At the same time, it stains cytoplasm and secreted products varying shades of grey. It can be used for whole tissues as well as for sections. It is an excellent stain for chitin which it stains green, and probably for glycogen which stains pink or red.

Its main advantages are that it requires *no mordant* and *no differentiation*, but if by chance sections or tissues are overstained, they can be differentiated in terpineol or dilute 'Milton'. It can be used in either alcoholic or aqueous solutions, and as it is only slightly soluble a small amount of dry stain is all that is necessary. A saturated solution in 70 per cent spirit stains ordinary sections in from fifteen to thirty minutes. So far as I have been able to test it, slides do not fade even if left exposed to daylight for twelve months.

A supply of this colour has been reserved by Imperial Chemical Industries, Ltd., and I have tested it and found it to be satisfactory. It can be obtained from any of the sales offices of Imperial Chemical Industries, Ltd.

H. Graham Cannon.

The University,
Manchester, 13.
Feb. 26.

A Whale Shark rammed by a Steamer off Colombo, Ceylon

Early on the morning of November 23, 1932, the Dutch steamer *Johan van Oldebarnevelt*, Captain Julsing commanding, caught a whale shark on her bow in lat. 7° 5′ N., long. 77° 50′ E.—about 150 miles west of Colombo, Ceylon. The shark (size not noted) was killed, and when the vessel was slowed down it sank. Captain Julsing knows the whale shark and states that this fish in size, shape and colour markings was a counterpart of the other which his vessel killed in 1933—presently to be noted. This phenomenon seems worthy of brief record for a number of reasons. It is an extraordinary thing in itself. Also, it is the second time that this vessel has impaled a whale shark on her bow, and it makes the fifth record of such an extraordinary happening. Finally, it adds another *Rhineodon typus* to the roster of this fish recorded for Ceylonese waters.

In November 1933, the *Oldebarnevelt* struck and killed a whale shark off the Island of Perim, in the Strait of Bab el Mandeb. Fortunately for science, the Dutch ichthyologist, Dr. H. C. Delsman, was on board. He saw the fish hung on the stem of the vessel, positively identified it, and recorded the occurrence in Nature[1].

However, this is neither the only nor the first whale shark rammed by a vessel in the Red Sea. On May 14, 1933, the Italian steamship *Francesco Crispi*, while off Port Sudan, on the west side of the Red Sea about half-way down from Suez, was slowed down by a great spotted shark bent double over the prow of the vessel. The whole matter was investigated and reported on fully with much photographic evidence by Renato Santucci[2].

Still earlier, I had recorded two similar happenings[3]. On July 6, 1924, the Elder Dempster and Co.'s motor vessel *Alba*, in the Gulf of Guinea (lat. 4° 28′ N., long. 6° 24′ W.), ran into a whale shark—breaking its back. Earliest of all, the Munson liner *American Legion* ran afoul of a 30-ft. specimen in lat. 17° 57′ S., long. 38° 41′ W.—near the Abrolhos Light, off the coast of Brazil.

Finally, it is of interest to note that the whale shark rammed by the *Oldebarnevelt* off Colombo, in 1932, makes a fourth definite record of this fish for Ceylonese waters. The whole question of *Rhineodon* in this region has been carefully gone into in a communication published by me in 1933[4]. In this a number of reputed occurrences were shown to be erroneous. In addition to the four whale sharks definitely to be assigned to Ceylon, three have been recorded from the neighbouring waters of southern India—one at Trivandrum and two at Madras. The total count for southern India is, then, at present, seven specimens.

E. W. GUDGER.

American Museum of Natural History,
New York City.

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[1] NATURE, **133**, 176 (1934).

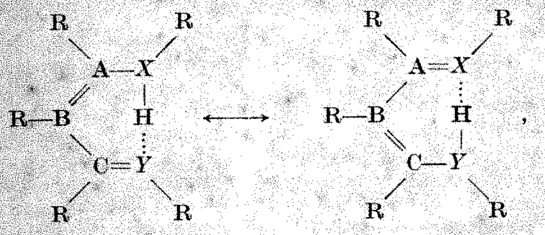
[2] *Boll. Mus. Lab. Zool. Anat. Comp. Univ. Genova*, **14**, No. 14, 14, 7 figs. (1934).

[3] Gudger, E. W., *Bull. N.Y. Zool. Soc.*, **30**, 76, fig. (1927); *Natural History*, **23**, 62, 2 figs. (1923).

[4] Gudger, E. W., "The Whale Shark in the Waters around Ceylon", NATURE, **131**, 165 (1933).

Synchronized Oscillations in Hydrogen Bridges

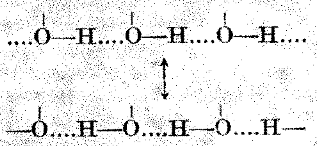
MOST of the compounds now known to contain intramolecular hydrogen bridges can be represented[1] by the formulæ:



in which *X* and *Y* denote oxygen or nitrogen atoms. As indicated, there is undoubtedly resonance between the two extreme structures represented. An equally important but apparently hitherto overlooked stabilizing factor is the tendency of the electron distribution around the ring to shift in synchronism with the oscillational motion of the bridge hydrogen. The electron shifts produced by motion of this hydrogen in the direction *X*—*Y* decrease the *X*—H attraction and increase the *Y*—H attraction. As a result, the small energy hump which would probably otherwise exist[2] in the centre of the bridge is greatly reduced or eliminated entirely, and the bridge stability is increased.

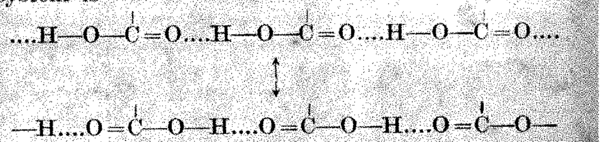
In rings containing two hydrogen bridges, such as occur in the formic acid dimer[3], in β oxalic acid[4] and in isatin[5], the two bridging hydrogens tend to oscillate synchronously, the oscillation of each aiding that of the other.

Synchronous oscillation of the hydrogens of hydrogen bridges suitably linked together in long strings must increase their stability. In resorcinol[6] and in a number of inorganic hydroxides, resonating bridge systems of the type



$$\begin{array}{c}\ldots\overset{|}{\mathrm{O}}\text{—}\mathrm{H}\ldots\overset{|}{\mathrm{O}}\text{—}\mathrm{H}\ldots\overset{|}{\mathrm{O}}\text{—}\mathrm{H}\ldots\\ \updownarrow\\ \text{—}\overset{|}{\mathrm{O}}\ldots\mathrm{H}\text{—}\overset{|}{\mathrm{O}}\ldots\mathrm{H}\text{—}\overset{|}{\mathrm{O}}\ldots\mathrm{H}\text{—}\end{array}$$

apparently exist. In α oxalic acid[4], the resonating system is



$$\begin{array}{c}\ldots\mathrm{H}\text{—}\mathrm{O}\text{—}\overset{|}{\mathrm{C}}=\mathrm{O}\ldots\mathrm{H}\text{—}\mathrm{O}\text{—}\overset{|}{\mathrm{C}}=\mathrm{O}\ldots\mathrm{H}\text{—}\mathrm{O}\text{—}\overset{|}{\mathrm{C}}=\mathrm{O}\ldots\\ \updownarrow\\ \text{—}\mathrm{H}\ldots\mathrm{O}=\overset{|}{\mathrm{C}}\text{—}\mathrm{O}\text{—}\mathrm{H}\ldots\mathrm{O}=\overset{|}{\mathrm{C}}\text{—}\mathrm{O}\text{—}\mathrm{H}\ldots\mathrm{O}=\overset{|}{\mathrm{C}}\text{—}\mathrm{O}\text{—}\end{array}$$

In proteins, the chief forces (other than those in the crystine and similar cross links) connecting the primary chains I believe to be due to hydrogen bridges. Both the so-called 'salt linkages' and the frequently assumed attractions between CO and NH groups may reasonably be assumed to be of this character. A reasonable structure for β keratin[1,7], for example, is one involving synchronized hydrogen and electron oscillations along..HNCOHNCOHNCO..strings comparable to the..HOCOHOCOHOCO.. strings in oxalic acid. With other proteins (and with keratin in less extended form) structures differing in detail must be assumed, but in all, I firmly believe, NHO bridges are most important in joining the primary chains. Pictures of this sort seem to me preferable to those proposed by Wrinch[8].

MAURICE L. HUGGINS.

Kodak Research Laboratories,
Rochester, New York.
Dec. 11.

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[1] Huggins, *J. Organic Chem.*, in the Press.

[2] Huggins, *J. Amer. Chem. Soc.*, **58**, 694 (1936); *J. Phys. Chem.*, **40**, 723 (1936).

[3] Pauling and Brockway, *Proc. Nat. Acad. Sci.*, **20**, 336 (1934).

[4] Hendricks, *Z. Krist.*, **91**, 48 (1935).

[5] Cox, Goodwin and Wagstaff, *Proc. Roy. Soc.*, A, **157**, 399 (1936).

[6] Robertson, *Proc. Roy. Soc.*, A, **157**, 79 (1936).

[7] *Cf.* Astbury, "Fundamentals of Fibre Structure" (Oxford Univ. Press, 1933); *J. Text. Inst.*, **27**, *P*282 (1936).

[8] Wrinch, NATURE, **137**, 411 (1936); **138**, 241 (1936); Frank, NATURE, **138**, 242 (1936); Wrinch and Lloyd, NATURE, **138**, 758 (1936).

Effect of Turbulence on the Propagation of Sound

IT is a well-known fact that the propagation of sound in the atmosphere is greatly affected by temperature and wind conditions, yet quantitative data on the actual field of intensity from a sound transmitter are scarce. During some recent studies of the acoustical effect of fog-horns, we determined the attenuation of the sound at the sea surface[1]. A condenser microphone was used at intensities greater than 40 decibels and an auditory comparison method was used at lower intensities. Intensity charts are reproduced herewith (Fig. 1) for two succeeding days on which there were weak winds and apparently homogeneous atmospheric conditions. The two charts show clearly the effect of differing wind direction, but other differences between them are also obvious. On December 13 (B, Fig. 1) the air probably was stratified either with respect to velocity or to temperature, since the intensity chart shows a marked minimum to the north-west.

Independently of these differences in the average field on the two days, our instruments showed rapid variations in the observed intensity. These were not discovered by the ear, the sensitivity of which to intensity differences is rather low for the frequency applied, 300 c./s. Within one sending period of the transmitter, namely, 3 seconds, the variations of energy at the place of observation were often 5–10 decibels (special measurements showed that these variations were not due to fluctuations of the transmitter). We must thus imagine that the surfaces of equal intensity were rapidly changing in a most irregular way, giving an average picture as represented above.

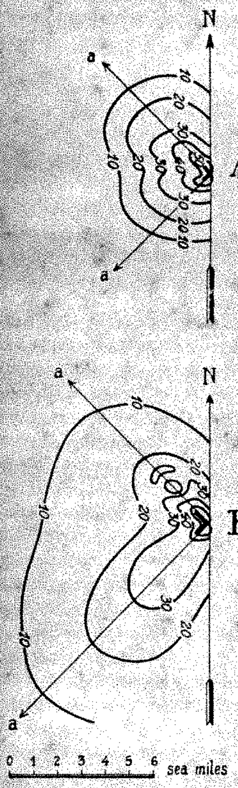

Fig. 1.

FIELD OF INTENSITY (IN PHONS) AT THE SEA SURFACE OF A DOUBLE SOUND TRANSMITTER. *a,a*, AXIS OF HORN. *A*. DECEMBER 12, 1935. WIND S.S.E.; BEAUFORT 2–3. *B*. DECEMBER 13, 1935. CALM OR WIND BETWEEN N.N.E. AND N.; BEAUFORT 1–2.

As already pointed out by Devik[1], the *turbulence* of the air is probably the cause of these great variations. We do not here refer to the molecular dispersion of sound (compare V. O. Knudsen[2]) but rather to the irregular distribution of rolling and whirling 'air bodies' of a great variety of sizes, which we assume will cause a dissipation of sound energy especially pronounced for those wave-lengths which are of the same order of size as the 'air bodies' themselves. If this be the case, the study of the attenuation of a sound spectrum in open air might furnish a method for studying the turbulence of the air. Experimental research in this direction is being prepared here.

HELMER DAHL.
OLAF DEVIK.

Chr. Michelsens Institut,
Bergen.
Feb. 1.

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[1] Devik, Olaf, *Chr. Michelsens Inst. Beretninger*, **6**, 2 (1936).

[2] Knudsen, V. O., *J. Acous. Soc. Amer.*, **6**, 199–204 (1935).

Raman Effect as a Method of Analysis of Amino Acid Solutions

THE possibility of using the Raman effect for quantitative analysis depends upon two conditions: (1) The components of the mixture in question should possess distinguishable spectra, a requirement depending on the nature of the molecules. (2) The photographed spectra should be sufficiently intense and the background clear enough to provide good microphotometer measurements. The accompanying account concerns an investigation of these conditions in the case of amino acid solutions.

The experimental arrangement was similar to that used by Wood[1], employing a 600-watt, air-cooled, quartz mercury arc. Because the solutions of recrystallized amino acids often exhibited fluorescence (due to minute amounts of impurities) when exposed to the blue light of the arc (4358 A.), it appeared advisable in the present case to adopt the green line (Hg 5461 A.) for the Raman excitation. A further reduction of fluorescence was effected by treating the neutral solutions with a small amount of potassium iodide. Two filter solutions, one of dilute potassium dichromate and the other of saturated neodymium chloride, served respectively to remove the blue end of the mercury spectrum and to absorb the region from 5680 A. to 5910 A. The spectrograph was a two-prism instrument providing a dispersion of 64 A./mm. in the yellow; exposure times varied from ten to thirty hours.

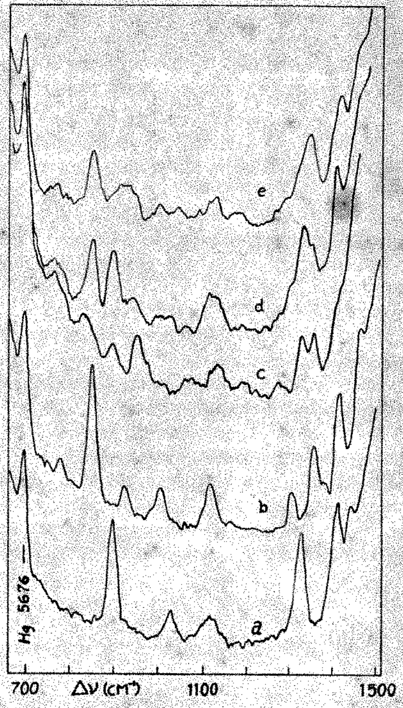

Fig. 1.

According to previous measurements by us on the Raman effect of several amino acids[2], the region corresponding to displacements of 700–1500 cm.$^{-1}$ (interval cleared of light from the arc by the neodymium chloride band in the present arrangement) was well adapted for the purpose at hand. Additional measurements of Raman frequencies made since the earlier publication are listed below: *dl*-Valine (aqueous solution, 5 per cent, 20 per cent potassium iodide): 760 cm.$^{-1}$ (6), 828 (6), 893 (4), 945 (8), 1063 (3), 1130 (4), 1196 (3), 1276 (2), 1326 (10), 1360 (9), 1410 (8). *l*-Leucine (aqueous, 1·55 per cent, 20 per cent potassium iodide): 840 (10), 964 (10), 1060 (2), 1135 (5), 1175 (2), 1351 (10), 1412 (2). *dl*-Phenylalanine (aqueous, 2 per cent, 20 per cent potassium iodide): 432 (1), 487 (1), 622 (3), 755 (1), 824 (2), 925 (1), 1003 (10), 1032 (4), 1211 (4*b*), 1270 (1), 1349 (2*b*).

Microphotometer records are shown in Fig. 1 of the Raman spectra of 5 per cent aqueous solutions of glycine (*a*), *dl*-alanine (*b*), *dl*-valine (*c*), and a mixed solution of 5 per cent each of the three (*d*). The spectrum (*e*) is that of a zein hydrolysate from which the less soluble amino acids have been partially removed by crystallization. These curves reveal the situation as regards analysis very clearly. With no more than three of the simpler amino acids together in a solution, overlapping of the lines most suitable for measurement can be observed. As most protein hydrolysates are vastly more complicated than this simple case, it would seem undesirable to attack such solutions without further chemical separation. If cases should arise, however, where solutions under examination contain very few different amino acids, the Raman effect might indeed be of great value in analysis.

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Department of Physics,
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[1] R. W. Wood, "Physical Optics" (3rd Edition 1934).

[2] NATURE, **136**, 300 (1935). See also J. T. Edsall, *J. Chem. Physics*, **4**, 1 (1936).

Research on Biological Control

REFERENCE is made in an article in NATURE of February 20, on inter-Imperial co-operation in scientific research, to the recommendation of the British Commonwealth Scientific Conference concerning Farnham House Laboratory, and to the fact that, though this method of controlling insect and plant pests is in its infancy, no reference is made to the need of research into it.

We at the Laboratory have clearly recognized the necessity for this fundamental research, without which practical work in biological control can never emerge from its present empirical status, and have been seeking, ever since the Laboratory was founded, to find some way of putting its research activities on a reasonably sure and lasting foundation. In 1929 the Empire Marketing Board, which provided the initial capital and maintenance grants, agreed to make an additional maintenance allotment, on the understanding that this should be used, so far as possible, for the development of research into fundamental problems; but the severe economies necessitated by the financial crisis in 1931 obliged us to recast our programme, and since that time we have been unable to make any definite provision for research. It was hoped that the Scientific Conference would make the necessary recommendations, as the desirability of this was mentioned in the report of the Laboratory for 1935–36[1], and had been previously stressed by the Imperial Entomological Conference[2].

Since official support for research work has not been forthcoming, and the necessity for fundamental studies is increasing because of the rapid growth in the practical side of the work, the only possible course seems to be to appeal to individual workers interested in research on biological control, to avail themselves of the facilities offered by the Laboratory for investigations of this kind. The accommodation is limited; but it will be gladly put at the disposal of students and others qualified for the work. The main lines of research requiring development concern parasite behaviour, population studies, from the biomathematical angle, particularly the interactions between host and parasite populations, and genetic studies, for which large masses of material collected under a considerable range of environmental conditions, are readily available. Abundant material for cognate studies in the development and morphology of insect parasites is continually coming in. There is thus an opportunity for the pursuit of many fascinating lines of investigation of great scientific and practical value.

I shall be glad to answer any written inquiries with regard to the work.

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(Superintendent).

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Farnham House Laboratory,
Farnham Royal,
Slough, Bucks.

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[1] Seventh Annual Report, Executive Council of the Imperial Agricultural Bureaux, 1935–36, Appendix XI, p. 85.

[2] cf. Report of the Fourth Imperial Entomological Conference, 1935, Appendix Ia, par. 21.

Base Exchange Capacity and Clay Content of Soils

VARYING factors have been reported for the base exchange capacity of soil clays. Mattson[1] gave results ranging from 0·16 to 1·1 milligram equivalents (m.e.) per gram. Williams[2] uses the value 0·57 for the evaluation of the exchange capacity of a soil from its clay and carbon contents. Hissink[3] found values between 0·36 and 1·00 for Dutch soils.

In general, 0·5–1·0 m.e. per gram has been accepted as the range to be expected for the base exchange capacity of mineral soil colloids. It is to be noted, however, that these values are dependent on the definition of particle size, such as less than 2 μ. Even if this upper limit can be accepted, the exchange capacity must depend on the relative particle distribution. Mattson's[1] and other data have shown the importance of chemical composition, in particular the $SiO_2 : R_2O_3$ ratio, in determining adsorption capacity.

The investigation of the base status of soil profiles on basic igneous parent materials has disclosed that some lower horizons, free from organic matter, have a base exchange capacity of up to 9 m.e. per gram of (< 2 μ) clay. The accompanying table shows some of the results obtained:

Soil	SiO_4/Al_2O_3	Clay Content	Exchange Capacity	m.e. per gm. Clay
4792	1·55	16·0	35·2 (32·9)	2·2
5048	3·83	11·6	42·5 (43·0)	3·7
5044	4·05	10·7	41·8 (39·0)	3·9
4784	5·95	9·8	42·1 (38·9)	4·3
5001A	8·40	15·7	88·0 (98·6)	5·6
5002	2·16	3·8	34·8 (29·6)	9·1

The exchange capacity figures used were obtained by the Parker method[4]. Those in brackets are the sums of the individual exchangeable cations. The agreement between the two sets of figures demonstrates the truly exchangeable nature of the cations. Apart from the last sample, there is an approximately linear relationship between SiO_2/Al_2O_3 ratio and exchange capacity per gram (< 2 μ) clay.

Further work is at present in progress on these soils, and the results obtained will be reported elsewhere. We desire, however, to point out that soils with very high exchange powers relative to their clay contents exist, and to direct attention to the danger of indiscriminate application of clay exchange capacity factors to soils to which they do not apply.

R. L. MITCHELL.
ALEX. MUIR.

Macaulay Institute for Soil Research,
Craigiebuckler,
Aberdeen, Feb. 16.

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[1] *Proc. 1st Inter. Cong. Soil Sci.*, **2**, 199 (1927).

[2] *J. Agric. Sci.*, **22**, 845 (1932).

[3] *Trans. 3rd Inter. Cong. Soil Sci.*, **2**, 60 (1935).

[4] *J. Amer. Soc. Agron.*, **21**, 1030 (1929).

Absorption of Fumigants under Reduced Pressure

THE importance of absorption of gases in reducing the effective concentration during fumigation of various materials for the destruction of insects, is now coming to be recognized, but the full effect of this factor in so-called 'vacuum fumigation' does not appear to have been realized.

Some preliminary experiments with a patent flour indicate that, if the bulk of the air be first removed, then most of the gas, which penetrates by virtue of the pressure difference established on admitting the fumigant, is rapidly absorbed, leaving, in the interior of the material, a very low concentration, which may not be effective in killing the insects. Afterwards the concentration in the middle of the material increases slightly owing to the diffusion, as in a fumigation at ordinary pressure. This is true whether the pressure is brought up to atmospheric by employing a fumigant diluted with an inert gas, or whether the pressure is raised only by the amount due to the pure or slightly diluted fumigant.

The result appears to be that the fumigation of absorbent materials under reduced pressure possesses little advantage over fumigation at normal pressure. This work is being continued and we hope to publish a detailed account in due course.

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O. F. LUBATTI.

Imperial College Biological
Field Station, Slough,
Bucks.
March 2.

Points from Foregoing Letters

COLONEL S. P. JAMES and Dr. P. Tate have found that the life-history of the malaria parasite *Plasmodium gallinaceum*, Brumpt, comprises, in addition to the usual schizogonic cycle of development in the red blood corpuscles of its vertebrate host and the usual sporogonic cycle in its insect host, a hitherto unrecognized vertebrate cycle occurring in cells of the reticulo-endothelial system of the spleen, liver and other internal organs and particularly, in certain cases, in the cells which line the capillaries of the brain. The finding of this endothelial cell cycle, whether or not it occurs in other malaria parasites than those of birds, opens up an entirely new field for chemotherapeutic research and may help to explain some of the clinical, therapeutic and epidemiological problems of malaria which hitherto have remained unsolved.

The usefulness of the Toepler *Schlieren* method for sedimentation observation in the ultra-centrifuge has been demonstrated by A. Tiselius, K. O. Pedersen and Inga-Britta Eriksson-Quensel. The method has the advantage of allowing direct observations, during the experiment, of the number of components in a mixture and their sedimentation velocities.

A method of obtaining liquid crystalline preparations of cucumber viruses is described by F. C. Bawden and N. W. Pirie. The authors compare some of the properties of these viruses (precipitation point in acid and salt solutions, etc.) with those of the tobacco mosaic viruses. The purified cucumber viruses can infect cucumber plants in dilutions of one part in a thousand million, and one eighth of a millionth of a gram will give a specific precipitate with antiserum.

A method of eliminating possible impurities in the electrodes used for spectrographic detection of plant constituents is described by W. A. Roach. It consists in preparing small electrodes from the plant material itself by suitable treatment and carbonization.

Reactions between nitric oxide and hæmoglobin, and also methæmoglobin, are described by Prof. D. Keilin and D. F. Hartree, indicating that a very stable compound is formed with hæmoglobin and an easily reversible one with methæmoglobin.

Drs. M. Dixon and C. Lutwak-Mann describe results showing that aldehyde mutase and aldehyde oxidase, hitherto believed to be identical, are in reality distinct enzymes. They can be prepared separately, and they show fundamental differences in behaviour.

The use of Chlorazol Black E as a biological stain for general purposes is described by Prof. H. Graham Cannon. It requires no mordant and no differentiation.

The ramming of a whale shark by a steamer near Colombo is described by Dr. E. W. Gudger, who discusses the occurrence of this fish in Ceylonese waters.

Dr. M. L. Huggins points out that hydrogen bridges, which recent work has shown to be of great importance in many chemical and biological fields, are more stable than they would otherwise be if the oscillation of the hydrogen is accompanied by a synchronous oscillation of the electron system in a ring of which the bridge forms a part. Two hydrogen bridges in the same ring tend to oscillate together, each stabilizing the other. Synchronous oscillation of bridging hydrogens suitably connected together in long strings also increases the stability.

Microphotometer records of the Raman spectra of solutions of several amino acids (glycine, *dl*-alanine, *dl*-valine) separately and mixed are submitted by N. Wright and W. C. Lee, and compared with a similar record of a zein hydrolysate, from which the less soluble amino acids had been partially removed. It appears that the Raman effect might be used for quantitative analysis of proteins in solutions containing very few different amino acids, but that it is not applicable to more complex mixtures.

Quantitative measurements by H. Dahl and Dr. Olaf Devik of the intensity of the sound field of fog-horns has shown rapid variations which were not observed by the ear. The cause of these rapid variations is considered to be the turbulence of the air. If this is the case, the study of the attenuation of a sound spectrum in the open air might furnish a method for studying the turbulence of the air.

Dr. R. L. Mitchell and Dr. Alex. Muir direct attention to the high base exchange capacity relative to the clay content of certain soils derived from basic igneous parent materials in Scotland.

A preliminary study of the concentration of gas inside certain materials fumigated by various methods employing reduced pressure shows, according to Drs. A. B. P. Page and O. F. Lubatti, that owing to absorption there is no resultant increase of penetration. It appears that, with these materials, a vacuum process has no advantage over one at normal pressure.

Research Items

Early Contacts of East and West

Prof. C. G. Seligman in his Lloyd-Roberts Lecture for 1935, delivered before the Royal College of Physicians, on "The Roman Orient and the Far East" (*Antiquity*, March) dealt mainly with historic contacts extending over something more than a thousand years, from 200 B.C. to A.D. 900, touching in the prehistoric period only on the distribution of the socketed celt, one of the most characteristic implements of the Late Bronze Age in central and eastern Europe, which probably reached China five to six hundred years before Christ. Its presence may be associated with events in the far north-west which started the movements of the Scyths. It was borne eastward on a wide front across the Urals. In the historic period, the great silk route, five thousand miles long, joined the Far East with Antioch, the most important city of the Roman Orient. It was first organized in the second century B.C., though long before this lapiz lazuli had reached Ur and pre-dynastic Egypt (that is, 3000 B.C. and earlier). The eastern section of the route may be regarded as starting at Ch'ang An (the Han capital), or at Lang-chow in western Kansu. It crosses Sinkiang to Kashgar, 1,500 miles away, Turfan lying half-way. The middle section crosses the Pamirs to Merv, either by Samarkand or Balkh. From Merv it runs west and south across north Iran to Seleucia-Ctesiphon, just below the modern Bagdad, crosses the Euphrates at Zeugma, and so thence to Antioch. The factors tending to the use of the silk route in the first instance were neither commercial, desire for knowledge nor love of conquest, but sheer military necessity—to counter the attacks of the barbarians. But there was also the desire for a supply of fine horses from Iran, while another gift from Ferghana was the grape for wine. From east to west the road essentially carried silk and secondarily furs. In addition to gold the Roman Orient exported glass. In the great period of the T'ang dynasty (A.D. 621–907) the silk route attained its maximum importance ; and while China shows the effect of the impact of western art and art forms, as well as of legend and story, it gave to the west paper and printing.

Mammals of Oregon

The State of Oregon illustrates in general the history of any mammalian fauna under the rule of civilized man. The quest of valuable furs brought pioneers into the region, and the abundance of game is still an economic factor of some importance. As man and domestic animals increased, animals destructive to game, livestock, poultry and crops had to be destroyed or controlled, with the result that predatory animals are reported to be generally decreasing in abundance, while a few creatures such as wapiti and other deer, pronghorn antelopes and porcupines are said to be increasing in numbers. In his account of the "Mammals of Oregon" (*North American Fauna*, No. 55. U.S. Dept. Agr. Pp. 416), Vernon Bailey discusses with a large amount of detail the economic as well as the natural history and taxonomic aspects of a fauna which includes 246 species and races. Oregon shows great diversity of altitude and of climate, and the consequent zonal distribution of its vertebrates and its plants throughout five of the seven primary life zones of the American continent (tabulated on pp. 31–53) contains much that is of ecological interest. We note that the author does not fear any undue spread of the musk-rat, for although he admits that it is capable of doing serious damage in irrigated areas, he holds that more thorough trapping and a long open season usually afford all the protection necessary.

Digestion in Metazoa

The problem of the modes of digestion adopted by the Metazoa has been reviewed by Prof. C. M. Yonge (*Biol. Rev.*, Jan. 1937). In Protozoa and Porifera, digestion is obviously intracellular, and this method is retained to a certain extent in different groups of the Metazoa. Extracellular digestion is found to a greater or lesser extent in all of them. This method is obviously advantageous since it allows food to be digested and the non-utilizable material to be removed more quickly, thus permitting an increase in the rate of metabolism. It is also associated with a differentiation in certain regions of the gut and so produces more efficient mechanisms for dealing with the various processes involved in ingestion, digestion, absorption and the formation of fæces. Some groups have acquired enzymes which enable them to deal with special substances. In general, the food passes through the alimentary canal at such a rate as will enable it to be adequately digested, taking into consideration the temperature, *p*H and enzymes. Such specialization has enabled the successful groups to utilize a wider range of food-stuffs and to tap more varied sources of supply. A full bibliography is appended.

Sites for Anemographs

An account of the peculiar performance of a Dines anemograph at the Lizard (Prof. Note No. 73, Meteorological Office, Air Ministry, by M. J. Thomas. London : H.M. Stationery Office, 1936) shows the care that is required when selecting a site for an anemograph in order to get a representative record of the speed and direction of the wind. It was observed that with most winds the record showed the gustiness and variability of wind direction to be expected in a reasonably open situation, with the vane of the anemograph at a height of 40 feet above the ground, but that when the general wind in the neighbourhood was between about south-south-west and west-south-west the vane fluctuated wildly, and sometimes 'boxed the compass' at short intervals for hours. Inquiry was made into the cause, and it was found that violent eddies were being set up by a row of coastguards' houses about 30 feet high and more than 100 feet away in the direction from which the general wind was blowing during the most disturbed periods. These eddies were studied with the aid of ballons of zero lift, both free and tethered, and bamboo poles with long streamers, and the nature of the eddies was brought to light. The pamphlet shows their movement both in plan and elevation. The trouble was eventually cured by raising the vane of the anemograph to a height of 75 feet; that is, it was brought to a height of 45 feet above the houses instead of only 10 feet. After the change, normal gustiness and variation of direction was obtained, as is illustrated by the anemogram for several hours of a severe gale during which the average wind direction changed from south to nearly west.

Artificial Radioactivity Produced by Means of γ-Rays

ARTIFICIAL radioactivity has recently been produced in the elements copper, bromine and phosphorus by bombarding them with γ-rays obtained by the action of protons of energy greater than 450 kV. on lithium (W. Bothe and W. Gentner, *Naturwiss.*, **25**, 90; 1937). Observations of the half-life periods of the radioactive nuclei enables them to be identified. Copper gives a radioactive nucleus of half-life about 11 min. Heyn (NATURE, **138**, 723; 1936) obtained by another method, a half-life of 10·5 min. for the ^{62}Cu nucleus. It therefore seems likely that this is the nucleus formed in the present transmutation, and that the process involves loss of a neutron from ^{63}Cu. In the case of bromine, the radioactive nucleus had a half-life period of about 18 min., which is the same as that of ^{80}Br obtained by the action of slow neutrons on ^{79}Br. Phosphorus gives a radioactive nucleus of weak activity with a half-life period of 2–3 min. This is probably to be identified with ^{30}P, which has been obtained by other methods indicating for it a half-life of 3·2 min. As with copper, the radioactive nuclei obtained from bromine and phosphorus are produced by the loss of a neutron from the normal nuclei.

Long Wave Spectroscopy of Benzene

SPECTROSCOPIC investigation of C_6H_6 and C_6D_6 by Angus, Bailey, Ingold, *et alia* (*J. Chem. Soc.*, 912; 1936) pointed with considerable certainty to a molecular symmetry of D_{6h}, and this has recently been substantiated by the thermal-spectroscopic determination of the symmetry number by Lord and Andrews (*J. Chem. Phys.*, **41**, 149; 1937). But definite conclusions must await further experimental evidence on (*a*) the spectra of partly-deuterated benzenes of lower symmetry, and (*b*) the influence of temperature and change of physical state on the characteristics of the spectrum. Evidence on both these lines is forthcoming. Redlich has already published some interesting measurements on partly deuterated benzenes. Along the other line, the results of Sirkar (NATURE, **134**, 850; 1934; *Indian J. Phys.*, **10**, 189; 1936) are particularly interesting. From an examination of the Raman spectrum of C_6H_6 vapour at 210° C. and 16·6 atmospheres, he has shown that the intensity distribution of the rotational wings accompanying Rayleigh lines agrees with that predicted from the theory of rotational Raman scattering. In the later paper, he has given results for the temperature range from liquid air temperature to 210° C. and for solid, liquid and gaseous C_6H_6. At low temperatures he found a slight diminution in the numerical values of frequency displacements and an increased sharpness and intensity, in agreement with the earlier observations of Epstein and Steiner (NATURE, **133**, 910; 1934). By comparing the spectra of liquid and gaseous C_6H_6 at 210° C., he has shown that the numerical values of displacements are unchanged, but transition from liquid to vapour is accompanied by greatly diminished intensity. A similar comparison by Bhagavantam and Rao (NATURE, **139**, 114; 1937) leads to the same result. Knowledge of these variations will help to elucidate the part played by intermolecular forces, and will assist in explaining the apparent breakdown of selection rules when applied to experimental data.

Diamantine Compounds

IN the February issue of the *Berichte der deutschen chemischen Gesellschaft*, Dr. Oskar Böttger describes the synthesis of several complex cyclic compounds in which carbon atoms are linked together rigidly but without strain in the manner of the crystal lattice of the diamond. The parent hydrocarbon of such a series is still unknown, but as several of its derivatives have now been synthesized it is proposed to call it *diamantane*. Its highly symmetrical structure would result from the condensation into a three-dimensional network of four puckered cyclohexane rings of the *Z* variety, and its formula would be $C_{10}H_{16}$. By the action of methylene dibromide on the disodium derivative of bicyclo [1 : 3 : 3] nonane 2·6-dione 1·3·5·7 tetramethylcarboxylate, it was possible to synthesize a compound which possesses the same skeletal structure as diamantane and crystallizes in fine colourless octahedra, melting at 284° C. Hydrolysis of this ester to the corresponding tetrabasic acid was readily effected by dilute acids, whereas alkaline hydrolysis broke down one of the rings to yield a pentacarboxylic acid derivative of bicyclononanone, which could be extracted in the form of its methyl ester. The freedom from ring-strain of the polycyclic system can be inferred from the ease with which this pentamethyl ester reverts to the diamantine structure by eliminating methanol, when it is heated above 200° C. On the other hand, this structure appears to influence the chemical properties of its substituent groups, since the acid groups did not yield to the usual methods of decarboxylation, nor was it possible to reduce the two keto-groups to methylene groups, for even hydrogen iodide and phosphorus under pressure yielded only secondary alcohols. The optical isomerism of the products has not yet been investigated.

Scope and Development of Indian Astronomy

IN an article in *Osiris* of September 1936, Sukumar Ranjan Das says that Indian astronomy had its beginning in the Vedas, and was then very rudimentary. This is incorrect; the ancestors of the Vedic authors brought their astronomy with them when they came to India, and these astronomical conditions are both extensive and well founded, and were quoted throughout the much later Rg Veda and the liturgical Vedas and Brahmanas. The author has happily cut himself free, however, from the current idea that Indian astronomy was ever dependent on the Grecian or Ptolemaic systems; indeed India gave more than it ever got, except perhaps as regards planetary observations. Ranjan Das suggests that the Rg Veda has three allusions to the planets, but the contexts forbid this interpretation. The most interesting section is on the Samhitâs and older Siddhântas (dating between 500 B.C. and 500 A.D.). He gives a tantalizing reference to an observation in 215 B.C. of "the Sun and Moon in conjunction at sunrise *on a Sunday*" at the winter solstice, or the beginning of the solar month Māgha. Was time at that date divided into 7-day weeks for purposes of chronology, similar to our division of the Julian days? It certainly was so divided in the days of Āryabhata I, in the fifth century A.D.

The South-East Essex Technical College

THE construction of new arterial roads together with the development of estates like those of Becontree and Dagenham have resulted, within the last ten years, in a considerable increase in the population of Essex. The establishment, too, of large industrial centres, such as Ford's Motor Works at Dagenham, have also contributed materially to this almost mushroom growth. Acres of pasture land have thus been transformed into industrial and densely populated districts. It therefore became an urgent necessity to make some provision for extended educational facilities, and especially for further technical education.

After an exhaustive survey of the problem, the Essex Education Committee wisely decided that a regional system of organization for higher education generally would be, at present, the best solution. To carry this policy into practical effect, each region is to be provided with a central institution "to act as a focus of the more advanced forms of technical, art and commercial instruction". The first of these institutions—known as the South-East Essex Technical College—was officially opened by the Right Hon. Oliver Stanley, president of the Board of Education, on Tuesday, November 24, 1936, although some four thousand students had already started courses of instruction on September 28, 1936.

Through the courtesy of the Director of Education (Mr. J. Sargent) and the Principal (Mr. P. J. Haler), a recent tour of the college revealed the high practical ideal with which the Committee determined to give effect to its considered policy. Here is a veritable palace of learning, stated to be the largest of its kind in Great Britain. Along the Longbridge Road, about two miles from Barking Station and close to the south-eastern boundary of the Borough of Ilford, a stretch of land, about 17 acres in extent, was secured and upon approximately 6 acres the college building was erected (Fig. 1). Although the premises are really not yet complete, accommodation is to be provided for about 5,000 evening students and 1,000 full-time day scholars from eleven to sixteen years of age and 750 senior students. To meet the needs of the essential recreative facilities for so large a number, the Committee is trying to secure more land in order to extend the acreage to about 30. It also proposes, in the near future, to provide a swimming bath, two gymnasia, a sports' pavilion and other adequate accommodation. Indeed, in giving practical effect to its policy, the education authority has not confined itself merely to existing needs, but also has designed the various blocks of buildings "with reference as much to the future developments of the college as to its present requirements".

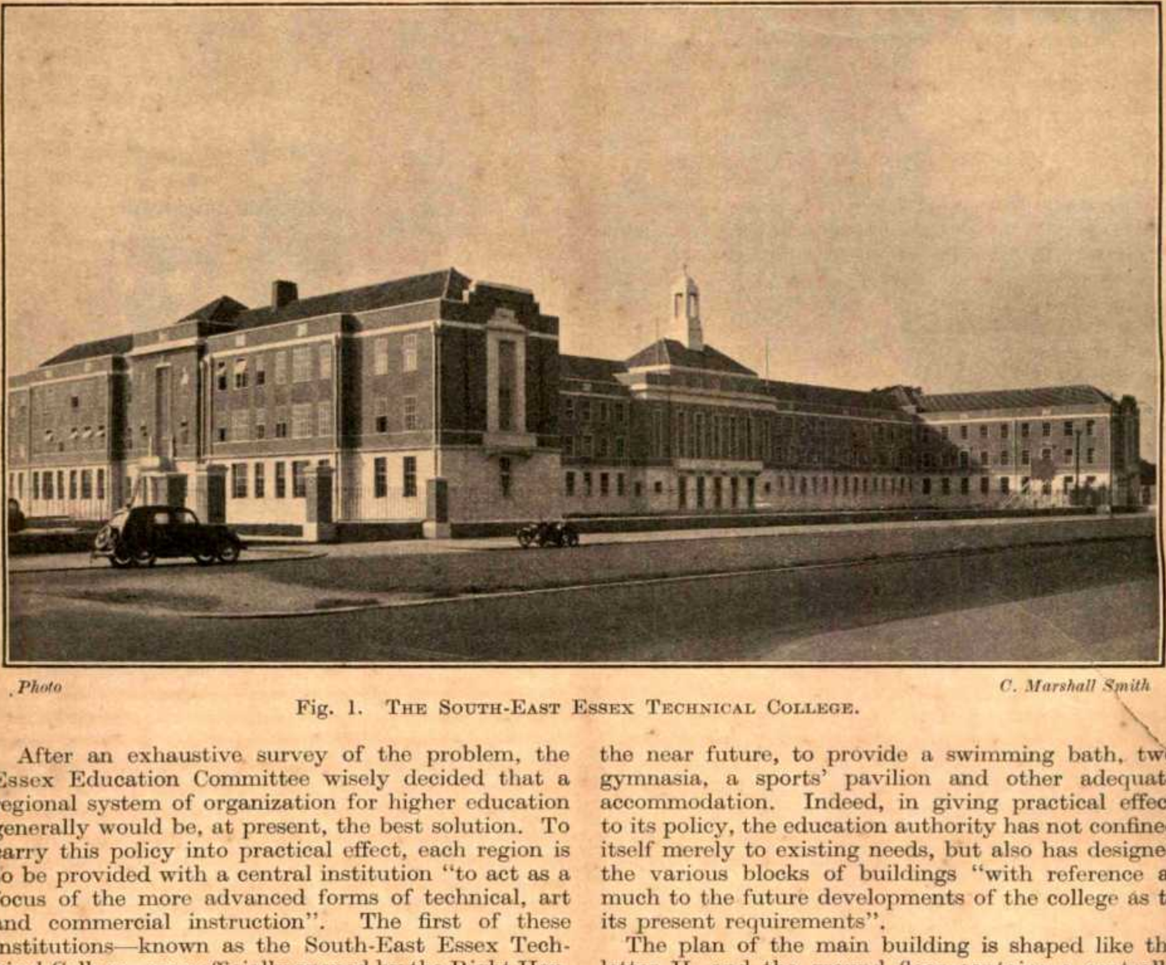

Photo *C. Marshall Smith*

Fig. 1. THE SOUTH-EAST ESSEX TECHNICAL COLLEGE.

The plan of the main building is shaped like the letter H, and the ground floor contains a centrally placed assembly hall to seat 1,000, with a stage for dramatic performances at the west end and a projector room at the back of the balcony at the east end. The acoustics of this hall have been very skilfully considered. On the other side of the central corridor or foyer are the exhibition hall and the administrative offices. Both the ground and first floors of the east wing are devoted to the department of domestic science, whilst the art department occupies the second floor. The west wing provides accommodation on the first two floors for the commercial department where the latest contrivances for mechanizing arithmetic may be seen. On the central portion of the first floor—reached either by stairs or lift—are the library, board room, Retail Trades and Commodities Room. Between the upper part of the assembly hall and the library is a wide corridor lined with many fine pictures. In fact, the portion directly over the foyer is called the Picture Gallery. Directly above the assembly hall on the second floor is the cafeteria and dining hall fitted with a complete kitchen unit.

Behind the main building and connected by covered corridors are the departments of science and engineering, with a car park between them. At present, these are on the ground floor, but the science block will eventually be enlarged by the addition of two more floors. It now comprises laboratories for biology, building science, chemistry and physics, all equipped with the most modern appliances. It is anticipated to develop specialized courses with particular reference to the needs of local industries, for in the neighbourhood there are several large manufacturing chemists, an important cement works and one of the largest factories in the country for the production of photographic materials. Co-operation with some of these has already been established.

In the engineering block are to be found workshops for carpentry, automobile construction, plumbing, electrical installation and machine tools, each of which is thoroughly equipped with the latest machinery, all unit driven. There are also a spacious drawing office and an applied mechanics laboratory. As in the case of the science department, it is hoped to correlate the work done with local industries, and already the Ford Motor Company is sending a large number of employees to the college for instruction.

Here, indeed, is a worthy institution wherein to "find out what a man can do and then teach him to do it better". F. G. W. B.

Excavations at Chandhu-Daro, Sind

CHANDHU-DARO, a mound site near Sukhpur in the Nawabshah District of Sind, was selected for investigation by the American School of Indic and Iranian Studies, with the active support of the Boston Museum of Fine Arts, in the hope that it would afford evidence bearing on the beginnings of the Harappa civilization, as known from the sites of Mohenjo-daro and Harappa in the Indus valley, or alternatively on the dark period between the disappearance of that civilization and the entry into India of the Aryan-speaking peoples at about 1500 B.C. The excavations have been conducted by Dr. E. J. A. Mackay, who described their progress to date before the Royal Society of Arts at a meeting on March 5.

The site of Chandhu-daro, situated east of the River Indus and eighty miles south-west of Mohenjo-daro, consists of a complex of two large mounds and one small mound. In ancient times they constituted a single city, which was cut right through by flood water of the Indus, a disaster which led to the city being abandoned. There is indisputable evidence that a similar disaster occurred on more than one occasion and as Mohenjo-daro also suffered similarly from flood on at least two occasions, it is now thought probable that the decline of this great civilization may have been due to the impossibility of occupying sites that were continually being surrounded by large sheets of water.

Although the city in size never approached that of Mohenjo-daro, a massive wall, averaging five feet wide and traced for eighty feet, which was among the earliest discoveries, suggests that the city was of considerable importance.

In order to ascertain whether the site had been occupied by any peoples earlier than those of the Harappa culture, Mound II was examined to its lowest levels by a pit which was taken down to water-level. It then appeared that some five thousand years ago Mounds I and II had constituted a single city, as already mentioned. In this part of the site, at least, no culture lay between subsoil water, which was reached at twenty-five feet below plain level, and the mound above. The lowest levels at Chandhu give the impression of being earlier than the strata immediately above water-level at Mohenjo-daro.

There are no less than five Harappa occupations. They were separated by layers of debris, and there could be no doubt, as there is at Mohenjo-daro, as to where one occupation ended and another began. Whether there are other occupations below water-level, it is impossible to say. The water-level has risen considerably. Of the five levels, the two uppermost on Mound II only have as yet been cleared, and the three lower are still to be examined. In the earlier of the upper Harappa levels the most striking feature is the existence of a bathroom in practically every house and the elaborate and careful system of drainage. There can be little doubt that bathing must have been a ritual. Where smaller and less important houses were not connected with street drainage, a system of cesspits or storage vessels was employed. In the main street of the second Harappa level a remarkable building was unearthed, which seems to have been some kind of a Turkish bath, with small chambers situated over flue holes. There is no other evidence that the ancient peoples of India used hot-air baths, but a somewhat similar building was discovered at Mohenjo-daro.

The buildings of the last Harappa occupation were the better preserved, but the area of occupation was very much less. Not long after the site had been abandoned, it was occupied again about 2000 B.C. by a small community of unknown origin, the Jhukar, living in houses of matting or mud. Of these dwellings all traces have disappeared, except the remains of the floors and the fireplaces, which were practically unknown among the Harappa people, who used open hearths.

After the disappearance of the Jhukars, Mound II was occupied once more by a small community, who used hand-made, polished, grey ware already known as the Jhangar culture from the site of that name in Sind.

The pottery from Chandhu-daro is perhaps the most interesting that has been found on any ancient site in recent years. The painted ware is quite distinctive, and can be confused with no other ware. Unfortunately, few jars have been found complete. As on a similar ware at Mohenjo-daro, the motifs are painted in a thick black paint on a highly burnished red slip, which is almost like lacquer. Among the motifs is a quadruped with an exaggerated plume-like tail, a peacock with a crest of bush or tree-like form, while another bird has a crest which terminates in two sun-motifs. The sun apparently is conceived as a rotating sphere with prominences, while the association of the sun with vegetation is indicated by plant or bud designs, which represent these solar prominences. The larger storage vessels are frequently decorated around the upper part only. Incised decoration of pottery is comparatively rare.

The pottery of the Jhukar people in fabric, mode of decoration and polychrome colouring is quite different from that of their predecessors. Violet-black paint was applied to a thick cream slip. Below the decorative border are bands of red paint. Nor have the shapes any relation to the earlier wares. A clue to origin is afforded by a herring-bone pattern painted alternately in red and black, which recalls the much earlier ornamentation on wares from Tell Halaf in Mesopotamia and that found by Sir Aurel Stein at Zayak in southern Baluchistan. One triple vessel of the Jhangar grey ware also recalls a find made by Sir Aurel Stein at Shahi-tump in Baluchistan. This suggests that these people too may have entered India from the west, and possibly at a much earlier date than has been thought.

The seals used by the Harappa people are like those found at Mohenjo-daro; but those of the Jhukar are more primitive, and for the most part made of pottery. In the Harappa period, Chandhu-daro was a great centre of bead making, and beads have been found in all stages from the raw material to the finished bead. Among them were the cornelian beads ornamented with designs in white, such as have been found in Sumer, but now known to have been manufactured in India or by Indians.

Metal working in copper and bronze was a craft that was largely practised. Heavy blade axes, a scoop, new to the ancient world, knives, daggers, razors in three shapes, and hairpins all show great experience in metal working.

A large number of toys of various kinds were found, and nearly every child must have had a toy cart, usually made in pottery and closely following the real cart in detail. Pottery rattles, owing to their substantial make, are rarely found broken. Of objects connected with religion, the most interesting are the figurines of the mother goddess, which are very different from the cult images of the goddess found at Mohenjo-daro. They were without legs, but had a hollow base to stand on. Like other figures of the Harappa culture, they were richly loaded with jewellery and their ears were pierced for ear-rings. Little jewellery was found.

Although the unique objects found on the site naturally have remained in India, the Archæological Survey has been generous in the allocation of objects to the Boston Fine Arts Museum. This is the only collection of objects illustrative of the early Indian civilization on exhibition outside India, and it is to be regretted that no similar collection is to be found in the museums of Great Britain. The exploration of the many sites of importance in India should not be left to other countries, and no British expedition organized to work in this most promising field.

Canadian Hydro-electric Power Development in 1936

ALTHOUGH the actual output of electricity in Canada during 1936 reached the new high level of 25,493½ million kilowatt-hours, the year was not specially remarkable for progress in development of the available water supplies. The annual review of hydro-electric power progress, issued by the Canadian Minister of Mines and Resources on January 1 of this year, shows that a comparatively small addition was made to the preceding year's aggregate of water-power developed in the Dominion, which at the end of 1935 had attained a figure of 7,909,115 horse-power. New installations during the twelve months increased this by 36,475 to the new total of 7,945,590. This is a little short of 8 millions, and, as the estimated total available is fully 40 millions, represents barely twenty per cent of the country's resources.

Notwithstanding the relatively small increment for the year, there is a number of projects actually under way which will add materially to the aggregate during the course of the next year or two. The progress of hydro-electric development in Canada within recent years has been largely influenced by the conditions arising out of a period of restricted output, lasting from 1930 until 1933. Prior to 1930, a number of important installations had been made in order to keep pace with a steadily growing demand for power which, however, slackened and ceased about six years ago. It was not until May 1933 that the demand resumed an upward tendency which has continued. But it produced a corresponding relaxation of effort in regard to new enterprises, the effect of which has not yet quite dissipated itself, though there is every likelihood of its doing so in the very near future.

The new installations during 1936 consisted chiefly of additions to existing stations at High Falls (a fourth unit of 30,000 horse-power), on the Lievre River in the Province of Quebec, by the Maclaren-Quebec Power Co.; at Rat Rapids (a new unit of 1,750 horse-power), on the Albany River in the Province of Ontario; and at Ruth Falls (4,300 horse-power) on East River Sheet Harbour, Nova Scotia. Several small installations have also been completed in British Columbia.

The Quebec Streams Commission has continued to maintain satisfactorily the desired regulation of flow on all the controlled rivers in the province by means of its extensive system of storage reservoirs, of which there are now seventeen, some of them of considerable size. It is actively pursuing investigations in regard to other available storage sites with the view of adapting them to the same purpose.

BRYSSON CUNNINGHAM.

Science News a Century Ago

Baron Antoine Dubois (1756–1837)

BARON ANTOINE DUBOIS, the celebrated French surgeon and obstetrician, whose death occurred on March 30, 1837, was born at Gramat, a small town in the Lot Department near Cahors, on July 17, 1756. After commencing his studies at Cahors, he went to Paris at the age of twenty years, where, like three other famous French surgeons, Ambroise Paré, J. L. Petit and Desault, he had at first a hard struggle with poverty until Desault made him his assistant. In 1790 he was elected member of the Paris Academy of Surgeons and in the following year Louis XVI made him professor of anatomy. Shortly afterwards, he joined the army and served first at the military hospital at Melun and then as member of the Army Health Council and inspector of the Army of the Eastern Pyrenees, and took part in Napoleon's Egyptian campaign. In 1811, when chief obstetrician to the Paris Maternity Hospital, he was summoned by Napoleon to attend the Empress Marie Louise during the birth of the subsequent King of Rome, and for his services on that occasion, when he successfully performed version, he was made a baron of the Empire. During the years 1830 and 1831 he was dean of the Medical Faculty of Paris.

Dubois was a clear and concise lecturer, an excellent teacher and an unrivalled operator. As a surgeon he is best known for his operations of lithotomy, aneurysm and anal fistula.

A National School of Mines

"Mr. John Taylor, well known as a lecturer on mineralogy, and great promoter of the search for subterranean riches, is at present actively engaged in endeavouring to found a national 'School of Mines', for giving instruction in all that relates to the theory, as well as the practice, of mining operations. Such institutions have long been in existence in Germany, where they have proved of great utility" (*Mechanics' Magazine*, April 1, 1837)

Watch Making at Geneva

"This manufacture commenced in 1587 and in 1600 the town council legislated upon it. In 1685 there were counted 100 masters and 300 journeymen watch makers at Geneva, who turned out by hand 5000 watches yearly. There were also 80 masters and 200 journeymen jewellers. The trade continued increasing till 1789 when it was at its height. In that year the number of those engaged in it in the city alone was 4000, and 2000 in the suburbs and villages. There are not now so many hands engaged, though more watches are made; the diminution of manual labour being occasioned by improved tools and machinery, and abridged mechanism of the watch. There has been a great falling off in this manufacture but very lately it has rather revived again" (*Mechanics' Magazine*, April 1, 1837).

European Medicine in the East

IN the issue of the *Quarterly Journal of the Calcutta Medical and Physical Society* of April 1, 1837, Dr. Henry Hurry Goodeve, editor of the journal and professor of anatomy and medicine at the Medical College, Calcutta, makes the following observations:

"Within the last twenty or fifteen years Anglo-Indian medicine has advanced with rapid strides. The immense improvements that have taken place in the medical science in Europe have doubtless contributed to this desirable end; for even in these distant regions we feel in our turn (though at times somewhat slowly) the influence of scientific studies at home. Thus following the track of our European brethren, we have pursued the never failing indications of pathology in the investigation of diseases; and aided by our knowledge of the true state of the affected organs, we have been able to employ with manifold advantage the improved modes of treatment which modern practice has brought into notice. Among these improvements one article of medicine deserves special attention. The discovery of Quinine has wrought a greater change in the treatment of disease than perhaps any other remedy which was ever introduced into the materia medica, not excepting its precursor and progenitor, the Peruvian bark. Nowhere has this change been so manifest as in India. In this country it has created a completely new epoch in the treatment of fevers of every kind, but most of all in those of the remittent class, in which it has almost brought back the old bark practice, although Quinine is administered in these maladies upon totally different principles from those which guided the exhibition of the cortex Peruvianii."

The Tread-wheel and Health

THE following extract from the second report of the Prison Inspectors of the Home District published on April 1, 1837, for presentation to both Houses of Parliament expresses the opinion of the governor of the Coldbath-fields House of Correction as to the effect of tread-wheel labour on the health of the prisoners:

"We had much sickness during the late epidemic, both among prisoners and officers, namely, the influenza in its various stages. Where prisoners are exposed greatly to the atmosphere and draughts, as is the case here on the wheels and in the passages, it must be injurious to health. Their coming off the wheels warm, for relief, and sitting in that state in the stages, must be bad. I think tread-wheel labour injurious to the health of some of the prisoners —to corpulent, or infirm and aged, or tall persons; but not to boys, lads, or men of light weight, if in good health. I take every possible means to prevent the bad effects of the tread-wheel by a judicious regulation of the labour, and by observing any ill-effects it may produce on the constitution of the prisoners; and if necessary immediately calling the attention of the surgeon to any cases of the kind, or by relieving them myself, according to circumstances in various ways; either by diminishing the labour, increasing the diet (often including porter), placing them to work in the grounds, etc. I find that the men in general are greatly distressed after three months' continuous labour, but tall and heavy men in a less time.

"With regard to women I believe tread-wheel labour, if judiciously used, is highly beneficial to health; particularly in cases of disorderly women, prostitutes, etc., committed for periods not exceeding three months, and who generally come into hospital in a deplorable condition from drink and intemperance, and quit it in good health. But these work less than the men, who labour in the proportion of twelve on the wheel to six at rest; the women in the proportion of twelve on the wheel to twelve off."

University Events

CAMBRIDGE.—At King's College, the following have been elected into fellowships: K. C. Dixon and D. G. Champernowne. Mr. Dixon was educated at Haileybury College. He was placed in the first class in both parts of the Natural Sciences Tripos and was awarded an additional Harold Fry studentship in 1934 and 1935. Mr. Champernowne was educated at Winchester College. He was placed in the first class in both parts of the Mathematical Tripos and in the Economics Tripos, Part II. He was elected Wrenbury scholar in 1935, and in 1936 was awarded the Adam Smith Prize.

At St. John's College a Research Studentship and Research Exhibitions are offered for competition in July. One Strathcona Research studentship of the annual value of £200 is offered for competition among research students who are (*a*) Graduates of any university other than Cambridge, or (*b*) graduates of Cambridge who are not already members of St. John's College. The successful candidate, if not already a member of the College, will be elected for two years, subject as regards a second year of tenure to his continuing in residence and to the College being satisfied with his progress; if he is already a member of the College, the tenure of the studentship will be for one year only. Two Strathcona exhibitions of the annual value of £40 are also offered for competition under the same conditions as the studentship. Further information can be obtained from the Senior Tutor, St. John's College, not later than July 1, 1937.

EDINBURGH.—The Senatus Academicus has resolved to offer the degree of LL.D. to the following among others: Prof. L. H. Baekeland, honorary professor of chemical engineering in Columbia University; Sir William Bragg, president of the Royal Society; Dr. Edwin Bramwell, a former president of the Royal Society of Physicians of Edinburgh; Dr. Alexander Morgan, formerly director of studies, Edinburgh Provincial Training College.

LEEDS.—Dr. J. B. Speakman, at present lecturer, has been appointed to a readership in textile chemistry, and Dr. W. T. Astbury, at present lecturer, to a readership in textile physics.

Prof. W. MacAdam, formerly professor of clinical medicine, has been elected to the chair of medicine in succession to Prof. G. W. Watson, and Prof. J. le F. C. Burrow, formerly professor of pharmacology and therapeutics, to the chair of clinical medicine. To the vacancy caused by these changes, the Council has elected Dr. S. J. Hartfall, with the title of professor of therapeutics and applied pharmacology.

LONDON.—Her Majesty the Queen has been graciously pleased to signify her consent to receiving an honorary degree from the University. The conferment of the degree will probably take place in the autumn.

Dr. H. L. Eason has been appointed principal of the University from July 1, 1937, until September 30, 1941 (see also p. 539 of this issue.)

Prof. Samuel Sugden has been appointed as from October 1 to the University chair of chemistry tenable at University College. Since 1928 he has been professor of physical chemistry in the University in respect of the post held by him at Birkbeck College.

The title of reader in mining geology in the University has been conferred on Dr. W. R. Jones (Imperial College—Royal School of Mines) and that of reader in palæontology in the University on Dr. W. F. Whittard (Imperial College of Science and Technology).

A further donation of £2,500 has been received towards the Institute of Archæology Appeal Fund from the same anonymous donor who had already contributed £12,500. Since the date of this last gift, the donor has died, and it can now be revealed that it was Mrs. Mary Woodgate Wharrie. Mrs. Wharrie was among the earliest and most generous benefactors of the recently established Institute of Archæology. Her gifts were the determining factor in the decision of the University to rehabilitate St. John's Lodge, Regent's Park, as the temporary home for the Institute and, in particular, for the display and utilization of the large collections of material excavated by Sir Flinders Petrie in Palestine and presented to the University by the British School of Archæology in Egypt. On the occasion of the opening of the Institute by the Chancellor of the University, it is proposed to dedicate the main gallery to Mrs. Wharrie's memory.

On the occasion of the meeting of the International Council of Scientific Unions in London in April an honorary degree will be conferred on Prof. N. E. Nörlund, the president of the International Council, and director of the Geodetic Institute of Copenhagen.

The degree of D.Sc. has been conferred on the following: Miss M. S. Lacey (bacteriology), B. D. Bolas (botany), Miss D. L. Reynolds (geology), A. K. Denisoff (physics), S. R. Rao (physics).

OXFORD.—Dr. J. A. Douglas, Keble College, lecturer in geology, has been elected professor of geology and fellow of University College.

SHEFFIELD.—The Rockefeller Foundation of New York has made a further grant of £250 in aid of research in the Department of Pharmacology of the University.

Societies and Academies

Edinburgh

Royal Society, March 1.

R. A. HOUSTOUN: The time lag of the vacuum photo-cell. The image of an electric filament was swept over the cathodes of two photo-cells, a *KMV*6 and a *KV*6, at various speeds, and the constancy of the photo-electric emission tested. Down to a duration of illumination of $7\cdot4 \times 10^{-8}$ sec. the law of proportionality held for the *KMV* 6, but there was a slight breakdown in the case of the *KV* 6. If this is ascribed to the presence of a time lag or period of induction, the latter will be about 5×10^{-10} second (see also NATURE, 139, 29, 330; 1937).

W. O. KERMACK and A. G. M'KENDRICK: Tests for randomness in a series of numerical observations. In a series of unequal numbers, some (maximal numbers) are greater, whilst others (minimal numbers) are smaller than either of their immediate neighbours. A sequence of runs extending from a maximal to an adjacent minimal number is called a 'run'. The average length of a run is 2·5, and the standard deviation is $\sqrt{3/5s}$, where s is the number (assumed large) of runs from which the average has been calculated. Other properties of randomly arranged numbers are also given. These results will probably be distributed by periodic or other regularities, and so afford tests of randomness.

A. C. Stephen: Production of large broods in certain lamellibranchs in relation to weather conditions. The fluctuations in the amounts of the broods of the littoral and sub-littoral species *Tellina tenuis* and *Tellina fabula* at Millport, Firth of Clyde, have been followed since 1926. There have been four specially large broods. Little or no correlation has been traced between these and the local sunshine and rainfall, but a very close connexion exists between the broods and temperature. The algebraic sum of the deviations of the monthly means from standard means has been used for comparison of temperature, sunshine and rainfall.

P. C. Koller: The genetical and mechanical properties of sex chromosomes. (3) Man. Two types of sex bivalent may be found at meiotic metaphase of man; one is asymmetrical and indicates the pre-reduction, the other is symmetrical and indicates the post-reduction of the structural inequality, which characterizes the sex chromosomes. The two types of sex bivalent suggest that the centromere lies in the pairing segment and crossing over may take place on both sides of the centromere. Genes which are localized in the pairing segment exhibit incomplete sex linkage. The occurrence of crossing-over in both arms of the pairing segment indicates that the total length of this region is more than 50 units, so that genes farthest from the differential segment should show very little sex linkage.

Vera Fretter: The structure and function of the alimentary canal of some species of *Polyplacophora* (Mollusca). The buccal cavity leads into the œsophagus, which expands laterally into a small pair of anterior pouches and receives the ducts of a pair of posterior pouches ('sugar glands') which secrete a diastatic enzyme. In the capacious stomach the food is mixed with a proteolytic enzyme secreted by the digestive gland. The soluble products of digestion are forced into the digestive gland from the anterior intestine by the action of an intestinal valve or sphincter. In the extensive coils of the posterior intestine the fæcal pellets are elaborated. Structurally the alimentary canal shows remarkable similarity to that of the lower Gastropods.

H. W. Turnbull: The revised complete system of a quadratic complex. A sequel to an earlier communication.

A. C. Aitken: Studies in practical mathematics. (1) The evaluation with applications, of a certain triple product matrix. In the solution of equations, the theory of correlation and in other parts of practical mathematics it is often necessary to obtain the reciprocal array of a given array of coefficients, and sometimes to transform the reciprocal array further by multiplying it before and after by other arrays. The paper describes a method, suited for practical use, by which such threefold product arrays may be evaluated by a uniform reduction. The method is exemplified in typical cases.

Rome

Royal National Academy of the Lincei

(*Atti*, 23, 807–911; 1936).

E. Bompiani: Normalization of linear differential equations.

G. Fano: Algebraic surfaces and varieties in three dimensions with canonical curve sections.

F. Severi: General theory of the correspondences between algebraic varieties (1).

G. Giorgi: The postulates of the second theory of relativity.

G. A. Blanc: Presence of *Equus hydruntinus* in the quaternary gravels of the Aniene.

A. Stella: Characteristics of the Italian metalliferous deposits in basic rocks.

C. Carbonaro: Completely derivable functions of one bidual variable.

S. Cherubino: Characteristic roots of holomorphous functions of matrices.

G. Bemporad: Development of the orbits of binary systems.

L. Gialanella: Meridian observations of Saturn, of Uranus, and of the moon in 1935.

G. Agamennone: Comparison of the epicentres of two recent similar earthquakes.

F. Odone: Absolute temperature *T* and the principal thermodynamic relationships.

A. Baroni: Chlorides of thiocyanogen.

S. Berlingozzi and G. Francini Naldi: Researches on rotatory amino acids.

V. Gaglioti and D. Gigante: Contribution to the biochemical knowledge of bones during development.

G. Centola: Relations between structure and mechanical properties of films and threads of acetylcellulose.

R. de Fazi and F. Pirrone: Chemical constitution of cholesterine (13). 13-18-Dimethyl-9-13-cyclopentane-5-6-dehydro-hydrophenanthrene-3 from cholesterine.

L. Mazza: Galvanometer amplification by means of differential photo-electric cells.

G. Tedeschi: Oxidation of monovalent nickel by the action of water in presence of CN^- ions.

R. Savelli: Observations on the chloroplasts of Cactaceæ.

G. Cotronei and T. Perri: Further researches on the embryonic compatibility and incompatibility in Amphibia studied by the method of grafting.

H. Grossfeld: Permeability of cell tissues cultivated *in vitro* (see also Nature, 138, 31; 1936).

A. Spirito: Studies of embryology (1). The phenomenon of anærobiosis studied comparatively in petromyzonts and in anuran amphibians.

(*Atti*, 23, 915–965; 1936).

G. Scorza: New contributions to the general theory of algebras.

F. Severi: General theory of the correspondences between algebraic varieties (2).

G. Arrighi: Problem of impulse in isotropic elastic bodies. Variations of thrust in a heavy liquid in equilibrium.

C. Morais: Spherical aberration of the fifth order of central systems.

A. Baroni: Oxidizability and structure of some industrial lamp-blacks.

G. Cotronei and A. Spirito: Phenomena of embryonic and larval growth studied in the grafting of anurans and urodelans.

H. Grossfeld: Discharge of protoplasm by removal of the electrolytes from the liquid medium in cells of tissues cultivated *in vitro*.

R. Savelli: Leucosterinoplast.

A. Orrù: Rate of growth of the hen's egg. Behaviour of the electrical conductivity of the albumen of the hen's egg with increasing and decreasing temperatures.

Forthcoming Event

Friday, April 2

Palæontographical Society, at 4—(at the Geological Society, Burlington House, London, W.1).—Annual Meeting.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Junior Scientific Officer (physics or engineering) for the Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, London, N.W.1—The Secretary (April 3).

Lecturer in Mathematics in the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3—The Principal (April 3)

Civilian Education Officer (grade III—engineering or physics) in the Royal Air Force Education Service—The Secretary, Air Ministry (E.S.1), Adastral House, Kingsway, London, W.C.2 (April 5).

Lecturer in Domestic Science and Hygiene (woman) and Lecturer in Physical Science and Hygiene (man) in the Normal College, Bangor—The Principal (April 7).

Lecturer in Geology in the University of Aberdeen—The Secretary (May 7).

Mycologist at the Rothamsted Experimental Station, Harpenden, Herts—The Secretary (June 20).

Lecturer in Biology (woman) in St. Peter's Training College, Peterborough—The Principal

Superintendent of Technical Development in the Survey Department of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Official Publications Received

Great Britain and Ireland

Ministry of Health. Departmental Committee on the Cost of Hospitals and other Public Buildings. First Report: The Acute General Hospital. Pp. 84. (London: H.M. Stationery Office.) 1*s.* 3*d.* net. [222

Physical Society. Reports on Progress in Physics, Vol. 3. General Editor: Allan Ferguson. Pp. iv+394. (London: Physical Society.) 20*s.* net. [232

Department of Scientific and Industrial Research Forest Products Research Records, No. 14 (Mycology Series, No. 1): Dry Rot Investigations in an Experimental House. By W. P. K. Findlay. Pp. ii+14+5 plates. (London: H.M Stationery Office.) 6*d.* net. [232

London County Council: Horniman Museum and Library. From Stone to Steel: a Handbook to the Cases illustrating the Ages of Stone, Bronze and Iron. Third edition. Pp. 98+2 plates. (London. P.S. King and Son, Ltd.) 6*d.* [252

Report from the Select Committee on Medicine Stamp Duties. Pp. 13 (London: H.M. Stationery Office.) 3*d.* net. [13

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1936; with Report of the Director of Water Pollution Research. Pp. iv+56. (London: H.M. Stationery Office.) 1*s.* net. [13

Liverpool Observatory and Tidal Institute. Annual Report, 1936. Pp 16. (Liverpool: Liverpool Observatory.) [13

University of London. University College. Annual Report, February 1936–February 1937. Pp. ii+171. (London: Taylor and Francis.) [13

Technical Publications of the International Tin Research and Development Council. Series A, No. 50 The Systems Tin-Germanium and Tin-Beryllium. By Prof. Dr. W Guertler and M. Pirani. Pp. 24+4 plates. (London: International Tin Research and Development Council.) Free. [43

Ministry of Labour. Statement relating to Special Areas, including Memorandum on Financial Resolution to be Proposed. (Cmd. 5386.) Pp. 11 (London: H M. Stationery Office.) [83

Scientific Horticulture: the Journal of the Horticultural Education Association. Vol. 5, 1937. Pp. 196+xxxii+20 plates. (Wye: South-Eastern Agricultural College) 3*s* 6*d.* net. [83

Other Countries

Publications of the South African Institute for Medical Research No. 39: The Blood Groups of the Bantu of Southern Africa. By Ronald Elsdon-Dew. Pp. ii+221–300. (Johannesburg: South African Institute for Medical Research) [232

Science Reports of the Tokyo Bunrika Daigaku. Section A. No. 55. Zur Axiomatik der linearen Abhängigkeit, 3 (Schluss). Von Takeo Nakasawa. Pp. 123–136. 20 sen. No. 56: Allgemeine Resultantentheorie bei Formen homogener Variablenreihen. Von Tikara Tôya. Pp. 137–150. 20 sen. Section C. No. 3: Oceanographical Observations of Simoda Bay, Izu Peninsula By Shinkichi Yoshimura Pp. 127–156. 40 sen. No. 4: Stratigraphical and Palaeontological Studies of the Titibu System of the Kwantô-Mountainland. Part 1. Stratigraphy. By Haruyosi Huzimoto Pp. 158–188+plates 27–29. 60 sen. No. 5: Meteorological Observations at the Simoda Marine Biological Station during the Years 1934 and 1935. By Enchirô Fukui. Pp 189–214. 35 sen (Tokyo: Maruzen Co., Ltd.) [226

Obras completas y Correspondencia cientifica de Florentino Ameghino. Vol 23 Correspondencia cientifica. Edición Oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli Pp. 642 (La Plata.) [262

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 67: The Shrinkage of Australian Timbers. Part 1: A New Method of determining Shrinkages and Shrinkage Figures for a number of Australian Species. By W. L. Greenhill. (Division of Forest Products: Technical Paper No. 21.) Pp. 54. (Melbourne: Government Printer) [13

Indian Institute of Science, Bangalore. Appendix to the Twenty-seventh Annual Report of the Council of the Indian Institute of Science, Bangalore. Pp. 133+11 plates. (Bangalore: Indian Institute of Science.) [13

Journal of the Indian Institute of Science. Vol. 19A, Part 6: A New Method of Detection of Cereal Flours separately and in mixtures by the "Agar-Plate" Method. By P. N. Bhargava and K. Venkata Giri. Pp. 53–56. 8 annas. Vol 19A, Part 7: Determination of Manganese in Soils. By C R. Harihara Iyer and R Rajagopalan Pp. 57–66. 14 annas. (Bangalore: Indian Institute of Science) [13

Forests and Floods in New Hampshire By Dr. Henry I. Baldwin and Prof. Charles F. Brooks. (Publication No. 47) Pp. 28+4 plates (Boston, Mass.: New England Regional Planning Commission) [13

Smithsonian Miscellaneous Collections. Vol. 91, No. 25 Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—A New Actinian. By Oskar Carlgren. (Publication 3401.) Pp. ii+4. Vol. 95, No. 20 Inactivation of Plant Growth Substance by Light. By Paul R. Burkholder and Earl S. Johnston. (Publication 3403) Pp. ii+14+2 plates. (Washington, D.C.: Smithsonian Institution.) [13

Proceedings of the U.S National Museum. Vol. 83, No. 2997: Review of the Seahorses (*Hippocampus*) found on the Coasts of the American Continents and of Europe. By Isaac Ginsburg. Pp. 497–594. Vol. 84, No. 3008: The Deep-Sea Zeomorph Fishes of the Family Grammicolepidæ By George S. Myers. Pp. 145–156+plates 5–7. (Washington, D.C.: Government Printing Office.) [13

Expédition Antarctique Belge. Résultats du voyage de la *Belgica* en 1897–99 sous le commandement de A. de Gerlache de Gomery. Rapports scientifiques Zoologie—Polychètes. Par Prof. Pierre Fauvel. Pp. 44. (Bruxelles: Musée Royal d'Histoire Naturelle) [13

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 23, Memoir No 1: Some Fossils from the Eurydesma and Conularia Beds (Punjabian) of the Salt Range By Dr F. R Cowper Reed. Pp. v+36+5 plates (Calcutta Geological Survey of India.) 3.14 rupees; 6*s* 6*d.* [13

Cornell University: Agricultural Experiment Station. Bulletin 654: An Economic Study of Land Utilization in Chenango County, New York. By H. S. Tyler. Pp 64. Memoir 192: Nitrogen Nutrition and Chemical Composition in relation to Growth and Fruiting of the Cucumber Plant. By R. B. Dearborn. Pp. 26. Memoir 193: Fire Blight; Overwintering, Dissemination and Control of the Pathogene. By K. G. Parker. Pp. 42. Memoir 195: The Transmission of the Fowl-Pox. By Arthur Louis Brody. Pp. 38. Memoir 197: Adsorption of Bacteria by Soils. By T. C. Peele. Pp. 18. Memoir 198: Experiments in the Physiology of Mammary Development and Lactation By S A. Asdell, H. J. Brooks, G. W. Salisbury and H. R. Seidenstein. Pp 32. (Ithaca, N.Y.: Cornell University.) [23

Southern Rhodesia: Geological Survey. Short Report No. 30: Preliminary Report on the Geology and Mines of the Gwanda Gold Belt By R. Tyndale-Biscoe. Pp 84+11 plates. (Salisbury. Geological Survey.) [23

Osmania University, Hyderabad. Publications of the Nizamiah Observatory. Vol 8, Part 1: Comparison of the Places of Stars in the "Catalogue de 9997 Étoiles" Algiers with the Photographic Measures on the Plates of the Hyderabad Section of the Astrographic Catalogue, under the direction of T. P. Bhaskaran. Pp. vii+58. (Begumpet: Nizamiah Observatory.) 4 rupees; 6*s.* net. [23

Soologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 1, Stuk 5: Die Anatomie van die Skouergordels en die Ontwikkeling van die Sternum by die Urodele—*Cryptobrancus alleghaniensis* en *Necturus maculatus* Deur Dr. A. C. Hoffman. Pp. iii+33–50. (Bloemfontein Nasionale Museum.) [23

Annuaire de l'Academie Royale de Belgique, 1937. Pp 277+7 plates. (Bruxelles: Academie Royale de Belgique.) [23

State of Connecticut. Public Document No. 24: Fifty-ninth Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1935. Pp. xii+772+110. (New Haven, Conn.. Connecticut Agricultural Experiment Station.) [43

Snakes of Maryland. By Dr. Howard A. Kelly, Audrey W. Davis and H. C Robertson. Pp. 103. (Baltimore, Md: Natural History Society of Maryland.) [43

Science Reports of the Tokyo Bunrika Daigaku, Section B. No. 48: On the Neuromotor System and some other Morphological Characteristics of *Protoopalina axonucleata lata* Metcalf By Yasuji Hara. Pp. 45–51. 20 sen. No. 49: Bryozoa Fauna collected by the *Misago* during the Zoological Survey around Izu Peninsula, 2. By Y. Okada and Sh. Mawatari. Pp. 53–73+plates 9–10. 40 sen. Supplement No. 1: Studies on the Crabs of Japan, 1. Dromiacea. By Tune Sakai. Pp. 66+9 plates. 1.50 yen. (Tokyo: Maruzen Co., Ltd.) [83

Transactions of the National Institute of Sciences of India. Vol. 1, No. 9: Notes on some Indian Species of *Lycopodium* with Remarks on the Distribution of the Genus in India By N. Chowdhury. Pp 187–226+plates 7–14. (Calcutta: National Institute of Sciences in India) 13 rupees. [83

British East Africa Meterorological Service Annual Report for the Year 1935. Pp. 15. Meteorological Report for Northern Rhodesia, Season 1934–1935 Pp. 34. (Nairobi: British East African Meteorological Service) [93

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British Engineers Abroad and their Prospects

IN the past, an important source of British influence and prestige has been the large number of British engineers occupying responsible positions in all parts of the world. One serious result of the many changes in world conditions since the Great War is that the position of the British engineer abroad is no longer what it was. The development of technical education in the Dominions and in India now enables these countries to dispense almost entirely with engineers from Great Britain to undertake ordinary engineering work, and from similar and other causes, including nationalistic pride, the openings in the United States, South America, Egypt and other States have been very greatly restricted. Young Argentine engineers, educated in Europe, now occupy responsible positions in their own country, which is developing very rapidly on the industrial side. In the Argentine, also, no engineer is allowed to practise on his own account unless he has graduated in, or has had his foreign qualifications revalidated by, an Argentine university : for this a very high fee is charged.

The national importance of this subject, and particularly its direct relationship to the lives and prospects of the young engineer, using the word in the widest possible sense to include technically trained men of all kinds, has caused the Old Centralians to discuss it in general meeting under the chairmanship of Sir Alfred Chatterton, who has himself had a long and distinguished career in India. The Old Centralians are the Old Students' Association of what is now the City and Guilds Engineering College, London ; they include many of the older generation in their ranks who are well qualified to give reliable evidence on the problem. The "Central" has now sent forth young engineers for more than fifty years : the first small batch included Sir Alfred Chatterton and Herbert A. Humphrey. At times more than half the students went overseas on graduation ; to-day very few are able to find work abroad.

There are still openings abroad for men of special experience who are required for specific work, but such normally involve only short-time engagements ; even in these there is increasing competition from American and Continental engineers. It is urged that in the future only first-class men would be wanted abroad and then for comparatively short periods ; the country which has the best engineering representation, whether on the professional or commercial side, will in the long run obtain the most foreign work.

Trade is said to follow the flag. The engineer carries the flag or even marches ahead of it ; he tends to buy the large quantity of material required for his projects in his native country. Hence it will be appreciated that his replacement will react adversely upon our industries.

The average Englishman to-day is strangely reluctant to go abroad ; the comforts of city life at home appeal more than the idea of roughing it There is no particular indication that the engineering schools and technical institutes are turning out more men than the industrial life of Great Britain can absorb ; indeed, at the moment when the nation is re-arming and its workshops are being largely rebuilt and reorganized, there is more than enough work. Another difficulty is the apparent prejudice against men who have returned from abroad, who often find it difficult to make a fresh start on their return. The discussion made clear that for appointments abroad there is a scarcity of men for the better positions—of all-round men possessing all the qualities which are necessary for success in the Colonies.

The immediate problem to be solved is how to prevent a period of overseas service, causing as it does a serious break in the home career, from injuring the future prospects of a technical man. Obviously no general solution is possible: the first practicable step suggested by the Old Centralians is to form an Overseas Engineers Association, which would enjoy the active support of all home professional bodies representative of engineers and engineering colleges as well as of old students' associations, consulting engineers, contracting firms and large engineering and industrial firms. Such an organization would keep a record of engineers qualified to carry out work abroad. It would constitute a source from which contributing organizations would draw engineering staff when need arose and make it easier for the employers to obtain fully trained and qualified men.

The problem is to some extent associated with the training of the engineer, and the time may be opportune to re-examine the engineering courses in relation to modern requirements. The young American engineer, for example, is more highly favoured on outdoor work by overseas employers; it may be that his training, though less theoretical, none the less fits him better for his work. Mining engineering is known to have this aspect of its teaching under consideration.

It is widely held that the present three-year undergraduate course in engineering in British universities and technical colleges should be extended to four years, not so much with a more extensive curriculum, but designed rather that the students should be given more time to think over their work and to read for themselves.

Looking at the question broadly, it would appear to have two aspects: one is that of giving Englishmen a chance to go abroad without injuring their prospects on their return, which is largely a question of organization and is possible of solution on lines such as the Old Centralians visualize. The more important aspect, however, is the technical equipment of the Englishman so as to enable him to hold his own in a competitive nationalistic world. Besides personality and character and professional knowledge, he must have ideas and originality. These can be trained out of a student more easily than developed in him.

The Trend of Population in Great Britain

THE debate on this subject which took place in the House of Commons on February 10 is one of the many signs of the increasing interest which is being felt in Great Britain in population questions. Mr. J. R. H Cartland, who moved the resolution, expressed the view, which was accepted by the House, that "the tendency of the population to decline may well constitute a danger to the maintenance of the British Empire and to the economic well-being of the nation"; and the Government was requested to institute an inquiry into the problem. No new facts were brought forward during the debate, which proceeded on what may be called orthodox lines. Attention was directed to the gradual diminution of the birth-rate since 1875; to the resulting fall in the net reproduction rate; and to the ageing of our population. The question of birth-control was touched upon, and also the present general tendency of married couples to have small families. Mr. Cartland mentioned the existence of the unofficial Population Investigation Committee, which has been formed at the instance of the Eugenics Society.

Mr. Cartland quoted the important pronouncement of the Chancellor of the Exchequer when he introduced the budget on April 15, 1935: "I must say that I look upon the continued diminution of the birth-rate in this country with considerable apprehension. At the present time it may seem that we have here a larger population than we are able to support in England. . . . But I have a feeling that the time may not be far distant . . . when the countries of the British Empire will be crying out for more citizens of the right breed and when we in this country shall not be able to supply the demand."

Mr. D. Sandys, who seconded the motion, directed attention to the rapid increase in the populations of Russia and Japan. He recalled the estimate of Dr. Enid Charles to the effect that, in sixty years' time, 64 per cent of the women in Great Britain may be past the child-bearing age. He indicated the possibility that, for want of British emigrants, the Dominions might eventually "be forced to seek emigrants from Asiatic and Eastern European countries". He is of opinion that a declining and ageing population is particularly vulnerable to attack.

These and other contributions to the debate are, no doubt, ultimately based upon the important calculations of Dr. Kuczynski, who has shown how to compute the net reproduction rate of a population by a consideration of the number of future mothers that, say, a thousand mothers will give birth to. To use the words of Prof. A. M. Carr-Saunders, in his book "World Population" (1936), "This simple and beautiful method which we owe to Mr. Kuczynski gives precisely what we need. He has applied it so far as the data are available. But in order to calculate the net reproduction rate we require data concerning specific fertility as well as specific mortality. . . . They are not available for England and Wales because the age of the mother is not recorded on the birth certificate." Here, then, is a simple step towards the calculation of accurate rates, which the Government can take at once, namely, to direct that, in future, the age of the mother shall be entered on the birth certificate.

One or two of those who took part in the debate stressed the desirability of paying attention to the quality of our population.

With regard to the unofficial Population Investigation Committee, alluded to above, this Committee, of which the chairman is Prof. Carr-Saunders, has been formed to examine the factors influencing contemporary trends of population in England and Wales, with special reference to the fall of the birth-rate. It is common ground that, unless a change—at present unforeseen—occurs in social conditions, it is probable that, after some fifteen years or so, the population of Great Britain will begin to decline somewhat rapidly. The objects of the Committee are to ascertain what are the causes of this state of things; to determine, so far as possible, the social effects of such a rapid decline; and to see how a catastrophic decline can be avoided. It has been stated on behalf of the Committee that it does not at present take part in propaganda designed to modify existing population trends.

It is to be noted that Mr. R. S. Hudson, speaking for the Government, said: "We do not propose to set an enquiry on foot, because the subject is continuously under enquiry in my Department [the Ministry of Health]. We shall welcome any assistance, but we think it is essentially a matter for the Government and not for outside societies." It may be presumed that the reports of the Population Investigation Committee will be studied and made use of by Mr. Hudson's department.

Mr. Hudson did not agree with those who hold extreme views about the population position. He said that statisticians are not infallible, and that they are not infrequently wrong in their forecasts. They are, of course, limited by the information available and they are obliged to accept existing data. They have not, alas! the gift of prophecy. Our social structure is of great intricacy, and the fall in the birth-rate may be due to many causes. One such cause may, perhaps, be a perfectly wholesome revulsion from the largely unsatisfactory conditions of the huge Victorian families of a generation or two ago. Few of those who have had the personal experience of membership of a very large family would desire their children to go through the same experience. The argument is not all on one side. There are some who think that a decline in our numbers of a few millions, if the decline could then be arrested, might not be altogether such a bad thing. From a defence point of view there would be less food to import if the country is beleaguered; we might strike a better balance between our consumption and our home production of food, if there were fewer of us; we might restore some of the lost amenities of our countryside; and the better spacing of the children might improve their quality.

It is not impossible that, as a result of the relief afforded by a reduction of our numbers, the population might tend to increase again. In the future—thirty-three years from now—if our numbers in Great Britain were to have come down by some five or six millions, from their present figure of 45·5 millions, as has been predicted, that would bring us to about the same numbers that we had in 1906. Some students of the problem would not object to such a diminution, provided always, as the lawyers say, that the diminution did not continue indefinitely, and that a stationary condition could shortly be reached. But there is no certainty about the matter, and at the best we can only make reasoned guesses. So we may hope that the Government, the Population Investigation Committee and other bodies concerned, may continue their useful labours, moved by a single desire to predict with reasonable probability the situations which may arise in the future.

Recent Progress in Chemistry

Inorganic Chemistry:
a Survey of Modern Developments. By Sir Gilbert T. Morgan and Francis Hereward Burstall. Pp. ix+462. (Cambridge: W. Heffer and Sons, Ltd., 1936.) 15*s.* net.

THIS book is not a treatise on inorganic chemistry, but appears to have developed out of three lectures delivered by Sir Gilbert Morgan in 1933 to the Institute of Chemistry, in which a survey of inorganic chemistry was attempted in the light of the remarkable discoveries of the last few years. For the startling revelation in the year 1933 of the isotope of hydrogen, and of the existence in ordinary water of an undreamt-of heavy constituent—a new variety of water in fact—can only be compared to the surprising discovery in 1894 of a new inert gas, argon, in atmospheric air, and in very appreciable quantity. That the commonest and most extensively existent liquid—forming the great oceans themselves—and the very atmosphere which we breathe, should possess concealed within them hitherto unknown constituents in such appreciable quantities, were facts indeed to give a new outlook to chemistry; and not merely to inorganic chemistry, but as regards the isotope of hydrogen, also to organic chemistry, considering that hydrogen is so important a constituent of countless carbon compounds. Indeed, at first sight an appalling vista of new hydrocarbon compounds and derivatives arises before us. When to all this we add the astonishing progress made by physicists in our knowledge of the structure of the chemical atoms, and especially of the atomic nucleus, and also in the artificial disintegration of the chemical elements—a whole series of new fugitive elements possessing induced radioactivity being called forth—there can be no wonder that it becomes necessary to take stock of the position.

The introductory chapter affords a brief survey of the development of our information concerning the ninety-two chemical elements, their classification, atomic weights and atomic sequence numbers; it marks the milestones on the fascinating road which inevitably led to the recognition that the atoms themselves have structure. The most notable referred to are the discovery by Sir William Crookes in 1879 of the cathode rays, electrons; by Moseley in 1913 of the meaning of the atomic sequence number of the element, as defining the positive charge on the central nucleus, and the number of negative planetary electrons around it, affording a wonderful explanation of the long mysterious periodic classification of the elements; and the discovery by Sir J. Thomson of positive rays, and of isotopes by Soddy in 1913, leading to the development by Aston in 1919 of his positive-ray mass-spectrograph, by which an immense number of isotopes (elements corresponding to the same atomic number but having atomic weights differing by one or more whole numbers) have been identified, one for almost every whole number up to the atomic weight of bismuth, 209. It then passes on to discuss the electronic conception of valency, the distinction to be drawn between electrovalency (as in sodium chloride), and co-valency (as in methane) involving the sharing of electrons, and to a wider application of the co-ordination theory. The second chapter deals with the key elements, the inert gases, and hydrogen. Chapter iii then proceeds to relate the facts concerning the isotope of hydrogen and heavy water, deuterium oxide, D_2O, of the properties of which latter liquid an excellent account is given, including its physiological effects as far as they have yet been examined. The chapter concludes with a description of other deuterium compounds, such as the deuteroammonias (deuteramines), deuterium halides, and deutero-methane CD_4, and heavy benzene C_6D_6 and naphthalene.

In a succession of further chapters, the periodic groups of closely related elements are dealt with in turn, and this portion of the book is full of structural formulæ, largely in connexion with the theory of co-ordination. At the end of the discussion of the eighth (iron-platinum) group, attention is directed to the necessity of remembering "that the cosmic pendulum traces out the evolution of chemical elements in a continuous helical curve which for convenience may be regarded as being described around an octagonal prism on each face of which is tabulated a vertical series of elements arranged in two alternating natural families". Referring to the noble metals and the inert (noble) gases, the authors express their opinion as hardworking chemists that "the badge of nobility seems to be idleness and detachment from ordinary mundane matters. To this ideal the inert gases—the key elements—thoroughly conform in all readily realisable circumstances. They are the *rois fainéants* of chemical elements".

A very interesting chapter (xii) follows, on the transmutation of the elements, natural and artificial, and an account is given of (1) spontaneous disintegration, exemplified by uranium and radium, (2) artificial disintegration by means of high-speed particles such as helium nuclei (${}^4_2\mathrm{He}$), protons (${}^1_1\mathrm{H}$), deuterons (${}^2_1\mathrm{D}$), or neutrons (${}^1n$), and (3) induced radioactivity by bombardment with helium nuclei (α-particles), neutrons, deuterons, or γ-rays. The light particles concerned in all these transmutations or disintegrations are considered as the "primordial stuff common to all elements". The electron, the particle of the cathode rays and the negatively electrified and planetary non-nuclear part of any atom, is considered as truly particulate, but in view of the diffraction of electrons they are also considered to possess some wave-like attributes. The positron, the positively electrified electron discovered by Anderson in 1932 as arising from the action of cosmic rays on terrestrial matter, and since also obtained by Curie and Joliot by bombardment of light elements by helium nuclei (α-particles) or neutrons, has the same ratio of electrical charge to the mass as the electron, but the sign of the charge is opposite. The positron may, indeed, be also obtained by the action of γ-rays on aluminium, copper, silver, platinum, lead, bismuth and uranium. It is not surprising that the positron should have eluded discovery so long, for its length of life is only the fraction of a second.

The neutron is a particle, first clearly recognized in 1932 by Chadwick, without charge and having a mass 1·0085 nearly identical with that of the proton, and its discovery has led to a most important change of view as to the nature of the nucleus. For the fundamental units contained in it are now seen to be protons and neutrons instead of protons and electrons. Indeed, protons and neutrons may be regarded as the same fundamental particle in two different quantum states; the neutron becomes a proton by liberation of an electron, and a proton becomes a neutron by giving rise to a positron. The stability of the nucleus appears to be dependent on the relative numbers of neutrons and protons which it contains. The proton is now fully substantiated as the hydrogen ion (${}^1_1\mathrm{H}$) of mass 1·0081 (${}^{16}\mathrm{O} = 16$), and carries a positive charge. It may, in fact, be regarded from the above as a neutron plus a positron. Protons are readily produced by passing an electric discharge through hydrogen, while neutrons are most easily obtained by treating beryllium with either γ-rays from radium or with X-rays of $1{\cdot}5 \times 10^6$ volts.

The helium nucleus (α-particle) is now accepted as possessing a mass of 4·002 (${}^{16}\mathrm{O} = 16$), and carrying a positive charge of two units, and is the only massive particle yielded by the spontaneously disintegrating radioactive elements. Although complex, containing two neutrons and two protons, it is a fundamental particle which has never been disintegrated, being uniquely stable. The nuclei of all elements of greater atomic weight than helium itself are largely made up of helium nuclei. The neutrino of which we have lately heard is probably only a mathematical conception.

The above facts are clearly brought out in the book, and it is a comfort to see them so, for of late it has not been at all easy to follow the rapid sequence of new discoveries in this sphere. It has to be remembered, however, that besides the uranium, thorium, and actinium series of spontaneously radioactive elements, potassium, rubidium and samarium have also been observed to exhibit the phenomenon of radioactivity. In the case of potassium it is probably the isotope ${}^{41}\mathrm{K}$ which shows it, the isotope which is only present to the extent of seven per cent in the metal. But since 1934 we have been confronted with the most astonishing phenomenon of all, that of induced radioactivity, by the discovery by Curie and Joliot of the effect of bombarding boron and aluminium with α-particles (helium nuclei), or graphite with accelerated protons and deuterons, the former operation producing radioactive nitrogen ${}^{13}_{7}\mathrm{N}$ and neutrons from boron, and radioactive phosphorus ${}^{30}_{15}\mathrm{P}$ and neutrons from aluminium; the latter operation also gives the same active nitrogen, which disintegrates with expulsion of a positron, and with deuterons either the same result or the formation of protons and inactive carbon. Sometimes with boron an active form of carbon resulted, ${}^{11}_{6}\mathrm{C}$. More surprising still, Fermi and his colleagues in 1934 and 1935 have produced more than forty new radioactive elements having atomic numbers from seven to ninety-two, by bombarding inactive elements with neutrons.

The neutron proves to be particularly powerful in penetrating the nuclei of many elements, giving rise to the new radioactive elements. Water and common salt can now be made to furnish respectively deuterons and radioactive sodium, this latter possessing properties very like those of radium, and it may be of use in medical work. The life-period of these new elements is very short, varying usually from a few seconds to less than one hour, and exceptionally, in the maximum, three days. For example, active carbon, ${}^{11}_{6}\mathrm{C}$, lasts for forty minutes, while radio oxygen ${}^{15}_{8}\mathrm{O}$ lasts four minutes and radioaluminium, ${}^{28}\mathrm{Al}$, five minutes. It must be remembered, however, that so long ago as 1919 Lord Rutherford had effected the artificial transmutation of nitrogen, by exposing it to α-particles emitted by radium-C, oxygen (${}^{17}_{8}\mathrm{O}$) and high-velocity protons being produced; but only one α-particle in a million was actually effective.

A further chapter (xiii), on co-ordination compounds in Nature, the arts and industries, shows how the co-ordination theory explains many cases of simulated isomorphism, such as those pointed out by the late T. V. Barker. The cases of the silicates, classified by W. L. Bragg according to their structure as determined by X-rays, are also referred to as typical examples of the application of the theory. Then comes a chapter on the corrosion of metals, in the course of which the estimate by Sir Robert Hadfield is referred to, that the world's annual loss by the corrosion of iron, steel and other ferrous metals amounts to no less than seven hundred million pounds sterling. This is followed by a chapter on alloys, and the light which X-ray analysis has recently thrown upon them. Successive chapters then deal with (*a*) carbides ; (*b*) the metallic carbonyls, and the value of Raman spectra in deciding the character of the linkage between carbon and oxygen, and in thus revealing the cause of the remarkable stability of these compounds ; and (*c*) the nitrosyl compounds ; and finally (*d*) the organic derivatives of metals and metalloids.

In reviewing a book such as this, for which one can have only the highest admiration and gratitude for its production, only one slight criticism may perhaps be permitted. The great emphasis laid on the theory of co-ordination appears to have led to the overlooking of the wonderful way in which the progressive structure of the atoms of related elements of the same family group is reflected in the similarly progressive variation in the properties of their isomorphous compounds ; in their crystalline characters (including crystal-angles), the dimensions of their similar unit structural-cells, their optical, thermal, electrical, and elastic constants. It is indeed most striking how beautifully the addition of each shell of electrons, as we pass from one member of the family of elements to the next, is seen to be revealed and marked by the advance of every natural property and physical constant. If, in addition to the reference to the alums on page 93—which do not exhibit the variation in symmetry constants, as they crystallize in the cubic system the angles of which are fixed and invariable—the cases had been considered of the rhombic sulphates, selenates, chromates, perchlorates, permanganates, and especially the monoclinic double salts with $6H_2O$ now generally known as the Tutton salts, a series of seventy-seven salts all of which have been investigated in detail, it would have been clear that in these variations, following exactly the order of the atomic complexity of the interchangeable elements, we have one of the most wonderful and complete confirmations and exemplifications of the effect of atomic structure on chemical constitution and physical character possible to imagine.

The book is excellently printed, in good sized type very pleasant to the eye, and does great credit to the publishers. A. E. H. TUTTON.

The New Hebrideans

Savage Civilisation
By Tom Harrisson. Pp. 461 +32 plates. (London : Victor Gollancz, Ltd., 1937.) 16*s*. net.

MR. TOM HARRISSON was a member of the Oxford University expedition to the New Hebrides in 1933. When the expedition left the islands he elected to remain behind, and spent a year living as a native among the natives, was for a time an official, and ended by taking part in a cinematograph film.

Whether of set purpose or not, Mr. Harrisson's narrative is arranged with consummate skill. An account of New Hebridean culture, which sets out the principal features of the economic, social and religious complex, is followed by a survey of European contacts with the islanders from the time they were first discovered by de Quiros in the early years of the seventeenth century down to and including the present joint administration of French and British under the Condominium. The author has expended considerable pains on piecing together the narrative of missionary work and the obscure record of 'blackbirders' and sandalwood traders. His critical views on the Condominium are at first hand.

The reputation of the New Hedrideans for ferocity and treachery is based on the evidence of traders and missionaries, and is a long tale of murder and aggression. The contrast between native and Europeans, even as set out here, made this almost inevitable. The narrowness of the missionary outlook, and the brutalities, cruelties and injustice inflicted on the natives by traders and labour-recruiting ships, gave unlimited provocation. At the same time, narrow as the missionaries were, they are scarcely to be blamed if their ideas in the early days were not in advance of those of their contemporaries. Mr. Harrisson's vivid and racy story of his personal experiences among unadministered natives on Malekula and Espiritu Santo serves as a foil, and redresses the balance as against the traditional view.

A tribute is paid to the medical work of present-day missions. The tendency of the population at the present time to increase is attributed in large measure to improvement in hygiene and medical attention, although the latter is still inadequate. The view of the late Dr. W. H. R. Rivers that the decline in population among the islanders of the Pacific was psychological in origin, and due to a *tædium vitæ* caused by the break-up of native custom, is regarded as disproved, at least so far as concerns the New Hebrides.

As a picture of island life seen in intimate conditions, Mr. Harrisson's book is a notable, as well as an entertaining, addition to the travel literature of the Pacific.

A New Higher Algebra

Higher Algebra
By S. Barnard and J. M. Child. Pp. xiv+585. (London: Macmillan and Co., Ltd., 1936.) 20*s*.

THIS new "Higher Algebra" will be examined with great interest by all teachers and serious students of mathematics. A book of this type is certainly needed at the present time, and the one before us should go far towards providing that stimulus which the teaching of algebra urgently requires.

The book is rather an outsize, containing 585 pages, and at a first glance the reader is inclined to wonder why. For, in the main, the scope of the book is similar in extent to that of the older higher algebra texts; yet more than the usual amount of previous knowledge of mathematics is assumed: a "knowledge of the progressions and permutations and combinations". The authors might have added that the binomial theorem for a positive integral power is also assumed.

A closer examination shows that the various topics are treated very fully indeed, and that there are, in addition, several chapters which do not appear in the usual algebra text. For example, the early part of Chapter v, which deals with complex numbers, leads to the statement and development of De Moivre's theorem, the real and complex factors of $x^n \pm 1$ and vectors. Similarly, the discussion of continuity leads naturally to the derivative of a function and to the notation and methods of the calculus.

It is apparent that the authors have attached considerable importance to placing the notion of real number on a firm and sound basis; in this connexion, the book compares very favourably with many of its predecessors. On this sure foundation the subject is "developed logically, complete as far as it goes and serving as an introduction to modern analysis". Indeed, the title might well have been "An Introduction to Mathematical Analysis".

The arrangement of the work differs from that adopted in most higher algebra texts in that only as much of a topic is introduced as is immediately necessary for the development of the subject. For example, the theory of equations is not confined to a single chapter—the topic is introduced so early as Chapter vi and is further developed in Chapter xviii; similarly with theory of numbers, polynomials, convergency, continued fractions, etc. In this way there is no suggestion of watertight compartments. Most of the topics are treated in considerable detail; this is particularly the case in the treatment of the theory of numbers and the theory of equations.

Although a mathematically minded student might work through the book unaided (and so many hints are embodied in the exercises one feels that the authors have not forgotten this class of student) it is not suitable and is not intended for beginners. The Higher School Certificate students mentioned in the preface are students taking the mathematics group—and such students are supposed to be of special mathematical ability.

Both the publishers and the authors are to be congratulated on the finished appearance of the book; the printing is excellent, though some rather small type has been used in the worked examples, and the book has an appearance of solidity which is in keeping with its contents. There are many good sets of examples. Although the book is rather large, one feels that a few historical notes would have made for even more completeness than there is already. No teacher or serious student of mathematics should be without a copy of this excellent book.

Methodik der Hormonsforschung

Von Dr. Christian Bomskov. Band 1: Schilddruse, Nebenschilddruse, Nebennierenrinde, Nebennierenmark, Pankreas. Pp. xxi+716. (Leipzig: Georg Thieme, 1936.) 54 gold marks.

DR. CHRISTIAN BOMSKOV has undertaken the production of a reference work dealing with all the methods used in the investigation of hormones The first volume contains a general discussion of methods, and special sections dealing with the thyroid, the parathyroids, the suprarenal cortex and medulla and insulin.

It would be impossible for one man to prepare a critical review of so large a field, and those who have specialized will be able to criticize details, but there can be no doubt that Dr. Bomskov has produced a work that will be very useful to those who wish to know the details of the experimental methods in use. Most of the important methods are described in full detail, and references are given to descriptions of other methods.

The general discussion is divided into sections dealing with surgical methods, histological methods, biological methods and chemical methods. These are each discussed in detail. For example, the section on biological methods deals, among other things, with the obtaining of samples of blood, stomach tubes, injections, weighing, measuring the body temperature, the registration of respiration and blood pressure, isolated hearts, perfusion and isolated plain muscle.

Each of the special sections is subdivided in the same way and the general arrangement is so good that it is easy to find any particular piece of information without reference to the index. The surgical part of each section contains full instructions, illustrated by diagrams and photographs, for removing each gland from all the commoner laboratory animals. The histological part discusses special methods appropriate to each gland and gives photomicrographs of the appearance of the glands. The biological part discusses all the effects which the different hormones produce, and methods of assay. The chemical part gives methods of isolation, chemical assay and, where possible, methods of synthesis.

This book meets a definite need and can be warmly recommended as a book of reference. It gives a reasonably complete list of the methods available, including the bad methods with the good methods, without much attempt to discriminate between them.

Lehrbuch der Mineralogie

Von Prof. Walter Schmidt und Dr. E. Baier. Pp. vi+320. (Berlin: Gebrüder Borntraegar, 1935.) 14 gold marks.

THE two authors of this text-book are in charge of the tuition in mineralogy at the Berlin Technische Hochschule. Mineralogy is a science which impinges upon several other sciences, especially geology, physics and chemistry and the number of students who have to acquire at least a general acquaintance with it tends steadily to grow. Prof. W Schmidt is responsible for the text in general, while the special sections in smaller type have been contributed by Dr. E. Baier, his assistant.

The book is in reality in two parts, although not definitely so divided. The first part, which forms a general introduction to the subject, is occupied with such parts of crystallography, optics, chemistry and geology as apply to mineralogy. The treatment is confined to general principles; nothing, for example, is said about goniometers, refractometers or other apparatus. The part includes interesting chapters upon the classes of crystal symmetry, the X-ray study of crystal structure, geochemistry and paragenesis. In the second part the important characters of the principal mineral species are concisely yet fully described, the arrangement being by elements, sulphides, oxides, silicates, etc., and halogens.

The numerous illustrations greatly add to the value of the book; thanks to the calendered paper used, they are clearly printed, but, on the other hand, the shiny surface is irksome to the reader. Mention should be made of the excellent figures in colour which are inserted at the end, representing a quartz wedge between crossed nicols and uniaxial and biaxial interference figures. Subject and mineral indexes facilitate reference to the book, and the clarity of the exposition throughout is admirable.

Back in the Stone Age:

the Natives of Central Australia. By Dr. C. Chewings. Pp. xx+161+23 plates. (Sydney and London: Angus and Robertson, Ltd., 1936.) *7s. 6d.*

DR. CHEWINGS'S experience of the blackfellow dates back to 1881, when he took up a grant of land in the MacDonnell Ranges of Central Australia. The tribes with whom he then came into contact were the Aranda (Arunta) and Loritja described in detail by C. Strehlow, a missionary of the Hermannsburg Mission, more than thirty years ago. When Dr. Chewings first met them, they were living literally in the stone age, their only cutting implements being of stone. He describes their daily life, their social organization and magical beliefs and practices as they presented themselves to the squatter, but with certain explanatory additions to make them intelligible to the ordinary reader, which he has gleaned from the work of Strehlow and Spencer and Gillen. His actual experiences as an employer of the blackfellow in the work of the station and in his contacts with them and their *lubras* tell us even more of their characters and capacities than his account of their customs.

Notwithstanding the reserve policy and the care of the Governments for the aborigines, Dr. Chewings thinks the drift towards the centres of civilization is inevitable and the ultimate fate of this people extinction. This opinion, based on long experience and understanding of the blackfellow, cannot be ignored; but the Federal Government has already carried out some of the measures advocated by the author, and experience elsewhere in analogous conditions among backward peoples suggests that extinction is by no means so inevitable a fate as he thinks it to be.

Old Diseases and New*

By The Right Hon. Lord Horder, K.C.V.O.

IT would be impossible to say that any disease has completely died out, and it would be an unwarrantable assumption to say that any disease is a new disease. All the same, it is certain that a number of diseases, which were formerly rife, not to say decimating in their effects in the past, have become obsolete, and it is almost, though not quite, as certain that other diseases have increased considerably during recent times. It is in the sense of the general nature of the problem which diseases present to-day as contrasted with years ago, that I use the words "new" and "old".

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Diseases of the heart and blood vessels have taken a prominent position in medicine during recent years. To what degree this is due to an increase in their incidence, or to our improved methods of detecting them, or even to more notice being taken of them now that the more obvious 'villains' have quitted the stage—these are difficult questions to answer. But physicians of two, and still more of one generation ago, were very good observers, both by the bedside and in the autopsy room. So that we have their, and our own, experiences to compare, and on this basis there seems no doubt that diseases affecting the organs of circulation are relatively more rife than formerly.

What is called atheroma, or degeneration in the large arteries, is a very ancient disease. Egyptian mummies, embalmed 2,000 years before Christ, show it. Aneurysms, which are saccular dilatations of the big arteries and which were certainly fairly common until fifty years ago, have become comparatively rare. This is because the particular infection which attacks the walls of the vessel is diagnosed much earlier, and is successfully treated, But the more diffuse and less dramatic disease of the arteries which we term arteriosclerosis is very common indeed. This sort of arterial thickening overlaps with other troubles which are partly a result of the loss of elasticity in the vessel wall, and partly compensatory in nature. One of these is arterial hypertension, 'high blood pressure' as it is popularly called. This state of affairs was well known to the physicians of the generations immediately past, who could quite well detect it, even in its early stages, without the help of that instrument of precision by which it may now be exactly measured.

High blood pressure is not a disease in itself; it is an expression of disease; it is one aspect of that 'rock' or disturbance in the equilibrium by which we have defined disease. It may even, at certain epochs of life, be regarded as physiological. In many cases the increased arterial tension follows, or accompanies, increased nerve tension, the latter being of greater importance in the diagnosis than the former. The older physicians regarded high blood pressure as part of a generalized gouty state. It may well be that, with the great decline in gout in its more classical phases, such as an acute inflammation of the big toe, the same morbid processes—chemical, nervous and infective—are expressing themselves nowadays in the direction of these changes in the circulatory apparatus.

Blood pressures that are below the average are also common. These give the medical man quite as much food for thought as do the high pressures, but they have not, so far, engaged the popular imagination, because the results of them are not dramatic. Perhaps they are the modern equivalent of what used to be called 'poor man's gout'.

Then there is another disease of the blood vessels, and a serious one, which some of us consider to be a comparatively modern disease, and this is a tendency for the small arteries which supply blood to the wall of the heart to become blocked. Our technical term for this is 'coronary thrombosis'. Even when we have allowed for the number of these cases which were formerly included in the category of 'angina pectoris', the incidence of the disease is still, many of us believe, higher than it formerly was. Like all diseases of the circulatory apparatus, it is more common in males than in females. The main causative factors are as yet obscure. Tobacco, and especially cigarette smoking, has been suspected, and there would seem to be something in the life of a medical man which makes him specially prone to this affection.

There is also that curious condition termed 'halt-palsy', in which we postulate a spasm of the arteries in the legs with, in most cases, an early degree of thickening of the vessels. The main symptom is so striking that it is scarcely credible that it would not have attracted the attention of the older physicians had it been as frequent in the past as it is to-day. The patient is suddenly seized with pain in one or both legs when walking; he halts for a minute or so and the pain ceases; he starts off again and is brought up sharply at about the same distance, stops, and is again relieved.

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* From a Friday evening discourse delivered at the Royal Institution on February 26.

Nor are our veins exempt from a 'new' disease. Inflammation of a large vein, with the formation of a clot, has been known for a very long time. But it is only during recent years that we have become familiar with a disease in which the inflammation affects a number of the smaller veins, and creeps about from one to another over a period of, it may be, several months. This tendency has given the malady the name 'phlebitis-migrans.

It is very difficult to say to what extent the work of microbes enters into the production of these troubles in our blood vessels. That it *is* a factor in some of them seems highly probable. The one thing that seems certain is that the type of germ concerned is not that which 'lays us out', as the expression goes, by a process of acute and lethal infection.

I want to deal with this last point rather more fully, and in connexion with the last of the modern diseases I will mention in which the organs of the circulation are mainly involved. This disease is what we call 'septic endocarditis'. The valves of the heart become the site of colonization of microbes, causing an inflammation which, at some time or other, produces ulceration. When this process has arrived, particles of tissue carrying masses of the microbe are swept off into the blood stream, and get lodged in the network of small vessels in various organs at the periphery of the circulation. In the great majority of cases these microbes are 'streptococci'. A form of blood poisoning is thus set up, to which the patient unfortunately, and despite all we can do, sooner or later succumbs in a very high percentage of cases.

If the germs concerned in this process are virulent germs, such as those which cause acute blood poisoning, or boils, or pneumonia, the disease is fulminant and of short duration—it may be days only. If, however, the germs are not virulent, or, as we express it, only feebly pathogenic, the disease is insidious, slow, and its duration may extend into two or even three years. There is no doubt that the old type of the disease (if I may speak of diseases in types) was generally of the former kind, whereas the tendency nowadays is towards the latter kind. Indeed, acute cases of septic endocarditis have become comparatively rare, and the chronic cases have become all too common. In the altered character of this one disease, therefore, we see illustrated the change that has taken place in bacterial diseases in general: the acute and virulent sorts have come under control, and are either obsolete or have diminished greatly in incidence; the chronic sorts have increased, and so far, have escaped control.

When we come to examine carefully the actual bacteria that are associated with these chronic infections, or, as Adami conveniently terms them, "sub-infections", we find that they are not to be distinguished by any known characters from the bacteria that are indigenous in our bodies during health. If, however, they pass the barriers of the mucous membrane, and enter the solid tissues of the body, or the blood stream—except perhaps in such minute numbers as can be promptly killed or as promptly eliminated by the kidneys—diseases may arise, generally of this insidious and chronic form. There are several more of such diseases, in addition to septic endocarditis, but I must not stay to speak of them. The general term under which we speak technically of this set of diseases is 'focal sepsis'. It is in connexion with them that many of our patients talk to us nowadays in the language of the bacteriological laboratory—perhaps with the possessive proudly added—as "*my* streptococcus, doctor", or "my bacillus coli".

What the factors are that determine these sub-infections we are as yet unable to say. We speak, rather loosely I am afraid, about 'lowered resistance', but we are quite unable to define this term exactly. Until we know more about the nature of the natural defences of the tissues against bacterial invasion, and perhaps more, too, about possible mutations in the bacteria themselves, this part of the mechanism of sub-infections will remain obscure.

If we turn now to another group of diseases which bulks largely in modern medicine, those associated with what are called the internal secretions of the body, or hormones, it is still more difficult to say if these have increased in frequency, because our knowledge of these substances is comparatively recent, and the study of what we call endocrine imbalance is therefore also recent.

With that natural desire to unload the defects of behaviour upon anything that comes to hand which is outside our control, we like to think our 'glands' are at fault when our temper is not well governed, or when we are moody, or when, in any way, we are anti-social. Allowing fully for this weakness, there still remains a large residue of cases in which we can trace the jostle suffered by the normal equilibrium to disturbances in this part of our economy.

If we include diabetes in this group, on account of its close association with the internal secretion of the pancreas, we have figures which show a considerable increase in the prevalence of this disease. The number of diabetics in Great Britain in the year 1923–24 was estimated at 29,000. The estimate for 1934–35 was 70,000. In the United States the increase is said to be even greater. Since diabetes is not a disease of old age, these figures are not explained by the increase in the expectation of life which has taken place during the same period.

In the sphere of the nervous system, the position appears to be this: that whilst the incidence of what we term the major psychoses, that is, the forms of mental derangement requiring institutional treatment or special nursing, remain much as they did, there is a large increase in the minor psychoses or psychoneuroses, as they are more properly termed. The condition called anxiety neurosis is very common and neurasthenia still more so—indeed neurasthenia is one of our major problems in medicine to-day, both as regards its causes and its treatment.

The first appearance of that form of inflammation of the brain called encephalitis lethargica is quite uncertain, because in the severe cases of influenza cerebral symptoms have often appeared, causing confusion in diagnosis. But serious outbreaks have occurred in the present generation, as well as many sporadic cases. The number of cases in which the brain symptoms appear, the fever having been overlooked, or being absent altogether, is probably still under-estimated. The same applies to influenza nerve symptoms, though these are, of course, less serious. Acute poliomyelitis, better known by its trivial name, infantile palsy, has close affinities with encephalitis, and as there is authentic evidence that this disease existed long ago in Egypt, it is probable that encephalitis did also.

The claim that there *are* new diseases might well be supported, even though they are more interesting than extensive. By way of illustration, there are diseases which are the direct result of modern treatments. There is what we call serum-sickness, for example, a state of things which often follows a week after the injection of serum derived from the horse, as for diphtheria or tetanus.

There are diseases which follow the use of X-rays and of radium. There are effects which we do not aim at, but cannot sometimes avoid, following the use of a number of drugs, both inorganic and organic. We may do an arthritic patient a great deal of good by injecting him with a preparation of gold, yet the metal may disturb his system in such a definite manner that we do, in effect, set up another disease. We may clear a man's tissues of gout by means of a drug called atophan, and give him disease of the liver. We may assist considerably in the healing of a gastric ulcer by the intensive use of alkalis, and induce a disease called alkalosis. A Scots patient for whom I once ordered bicarbonate of soda was so struck by the relief of his stomach ache that he expressed his fear lest his body would have to pay for a drug which was so "verra powerful". His fear had an element of justification.

By the use of insulin we are able to keep the amount of patient's sugar circulating in a diabetic blood at a proper level. But an overdose may reduce the sugar below the normal threshold and the result is a well-recognized disease.

Then there are new diseases incident upon new occupations. Occupational diseases were well known to the old physicians. Paracelsus described the lung disease of miners at the beginning of the sixteenth century. But T.N.T., and the disease of the liver which may follow from handling it, are entirely modern; and since our forefathers did not make war with poisonous gases, the diseases incident upon their inhalation are peculiar to this more civilized age.

Looking now at the germ diseases over which we still have practically no control, they are probably, nearly all of them, the result of infection of the body by a special type of microbe which we call a virus. Filtrable viruses, they are sometimes termed, because the infecting agent passes through the finest (porcelain) filter available. This infective material has been proved to contain extremely minute particles: the name "elementary bodies" is given to them. We owe the first description of these particles to a Scot named John Brown Buist, who found them in the calf lymph used for small-pox vaccination and also in material removed from small-pox pustules. After the delay that so often follows original observations like these, a number of other workers have studied these Buist bodies, and have confirmed their presence and importance. British bacteriologists have been amongst the foremost in these researches, and in particular, Dr. Mervyn Gordon and Prof. J. C. G. Ledingham.

There is a lot of evidence for regarding virus bodies as being the cause of influenza, encephalitis lethargica (or sleepy sickness), infantile palsy, mumps, measles, and also (some would add) the common cold. What is equally important, there is a growing belief that the mystery of cancer, a disease which equally lacks control in the true sense of the word, may find part of its solution in the discovery of specific virus bodies. That cancer *is* a microbic disease becomes more and more a convincing hypothesis as intensive research into its problems continues. It is not difficult to visualize these minute virus bodies—each one is from five to ten times smaller than the ordinary micrococci—settling like so much dust, inside the very substance of the cells of an organ, successfully colonizing there (successfully, that is, from their own point of view) and thoroughly disorganizing the cell economy. The life of the cell continues—it is not killed—but it is stimulated (irritated) into that state of chaotic over-growth which is the very essence of cancer. I do not know of any problem connected with cancer as a disease which is not capable of explanation upon the basis of a hypothesis like that. We shall see, if we continue to be patient and painstaking and work with some vision, if this be the truth or not.

It is often held that the incidence of cancer has increased during the past fifty years. This is very difficult to prove. Several possible fallacies come into the argument, especially improved diagnosis, and better methods of registration. Cancer is a disease of the second half of life ; indeed, to a large extent it is a disease of old age. An increase in the number of cases of cancer may therefore be no more than a confirmation of what we know already—that the expectation of life has risen by 15 years during the past two generations. Old age brings not only its own infirmities but also its own diseases. Senility is itself a disease, and it is on the increase. If we go on as we are going, a man giving this lecture in sixty years' time will probably stress senility as being one of the most striking of the 'new' diseases.

It seems to me that certain generalizations emerge from this discussion of 'old' and 'new' diseases. There has certainly been a swing over, as it were, from those frequent and devastating gusts of acute and virulent germ diseases to more insidious and chronic maladies. Life was very precarious in Elizabethan days and in the centuries immediately preceding and following them. We must remember that what we know to-day about those terrible scourges refers only to the big epidemics ; there must have been thousands of what are called 'sporadic' cases, and there were places where some of these pests made themselves endemic. So that, in addition to the big waves of fevers that brought death in great swathes, there was the steady, constant loss of life in these other ways. Sydenham estimated that in his day fevers accounted for 70 per cent of the whole of medical practice. To-day this figure is not more that 10 per cent.

The Elizabethan was very alive to-day and very dead to-morrow. If we exclude influenza, which still seems to possess something elemental in its potentialities—that is, judging by 1918–19, rather than by the mild epidemic we have just experienced—there are no diseases nowadays that spell violence as diseases did in Sydenham's time. Unless we call venturing upon the streets and roads a disease. Or war ; which is, after all, the greatest of all modern diseases, though it is a disease of the mind and not of the body. It has existed since the race began, but its casualties were formerly trivial by comparison with those due to disease. To-day the proportions are reversed. The Great War cost us more than 700,000 lives and 2½ million total casualties. At the beginning of 1920 there were just over one million war pensioners, and even in March of 1936 there were 400,000 permanent pensions being paid. Of these, 40,000 were on account of mental and nervous diseases. Science has reduced enormously the casualties due to the attack of the microbe upon man ; but science has increased in much greater proportion the casualties due to the attack of man upon man.

Then, again, the question arises, what of the integral stuff of our bodies and of our minds ? It looks as though our enemies have become the men of our own house, rather than those who have got entrance from without. Why is this ? Has something gone wrong with the control ? Or, to change the metaphor, are we discharging the battery at too high, and charging it at too low, an amperage ? *Why* are we becoming the preys of our own saprophytes ? *Why* is the tubing of our blood vessels, and why are the working parts of the pump, wearing so badly ? These questions cannot yet be answered, or not in this place !

We are living longer ; that is one of the most striking results of the past fifty years of hard but intelligent work on the part of those who have inspired and administered our public health services. Does someone ask *cui bono ?* Why live longer if we cannot live more healthily and more happily ? For it certainly does look as though, for many of us, our lives become 'thin spun' long before the 'abhorred shears' are due—so why take such pains to defer them ? Is our meticulous care of our shadowy present worth it ? Is it worth suggesting security to ourselves in a gas mask and an (alleged) bomb-proof cellar ? But surely the answer is with us who do the living ? How *long* a man lives depends upon his ancestors and the state of the public hygiene. How *healthily* and how *happily* he lives depends upon himself. Also be it observed that mere absence of disease is not enough. Therefore we welcome an attempt by the State to organize the national physique. Later, but I trust not too late, perhaps we might do something to organize the national mind ; and so get back some of the *zest* for living that we seem to have lost, and the ability to enjoy this immunity from disease that we have accumulated.

The Transition State in Chemical Kinetics

By Prof. M. Polanyi, University of Manchester

THE energy barrier separating the initial and final states of a reaction has ceased to be a fictitious concept since the main principles of chemical inertia were discovered by F. London (1927). For some simple cases, we can now calculate the energy changes occurring during the process of reaction, and follow the paths along which the atoms move. We can, in particular, obtain in many cases a clear picture of the configuration which corresponds to the top of the energy barrier. This configuration is called the *transition state* τ of the reaction.

It is interesting to deduce Arrhenius's equation by thermodynamical considerations relating to the transition state. At chemical equilibrium we see the atomic configuration changing forwards and backwards between the initial and final states of a reaction, and passing on each occasion through the transition state τ. The positions which the atomic system takes up between the initial and final states form a continuous sequence and can, therefore, be defined by one co-ordinate l which is called the 'reaction path'. At equilibrium we have a certain infinitesimal number of reacting systems in the transition state, that is, near the top of the energy barrier. This number (population) can be equated to the concentration product of the reactants, say, $c'.c'' \ldots$ into an infinitesimal equilibrium constant $K_1 dl$.

$$\text{Population } (\tau) = c'.c'' \ldots K_1 dl$$

Since

$$\text{Population} = \text{birth-rate} \times \text{average life},$$

we can calculate the birth-rate by noting that the average life of τ is equal to a thermal velocity v over dl, and that thus:

$$\text{Birth-rate } (\tau) = c'.c'' \ldots K_1 v.$$

Now the birth-rate of τ is equal to the rate of the forward reaction (1) plus the rate of the back reaction (2), and since at equilibrium, rate (1) = rate (2)

$$\text{rate } (1) = c'.c'' \ldots K_1 v/2$$

and the rate constant k_1 is

$$k_1 = K_1 v/2 \ldots \text{(A)}$$

Applying van t'Hoff's isochor to K_1, we obtain:

$$\frac{d \log k_1}{dT} = -\frac{q}{RT} + \frac{d \log v/2}{dT}.$$

The second term on the right being negligible, this gives $k_1 \propto e^{-q_1/RT}$, that is, Arrhenius's equation.

The 'transition state method' of treating problems of reaction velocity consists in a generalization of this procedure to other variations than those of temperature. Supposing the reaction rate in solution changes under the influence of hydrostatic pressure π, then applying thermodynamics to equation (A) we obtain

$$\frac{d \log k_1}{d\pi} = \frac{V_1 - V_\tau}{RT} + \frac{d \log v/2}{d\pi},$$

where V_1 is the volume of a solution containing one mol of the initial state and V_1 the volume of a solution containing one mol of the transition state. We can again neglect the differential of v and set

$$k_1 \propto e^{(V_1 - V_\tau)/RT}$$

The fruitfulness of this deduction depends on our capacity to interpret the values of $V_1 - V_\tau$ derived from observation. This is easiest in the case of reactions of the type $A + B = AB$; for these we can predict $V_1 - V_\tau$ with some accuracy. The configuration of the transition state must here be intermediate between the configuration of the initial and final states and quite near to that of the final state, and the same will hold for the volume V_τ. V_τ will lie between V_1 and V_2 (the volume of the final state) close to V_2. This has, in fact, been confirmed by experiment. It thus seems that the rate at which reaction velocity varies with hydrostatic pressure is predictable for certain types of reactions.

The method is capable of further generalization. Variations in reaction velocity can be observed under the influence of an electric field, for example, when the rate of electrolytic evolution of hydrogen is governed by the polarization (ϵ) of an electrode. In this case we might write for the equilibrium constant K which relates the concentration of the hydrogen ions in solution to that of the hydrogen gas at the electrode,

$$\frac{d \log K}{d\epsilon} = \frac{n}{RT},$$

where n is the effective (molar) charge of the proton. The effective charge is equal to $F = 96{,}500$ coulombs for the hydrogen ion which constitutes the initial state, and equal to zero for the final state when the proton is neutralized at the electrode. If we assume that in the transition state the effective charge has an intermediate value, say, αn, α being about 0·5, we obtain

$$\frac{d \log K_1}{d\varepsilon} = \frac{\alpha F}{RT} ; \alpha \sim 0.5 ;$$

which on comparison of the differential of equation A with respect to ε and by neglecting $\frac{d \log v/2}{d\varepsilon}$ can be identified with $\frac{d \log k_1}{d\varepsilon}$. If we measure k_1 by the intensity i of the current, we have $\log k_1 \propto \log i$ and finally

$$\log i = \frac{\alpha F \varepsilon}{RT} + \text{const.} ; \alpha \sim 0{\cdot}5 ;$$

which is the well-known over-voltage equation of Tafel. This equation is thus interpreted as indicating that the effective charge of the transition state lies about half-way between that of the initial and the final states of the reaction.

The field of such generalizations has been extended to other variations of reaction velocity arising from changes in chemical constitution, from the transfer of a reaction from the gas phase into solution, and from variations of solvents.

The principle consists in introducing a parameter of the transition state arising from the general equation

$$\frac{d \log k_1}{d\chi} = \frac{p_1 - p_\tau}{RT} \quad . \quad . \quad . \quad (B)$$

where χ is an external parameter causing the variation in reaction rate and $p_1 - p_\tau$ is the change in the corresponding parameter accompanying the formation of the transition state from the initial state.

The advance in the various directions to which I have referred is, as yet, tentative, but the method seems to provide a rational framework for the interpretation of many empirical rules of reactivity as well as a guidance to the discovery of new relationships.

REFERENCES

The derivation of a reaction velocity from a statistical treatment of the transition state was first put forward by Wigner and Pelzer (*Z. phys. Chem.*, B, 15, 445 ; 1932) in their treatment of the reaction $H + H_{2}\text{para} = H_2 + H$; this treatment was generalized by Eyring (*J. Chem. Phys.*, 3, 107 ; 1935) and by Evans and Polanyi (*Trans. Far. Soc.*, 31, 875 ; 1935). The thermodynamic formulation equation (*A*) is due to the latter authors and to Wynne-Jones and Eyring (*J. Chem. Phys.*, 3, 492 ; 1935) Equation (*B*) and its various applications sketched out in this paper are due to Evans and Polanyi (*Trans Far. Soc.*, 31, 875 , 1935 ; 32, 1333 ; 1936).

Obituary Notices

Sir Albert Kitson, C.M.G., C.B.E.

SIR ALBERT KITSON, whose death occurred on March 8, was a geologist of world-wide repute, and the discoveries which he made and which are now being exploited in many parts of the world entitle him to be classed as one of the foremost economic geologists of his time.

Kitson was born in Manchester in 1868, but when six years old accompanied his parents to Australia. He entered the Civil Service of Victoria by competitive examination, and having a bent for geology he took courses in this subject at the University and School of Mines, Melbourne. Later on, he also took courses in mining and surveying, thereby equipping himself for the career which he was afterwards to follow.

As a result of his studies, Kitson was transferred to the Geological Survey of Victoria. In 1903 he became senior geologist, and while he occupied this post was responsible for some magnificent field work. In 1906 he went to Southern Nigeria as principal of the Mineral Survey, but resigned in 1911. In 1915 he was appointed director of the Geological Survey of the Gold Coast, which position he held until 1930 when he retired, having reached the age limit. So valuable were his services considered, however, that his period of service was extended five years beyond the usual period. It was while he occupied this position that his name became known in ever-widening circles, not only on account of the remarkable discoveries which have already been referred to, but also on account of the energy and drive which he put into his work. By many of the Gold Coast natives he was regarded as a fetish doctor owing to his seemingly reckless handling of snakes, an ability which he had acquired during his boyhood in the Australian bush. Nor did he know what fear meant. In the early days of his Southern Nigerian appointment, when he was geologizing in the wake of a punitive expedition, he was continually in trouble with the military authorities as he was always getting ahead of them.

Among Kitson's discoveries on the west coast of Africa may be mentioned the black and brown coalfields (Nigeria), manganese, bauxite, diamonds (Gold Coast) and many others of lesser importance, the development of which has contributed enormously to the prosperity of these two colonies. But he followed up these discoveries by coming home and describing their possibilities to interested parties in the business world of London for, as already indicated, he had the economic side of geology very strongly developed. Moreover, he was a great enthusiast and he managed by some subtle gift to impart his enthusiasm to others.

After his retirement, Kitson was requested by the Government of Kenya to carry out a preliminary geological survey with special reference to the discoveries of gold which had begun to interest financiers. He therefore went out in 1932 and made his report. All his recommendations were accepted by the Government, and although Kenya may never become one of the world's great goldfields, the progress made since his report was written is quite remarkable.

Kitson was responsible for many papers; indeed he was a most prolific writer on his subject. In 1918 he was awarded the Wollaston Fund by the Geological Society and in 1927 the Lyell Medal. He was president of Section C (Geology) at the Johannesburg meeting of the British Association in 1929; and he attended geological and mining conferences in many countries, nearly always as a responsible delegate. On his retirement he was warmly commended by the Secretary of State for the Colonies for his services on the West Coast. He was knighted in 1927, having previously been awarded the C.B.E. in 1918 and the C.M.G. in 1922. Within recent years he joined the boards of several mining companies, a distinction which has seldom fallen to any geologist. He was actively associated with many scientific and technical bodies and on some of these the present writer, who knew him for many years, was also actively associated.

Kitson had always something useful to say when he did take part in discussions, and his keenness and his enthusiasm will be sadly missed. He was indeed a remarkable man as the foregoing will indicate; it falls to the lot of few to be as well known 'in the City' as in scientific circles.

WE regret to announce the following deaths:

The Duchess of Bedford, D.B.E., fellow of the Linnean Society, author of papers on ornithology, well known for several aeroplane flight records, lost during an aeroplane flight last week, aged seventy-one years.

Brigadier-General Sir Capel Holden, K.C.B., F.R.S., director of mechanical transport in the Ministry of Munitions during the Great War, on March 30, aged eighty-one years.

Prof. Dragutin Gorjanovitch-Kramberger, professor of palæontology and geology in the University of Zagreb, who in 1896 discovered the remains of early man of Krapina of Neanderthal type, aged eighty years.

Mr. C. E. Haselfoot, fellow (formerly dean) of Hertford College, Oxford, lecturer in mathematics in Wadham College, from 1888 until 1913, on October 28, aged seventy-two years.

Prof. Paul Janet, director of the School of Electricity, Paris, formerly professor of physics in the University of Paris, aged seventy-three years.

Sir Thomas Mottram, C.B.E., formerly H.M. Inspector of Mines, on March 24, aged seventy-eight years.

Prof. D. A. Low, emeritus professor of engineering in East London (now Queen Mary) College, on March 24, aged eighty years.

News and Views

Prof. A. Hutchinson, O.B.E., F.R.S.

BY the retirement of the Master of Pembroke College, Cambridge, Dr. Arthur Hutchinson, emeritus professor of mineralogy in the University, under the age limit of the new statutes, the University loses the services of one of its outstanding figures. For many years as lecturer in crystallography and demonstrator of mineralogy during the long tenure of the chair of mineralogy by the late Prof. Lewis, before himself succeeding to the chair in 1926, Dr. Hutchinson was the life and soul of that Department, and the inspirer of most of the original investigations carried on therein. His own contributions to original research were many and noteworthy, and his affectionate care for the valuable and ever-increasing collection of crystals and minerals in the New Museums, while at the same time it was kept usually available for actual study, was obvious to all who entered the Department; it was indeed often remarked upon by the many distinguished foreign mineralogists who visited Cambridge, and enjoyed the kindly hospitality of Dr. Hutchinson and his devoted wife, herself the sister of another eminent man of science, the late Sir Arthur Shipley.

AMONG the most useful of Prof. Hutchinson's contributions to the advance of his subject were his ingenious aids to graphical crystallography, such as the Hutchinson stereographic protractor and net, and his simplification of crystallographic calculations by graphical methods. Also his universal apparatus for the measurement and optical examination of small crystals, described to the Mineralogical Society in 1911, has proved to be of maximum utility at minimum cost. Again, in his work in collaboration with Dr. A. E. H. Tutton on the exceptionally interesting optical properties of gypsum at different temperatures, it was a clever device of Dr. Hutchinson which enabled the exact temperatures for the changes to be determined for the first time with absolute certainty. Indeed, extreme accuracy was characteristic of him, and another instance of it was afforded by his memoir on colemanite, in which he showed that the so-called neocolemanite was a myth, being identical with colemanite itself, the mistake of other observers having been due to inaccurate methods. Dr. Hutchinson's services to the Mineralogical Society, to the membership of which he was elected so long ago as 1890, can never be overestimated, whether as member of council, foreign secretary, or president (1921–24). But fortunately, Dr. Hutchinson is retiring in excellent health, so that we may trust that his interest in the work of the Society may be long continued.

Prof. A. E. Trueman

THE chair of geology in the University of Glasgow, rendered vacant through the resignation of Prof. E. B. Bailey on his appointment as director of the Geological Survey of Great Britain, is to be filled by Prof. A. E. Trueman of the University of Bristol. Prof. Trueman was educated at High Pavement School and University College, Nottingham, and he received the degree of D.Sc. in geology from the University of London in 1918. He was appointed assistant lecturer in geology at Cardiff in 1917, and head of the Department of Geology in University College, Swansea, in 1920. In 1933 he succeeded Prof. S. H. Reynolds as Chaning Wills professor of geology in the University of Bristol. Prof. Trueman is best known by his researches in problems of Coal Measures Geology. In particular, he has taken an important part in the zoning of the Coal Measures of South Wales by means of non-marine lamellibranchs, and in their correlation with other areas. He has also co-operated in research work carried out on dust from coal mines, in connexion with its bearing on the problem of silicosis among miners. In addition to his purely scientific work, Prof. Trueman has interested himself especially in the Workers Educational Association and other university extension activities. He is also a member of a committee appointed at Blackpool last year by Section C of the British Association to study the position of geology in the present educational system.

The National Government and Democracy

A PAMPHLET entitled "The Case for the National Government" by Earl de la Warr, chairman of the National Labour Committee, stresses the failure of democratic politicians to grapple with the problems of the new world with which the man of science is confronting this generation. In many countries they are unprepared for this new challenge of the scientific world, and the seriousness of the new problems and the pace at which solutions are demanded is too much for politicians either of the Left or of the Right. He believes that dictatorships have revived because democratic politicians have been unable or unwilling to adapt themselves to the new age and therefore have been weak and indecisive in dealing with modern problems. Earl de la Warr claims that Great Britain, in its National Government, is giving the democratic reply to conditions which have led to dictatorships elsewhere. Since we are finding our way into a new world, much of the work of the Government is necessarily experimental.

THIS new world is very largely the result of the discoveries and inventions of the chemist, the physicist, the biologist in the last hundred years or so. Science has given more to the world in that period than in any previous thousand years. Hitherto the politician has been concerned rather with the rights and liberties of man than with the possibilities of transforming everyday life by organizing the gifts of the scientific worker. The economic and social sciences have barely begun to keep pace with the physical and technical sciences. Nations should now be thinking not in terms of access to raw materials but to markets or even more of the creation of markets. The problems of to-day are the problems not of shortage as in the past but of plenty. The challenge of science cannot be met by limiting production or inventions but by dealing on rational and scientific lines with the factors which undermine national physique and welfare such as poverty, malnutrition, overcrowding. This is a matter of scientific organization whether of distribution, consumption, education or the like, and that such an approach is not easily turned into a fighting appeal to a democratic people is a real difficulty. Unless, however, democracy succeed in directing man's inherent pugnacity into fruitful and creative channels, the downfall of civilization is certain, and Earl de la Warr believes the National Government is an attempt to give a wise and courageous answer to many of these vexed questions.

English Terms in Scientific Writings

THE S.P.E. Tract No. 48 (Oxford, Clarendon Press; 1937) contains three articles that are of interest to writers on scientific subjects. Mr. Otto Jesperson deals with the use of such terms and phrases as 'almost' before a verb or noun, 'kind of' or 'sort of', 'rather than', 'as much as', and so on. Sir W. A. Craigie notes many variations in the spelling of English words, but concludes that "the irregularities of modern English are of slight importance in relation to the language as a whole". Dr. C. G. Darwin's article on "Terminology in Physics" is reprinted from NATURE (138, 908; 1936). His main points, it will be remembered, are: the difficulty of translating appropriately a term from a foreign language, the use of an inventor's name instead of a descriptive term, and the use of adjectives, such as 'microscopic' and 'macroscopic', to express opposite ideas by words of nearly the same sound and spelling. Others may be added to this list. For example, 'sismi', an equivalent for earthquakes, is simple to pronounce in Italian, and 'séismes' still more so in French, but the corresponding English term 'seisms' is intolerable. Another point is the formation of the singular of a word that has come down to us in the plural only. It would seem permissible, because natural and convenient, to use 'scree' as the singular of the Icelandic word 'screes'.

Popularization of Science

IN an address on the "Popularisation of Science" when receiving the fellowship of the American Institute, New York, on February 4, "for interpreting to the people of the nation the rapid progress of science upon which modern civilization depends and for the organised dissemination of research findings as news", Mr. Watson Davis said that the reporting and interpretation of science failed of its purpose if it did not bring about an appreciation and utilization of scientific method in everyday life. This he believed was best achieved by giving the mass of the people, through accurate and interesting accounts of science's successes and failures, some understanding of the essence of science which would lead them to apply it more widely to our everyday life, our human relationships, business and government. Many of the ideals we most cherished such as liberty, opportunity, the pursuit of happiness, freedom, democracy, were achieved by the utilization of scientific method, and the mistakes of democracy were best corrected by science.

THIS belief, that the only way of making democracy safe for itself was to make it more intelligent and accordingly more scientific, inspired the founders of Science Service, E. W. Scripps and Dr. W. E. Ritter. Many opportunities of such service were as yet only imperfectly used. For example, the scientific aspects of the recent disastrous floods had received little publicity, and the possibilities of books and magazines as media have yet to be fully developed. In this work quality is all important, and the first objective is the exact opposite of propaganda. It is to present facts in a readable and interesting form, on which the reader could base his own opinions on a subject of politics, sociology or his duty to his fellows. In recalling this statement of the founders of Science Service as to its objectives, Mr. Watson Davis emphasized that not even science must be allowed to become a dictator. It should set the example for straight thinking, confident that the process of democracy, guided by scientific method and reason, would give effective results.

Development of the Oil Engine

THE millions of compression-ignition oil engines in use to-day have all sprung from the initial work of Herbert Akroyd Stuart (1864–1927) and Rudolph Diesel (1858–1913), whose outstanding patents were taken out in 1890 and 1892 respectively. Vast sums of money have been spent by Governments, firms, institutions and individuals in experiments with oil engines, but just as the first successful Diesel engine was the outcome of the work during 1893–97 of the Maschinenfabrik-Augsburg-Nurnberg, so the success of the engine invented by Akroyd Stuart—known as the "Hornsby-Akroyd" engine—was due to the pioneering work of Messrs. Hornsby and Sons, Ltd., of Grantham, now Ruston and Hornsby, Ltd., of Lincoln. Having offered his patents to various gas engine makers, Stuart approached Messrs. Hornsby, and in 1891 they agreed to take up the development of Stuart's engine on a royalty basis. The necessary experimental work was entrusted to Mr. J. W. Young, who in a paper entitled "Notes on the Practical Development of the Oil Engine" read to the Newcomen Society on March 17, gave an interesting account of the difficulties which had to be overcome before the "Hornsby-Akroyd" engine could be placed on the market.

STUART'S principal patents were No. 7146 of May 1890 and No. 15994 of October 1890 and these covered compression ignition and airless injection, and also the use of a vaporizer. The most difficult problem was that of combustion, and many forms of vaporizers were tried. The construction of oil engines, too, demanded a higher standard of workmanship than the steam engines, and cylinders, pistons and piston-rings were all the subject of many experiments. Both fuel oil and lubricating oil raised many problems, especially as the oil refiners of that time had not succeeded in removing certain resinous bodies from the oil. In connexion with this, Mr. Young was sent to Russia, where Messrs. Nobel Brothers co-operated in introducing a uniform standard of distillation. As regards the development of the "Hornsby-Akroyd" engine Stuart took no part after 1891. He migrated to Western Australia about 1900 and died there on February 19, 1927. The so-called semi-Diesel engine is properly an Akroyd-Stuart engine, and nearly all makers of Diesel engines now use his method of airless injection, and not air-blast injection as introduced by Diesel.

Chair in Biblical Archæology: an Appeal

AN appeal for funds to endow a chair in biblical archæology in connexion with the Institute of Archæology of the University of London, has been issued over the signatures of the Archbishop of Canterbury, Sir Frederic Kenyon, Sir George Hill and Sir Charles Peers, should meet with a ready and liberal response, especially as the generous gift by Sir Charles Marston of £1,000 has already reduced substantially the amount which it is considered necessary to provide. Palestine demands of the field worker a widely extended and detailed knowledge of the general cultural and historical background, owing to its geographical position and its political, economic, and cultural relations with contemporary peoples. The institution of a chair in biblical archæology, by making provision for that preliminary training in acquisition and manipulation of the historical and cultural facts of the Ancient World, should go far towards conserving the time and energy of senior members of an expedition, which must be devoted to the training and supervision of the younger workers in the field. Not only does the installation of Sir Flinders Petrie's Palestinian collections at the Institute of Archæology make this an opportune moment to inaugurate such a chair, but also the results which have been achieved by recent excavation in Palestine, as for example at Lachish, Jericho and Gaza, as well as indications of the bearing of Palestinian material on the excavations now being carried out in Syria, all point in the direction of the imminent possibility of important additions to knowledge. This should be an additional stimulus to the British public, who have always looked kindly upon research in Palestine. Contributions may be sent to Mr. E. S. M. Perowne, 7 Great James Street, Bedford Row, W.C.1, or direct to the Westminster Bank, Marylebone Branch, 1 Stratford Place, Oxford Street, W.1, marked "Institute of Archæology".

Earliest Monumental Remains in Iraq

THE joint expedition of the American School of Oriental Studies and the University of Pennsylvania, in continuing the excavation of the mound site of Tepe Gawra in Mesopotamia, upon which it has been engaged now for several seasons, has uncovered some remarkable remains of a monumental character in the level of stratification now being explored. This level is the thirteenth from the surface in the series of some twenty strata of deposits of which preliminary exploration showed the mound to be composed before virgin soil was reached. Its culture is that of the 'painted pottery' people, of which evidence has been found wide-spread over early western Asia and the ancient East, from southern Russia to China, and dated at approximately 4000 B.C. and later. In a recent report from Prof. E. A. Speiser, field director of the expedition, according to a communication circulated by Science Service, Washington, it is stated that the expedition has discovered the acropolis of the city. It consists of a northern temple, eastern shrine and central temple, which with other buildings surround an open square, or court, paved with gravel covered with stamped clay. In the central temple, all the rooms show traces of a purple-red paint. The buildings are of an imposing character, and being the earliest known of their kind, carry back the practice of monumental architectural art to a much earlier phase of civilization than had hitherto been thought, while Tepe Gawra is shown to be the centre of an organized civic life, on a scale and of a kind for which hitherto there had been no evidence in connexion with the presumedly primitive people of the stone age to whom the painted pottery had been ascribed.

Soil Drift in South Australia

MR. F. N. RATCLIFFE, of the Council for Scientific and Industrial Research, Melbourne, has sent a long communication, for which space cannot be found, discussing an article in NATURE of December 19, based on his recent report on wind erosion (drift soil) in the arid pastoral belt of South Australia. Mr. Ratcliffe appears to hold the opinion that the processes taking place in that part of the world differ from the causes which have, and are, producing the man-made desert in other regions. The factors responsible for the destruction of the vegetation in Australia are drought, overgrazing by stock and the rabbit. The extension of the Sahara and the dust bowl in America are (omitting the rodent) being brought about by the same causes—excessive cultivation or grazing, or both combined. But the word 'drought' as used in Australia and America requires definition. This is the chief factor in the case. The actual results of the over-utilization are the same, whether the land is actually covered up by sand, or the top soil is blown away, or the soil deteriorates *in situ*: the spring water-level is lowered in the soil, not by *drought* as ordinarily understood by that word, but by the desiccation brought about by the acts of man. The end is a desert, and the water disappears from the surface and sinks to varying depths in the soil. As regards wind erosion, that is, dust storms, few travellers or inquirers who have studied desert regions, many of them man-made, can have failed to become acquainted with desert clouds of that type, whether consisting of sand or blown soil of valuable types. Mr. Ratcliffe has conceived the idea that the erosion or drift in Australia is something apart. It would appear to be only a type.

Oceanography in New South Wales

THE seasonal fluctuations in nutrient salts in European coastal waters and their bearing on the production of phytoplankton and ultimately on the fertility of the sea are now well understood. However, there are still huge areas of the waters of the world, including those adjacent to civilized countries carrying on original research, about which nothing whatever is known. Off the New South Wales coast, W. J. Dakin and A. N. Colefax ("Observations on the Seasonal Changes in Temperature, Salinity, Phosphates, and Nitrate Nitrogen and Oxygen of the Ocean Waters on the Continental Shelf off New South Wales and the Relationship to Plankton Production", *Proc. Linn. Soc. New South Wales*, **60**, 303–314; 1935. Sydney University Reprints, Ser. XIII (Zoology), **3**, No. 8; 1936) have now found complete exhaustion of both phosphate and nitrate by spring and autumn phytoplankton outbursts. The depletion of nitrate persists through the summer as in the seas around Great Britain, but phosphate is replenished more quickly. On the whole, nutrient salts are less than were found in the English Channel in the nineteen twenties but are not very different from the reduced quantities found there now. It is to be hoped that the investigations will be continued for a number of years to discover whether similar long-period fluctuations take place in Australian temperate waters, and further, that a well-found ship may be obtained to permit of investigations over a wider area unhandicapped by the difficulties of carrying on exact scientific work in the open ocean from the decks of a small yacht such as that at present in use.

Electricity Supply Tariffs

THE question of the standardization of electricity supply tariffs is of interest to many. A recent paper read by J. F. M. Mellor to the Students' Section of the Institution of Electrical Engineers on the basis on which those tariffs are founded is both a timely and a useful one. There are many difficulties in the way of getting an equitable solution to some of these problems. Take the case, for example, of an 'isolated consumer', that is, one who is at a considerable distance from the supply mains. In this case it is quite customary to charge the consumer the whole or part of the interest and depreciation on the capital cost of the mains extensions to his premises. It is reasonable, therefore, to expect that in the event of other consumers being connected on to these extensions, some refund should be made to the original consumer, and this should be mentioned in his agreement. The difficulty arises as to the period of time after the laying of the mains before the liability of the supply authority ceases. Another difficulty is that the time of the peak load varies owing to the great increase in domestic water heaters and thermal storage apparatus which has recently occurred. In many places, when making a long-term agreement, no period of the day or night can now be regarded as 'off peak' and allowed for at a cheaper rate. A supply for a fixed number of hours per day at the lower rate can be arranged, but this is not so attractive to the consumer. Everyone agrees that standardization is desirable, but there are difficulties in the way until the many small undertakings in the country are amalgamated with the larger authorities. When this comes, a lowering of the tariffs will follow in the country districts, since the 'diversity' of the combined load will be increased and so less spare plant be required. A broader policy also can be adopted.

Education of Unemployed in the United States

EDUCATIONAL needs of unemployed young people are discussed in Bulletin, 1936, No. 18–3, entitled "Education for those out of School", recently published by a standing committee established two years ago by the United States Office of Education in cooperation with other Government agencies and educational leaders for the purpose of assisting communities and youth agencies, with the aid of youths themselves, to solve some of the problems overshadowing their outlook to-day (Washington, D.C.: Government Printing Office, 1936. 10 cents). This pamphlet, the third of a series of six bulletins issued by the committee, describes some of the plans that have proved serviceable to unemployed persons of ages 16–24 years. Of the twenty million persons of those ages in the United States, some four million are in full-time schools and colleges, nearly eight million are employed on full- or part-time jobs, and nearly five million are seeking employment.

ONE conclusion arrived at by the committee is that there is a large unsatisfied demand on the part of these young people, and especially girls, for training which will lead to, if it is not combined with, earning capacity. Another conclusion is that in the case of rural youth a combination of educational and recreational schemes is essential; neither the strictly educational nor the strictly recreational schemes have been found successful. Again, informal rather than formal procedures are desirable, and units of instruction and courses should be of short duration; for example, twelve to fifteen weeks to a unit with two-hour meetings once or twice a week. Above all, instruction should have specific goals and arouse a sense of achievement or arrival at a determined destination, and work should be so planned as to give a sense of continuity. Particulars are given of numerous schemes of vocational training for out-of-school youth which have been found to work well. The other bulletins of this series are entitled: how communities can help, leisure for living, vocational guidance for those out of school, finding jobs, and health protection.

Scottish Technical Colleges

THE Royal Technical College, Glasgow, reviews, in its report on the work of the session 1935–36, its own progress since its constitution in 1886 by the amalgamation of Anderson's College with a number of other separate institutions. In these fifty years, the number of its day students has increased from 124 to 1,001 and its gross income from £9,248 to £81,837. Among its more important developments during that time are the establishment of departments of architecture, textile manufacture, navigation, sugar manufacture, pharmacy and bakery, and the erection and equipment of new buildings at a cost of £400,000. Its counterpart in Edinburgh, the Heriot-Watt College, has far fewer day students (364) but its evening class students (2,460) are nearly as many as those of the R.T.C. Both colleges co-operate with city and county education committees in regard to the provision in continuation schools of courses preparatory to college courses. The Edinburgh college, however, records a serious falling off in the number of students from city continuation schools, and attributes this decline to lack of interest on the part of employers.

Heat and Power Station in Northern Russsia

ACCORDING to the Soviet Union Year Book Press Service, Grand Buildings, Trafalgar Square, W.C.2, plans have been completed for the building of a large heat and power station about twenty miles from Kotlas, a busy town in the northern province of the U.S.S.R. It will be built in virgin forest, near the site where building work is now proceeding in connexion with cellulose, chemical and wood-working enterprises for the Soviet timber and paper industry. This year the first section of the station with a capacity of 24,000 kW. will be brought into operation. It will have an annual output of 1·2 million tons of steam. Fuel will be provided by gas generated by pitch, a by-product from the local timber and chemical industries. Four boilers will produce 60–80 tons of steam per hour, at a pressure of 35 atmospheres, the steam passing into turbines of 12,000 kW. each. These boilers are fitted with special fuel jets for the new form of fuel. The turbines can run at various steam pressures, depending on the requirements of production.

The Midwifery Service

THE annual report of the Central Midwives Board for the year ended March 31, 1936, has been published (London: H.M. Stationery Office. 2*d*. net). It shows that there were 62,064 women on the midwives roll, an increase of 3,100 on the total for the previous year, although only a little more than a quarter of the total number of qualified midwives are actually engaged in the practice of their profession. The report states that during the year the Board approved a final draft of new rules for training and examination, which has since been submitted to the Minister of Health. The report also includes notes on interesting decisions given by the Board during the year on midwifery etiquette and practice.

German Institute of Psychological Research

A GERMAN Institute of Psychological Research and Psychotherapy has been founded under the auspices of the German Home Office. The members consist of representatives of the Pan-German Medical Society of Psychotherapy, the German Psychoanalytic Society, the Künkel co-operative group for "Applied Study of Character" and other well-known psychotherapeutists. The functions of the Institute will be (1) research, (2) educational and teaching activities, and (3) maintenance of a clinic for the indigent. The director is Prof. M. G. Göring, president of the Pan-German Medical Society of General Psychotherapy.

Public Health Investigation in India

Two Indian institutes have recently issued their reports. That of the All-India Institute of Hygiene and Public Health, Calcutta, for 1935 reviews the courses of instruction that have been given and summarizes the research work carried out. The last-named includes epidemiological studies on cholera and studies upon the chemical constitution of the cholera vibrios by Dr. Linton, the epidemiology of epidemic dropsy and the ætiology of black-water fever. Diet surveys of certain sections of the population and field studies upon malaria have also been carried out. The second report, that of the Haffkine Institute, summarizes the Institute's work for 1932–35. Plague investigations have been continued, and more than two million doses of plague vaccine were issued in 1933–34; Drs. Sokhey and Maurice have prepared a curative plague serum which experimentally possesses greater potency than any sera previously prepared. Anti-rabic treatment is also provided at the Institute, and 2,274 cases were treated during 1935, with a mortality rate of 0·17 per cent.

Natural and Artificial Manures

THE Ministry of Agriculture has issued a new and enlarged edition of Bulletin 36, "Manures and Manuring" (H.M. Stationery Office, price 2*s*.). A number of additions have been made since the last issue, the preliminary section dealing with the principles that govern the manuring of farm crops having been specially expanded. As before, the bulletin is divided into three main sections, namely, organic manures, artificial fertilizers and the purchase and use of artificial manures. The information is essentially practical, and should enable the farmer to make the fullest use of the wide variety of fertilizers now available. In view of the differences in local conditions, complete generalizations are of course impossible, and in the event of uncertainty the farmer is advised to consult the agricultural organizer for the county in which he resides. A pamphlet (Form *A.* 705/*TG.*) giving names and addresses of advisory staffs may be obtained free on application to the Secretary of the Ministry of Agriculture, 10 Whitehall Place, London, S.W.1.

Broadcasting of Cosmic Data

A REGULAR schedule of broadcasts of cosmic data and scientific news was inaugurated at Boston, U.S.A., on February 1 by the World Wide Broadcasting Foundation's short-wave station in co-operation with the Union Radio Scientifique International and Science Service. The primary purpose of these broadcasts is to make available internationally technical data on observations of sunspots, solar radiation, magnetism, ionized layer heights and other phenomena observed during the same day, and to interest laymen in making observations. The broadcasts will be heard daily from 4.55 to 5.00 p.m. (Eastern Standard Time) on 25·4 metres and weekly summaries on Monday evenings from 8.30 until 8.45 p.m. on 49·6 metres. The Monday evening broadcasts will be a weekly compilation. The programme inaugurating this service included brief talks by Dr. A. E. Kennelly of Harvard University, the co-discoverer of the Kennelly-Heaviside layer; Dr. Harlow Shapley, director of the Harvard College Observatory, and Watson Davis, director of Science Service, Washington.

Science Abstracts

THE issue of the two index numbers of vols. 39 of *Science Abstracts* for 1936 enables a comparison to be made with previous volumes. The physics volume includes 5,716 abstracts covering 1,332 pages, with a subject index of nearly 260 and an author index of more than 80 pages. The electrical engineering volume has 3,525 abstracts in 820 pages, with subject index 120 and the author index 55 pages. The former volume is about six per cent larger than last year's and the latter about eleven per cent. The average length of the abstracts is slightly less than last year. The subject index in the physics volume has a key to it which facilitates its use. Each volume of *Science Abstracts* is a valuable time-saving device for those who wish to keep abreast of research or look up past progress in the subject with which it deals.

Prof. T. C. Hodson: a Correction

PROF. T. C. HODSON writes to point out in reference to the announcement of his impending retirement from the professorship of social anthropology in the University of Cambridge (see NATURE, March 20, p. 497), that he did not take a degree at Queen's College, Oxford, and that during the War, his service with the Indian forces covered a brief period only, when he was transferred to Railways and later to Forestry G.H.Q., where he took over from the late Lord Lovat. It should be added that Prof. Hodson was honorary secretary of the Royal Anthropological Institute in 1912–1914–15.

Comet Whipple (1937*b*)

USING observations made at Harvard on February 4, at Norwood on February 26 by Steavenson, and on March 11 and 12 by Hay at Hendon and Steavenson at Norwood, respectively, the Rev. Dr. M. Davidson has computed the following orbit: *T*, 1937

June 19·96971 U.T.; ω, 107° 25′ 56·0″; Ω, 127° 57′ 11·0″; i, 41° 43′ 31·7″; e, 1·009143; q, 1·739393. The orbit fits in with a number of other observations, but in many cases there are residuals of the order 1^s in right ascension. The object must be difficult to observe accurately as even on the same night discrepancies of about 1^s arise between different observers. Generally speaking, the residuals in declination are small.

Announcements

Sir Thomas Holland will deliver the Huxley Memorial Lecture in the Huxley Building of the Imperial College of Science and Technology, South Kensington, on May 4, at 5.30. The subject of Sir Thomas's lecture will be "The Permanence of Oceanic Depressions and Continental Elevations".

The George Darwin Lecture of the Royal Astronomical Society will be delivered by Prof. N. E. Nörlund at the ordinary meeting of the Society on May 14. His subject will be "Astronomical Longitude and Azimuth Determinations".

Dr. Simon Flexner, director of laboratories of the Rockefeller Institute, New York, has been elected a foreign associate of the Paris Academy of Sciences in succession to the late E. P. di Sessa.

Prof. Julius Wagner-Jauregg, professor of psychiatry and neurology at the University of Vienna and pioneer in the malarial treatment of general paralysis, celebrated his eightieth birthday on March 7.

A correspondent, writing with reference to the article in Nature of March 27 on the work of the Department of Scientific and Industrial Research, informs us the fundamental research on the setting of keratin (p. 535) in the manner used in 'permanent waving' is due to Dr. J. B. Speakman, of the Textile Department of the University of Leeds, and not to the Woollen Industries Research Association. In the first paragraph of the leading article of the same issue, the reference to Mr. D. R. H. Wilkins should have read Mr. D. R. H. Williams.

The Central Executive Committee of the U.S.S.R. has conferred the Order of Lenin on Prof. A. N. Bach, on the occasion of the fiftieth anniversary of his scientific activity, and for his outstanding services in the field of biochemistry. Prof. Bach celebrated his eightieth birthday on March 17. During his half-century of scientific research, he has published about 120 works, mostly dealing with problems of biochemistry. The three fundamental problems to which he devoted his energies were the chemistry of photosynthesis, respiration and enzyme action.

The National Trust announces that through the generosity of Mrs. Pollard, honorary secretary of the Cornwall branch of the Council for the Preservation of Rural England, the beautiful cliff lands extending for three quarters of a mile from Mulli[illegible] Porth Pyg about a mile and a quarter south of Mullion to the north end of Prodannack Head have been preserved by means of covenants in connexion with which part of the land will pass into the actual ownership of the Trust. The Tehidy Minerals Co., Ltd., has generously co-operated in regard to the mineral rights which it owned. The Trust will now be protecting eighteen coastal properties in Cornwall.

The forty-second Annual Congress of the South-Eastern Union of Scientific Societies will be held at Hastings on June 8–12, under the presidency of Prof. F. E. Weiss. The title of Prof. Weiss's address will be: "Competition and Co-operation in Nature." Further information can be obtained from the honorary general secretary, Mr. W. C. Fishlock, 19 South View Avenue, Reading.

Under the terms of the Thomas Gray Memorial Trust, the Royal Society of Arts is offering a prize of £75 to any person for an invention, publication, diagram, etc., which is considered to be an advancement in the science or practice of navigation; and a prize of £25 for an essay on "The Stability of Ships". Further information can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2.

A special Summer School and Conferences on Strength of Materials will be held at the Massachusetts Institute of Technology for four weeks beginning on June 21. The following subjects will be considered: creep (Dr. A. Nadai and Mr. C. R. Soderberg); fatigue (Dr. H. J. Gough); strength of materials (members of the Institute staff). Further particulars may be had by communicating with Prof. John M. Lessells, Department of Mechanical Engineering, Massachusetts Institute of Technology, who is director of this Summer School.

On April 30, a joint meeting of the Institute of Radio Engineers and the International Scientific Radio Union (American Section) will be held in Washington. A group of papers on the more fundamental scientific aspects of radio communication, including radio measurements, radio circuit theory, radio transmission phenomena including ionosphere phenomena will be presented. The meeting is open to the public. Further information can be obtained from R. C. Ould, 3747 Huntington Street, Washington, D.C.

The sixth Italian Congress of Microbiology will be held at the Milan Institute of Serotherapy on April 21–24. Further information can be obtained from Segretaria del Congresso, via Darwin 20, Milano 124.

The twenty-eighth Congress of the German Röntgen Society will be held in Breslau under the presidency of Prof. Pleikart Stumpf of Munich on April 12–14, when an exhibition of X-ray apparatus will also be held. Further information can be obtained [illegible] Elektromedizin, Corneliusstrasse 1,

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 593.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Altitudes and Spectra of Red and Sunlit Auroras

As we approach the maximum activity of the sun, more and more interesting auroras occur. From my net of eight photographic stations in southern Norway, my assistants and I have in the last year got most interesting material, in particular from the auroras of April 20–21, 21–22 and October 16–17. On the two first nights, about 400 pictures were successful, among which is a series with the long base-line Oslo–Trondheim (391 km.). Of special interest were rays of sunlit auroras lying at the level 200–600 km. of the atmosphere, of which a spectrum on a panchromatic plate (Agfa *ISS*) was taken. This spectrum was measured by Mr. Harang, who found for the lines 6300 A., 5577 A. and 4278 A. the relative intensities 100, 100 and 55. A green aurora curtain gave, on the same plate and for the same lines, the intensities 32, 100 and 39. This enhancement of the red oxygen line was also observed for sunlit auroras by Currie and Edwards at Chesterfield during the polar year[1], by Kosirev and Eropkin at Kirowsk (March 1935)[2] and by Vegard and Tönsberg in October 1935[3] for the arcs of sunlit auroras. Flaming aurora was also observed which lay midway between Oslo and Trondheim. From both stations the motion was *upwards*, which showed that this really was the direction of motion of the auroral flames.

The aurora of October 16–17 last year was observed during 10 hours and more than 700 very successful pictures were taken from eight of my stations. The most conspicuous features were red auroras of long duration and sunlit aurora rays of quite unusual height. Of the first, 24 very successful sets were taken; of the second, 60 sets, all from two, three or four stations at the same time, simultaneously with 14 spectra, several of which are of unusual interest.

The first sunlit aurora rays in the morning appeared five hours before sunrise in the north-north-east and were photographed simultaneously from four stations, with maximum base-length of 159 km. The measurements of the plates showed that the rays were lying over Russia near Archangel. The lowest points were at the borderline between the sunlit and dark atmosphere at 600 km., and the summits reached the astonishing height of 1,100 km. above sea-level. The rays were red. Later, sunlit aurora rays of the common feeble grey-violet colour appeared and lasted until dawn. Several had their summits above 600 km., and some above 800 km., and the situation relative to the earth's shadow was similar to the diagram for March 23, 1920[4].

The red auroras were, with the above mentioned exception, all lying in the dark atmosphere, from 100 km. up to 500 km. over north-east[illegible] Scandinavia and Finland. Once I [illegible] rays which in a few sec[illegible] without altering their form and position, a phenomenon which I also saw on March 8, 1918[5].

The spectra were measured first by Mr. Harang and later by Mr. Björlykke. Details will be published later. The principal results were:

Agfa ISS Plates: For common *yellow-green arcs*, the two red lines 6550 A. and 6300 A. were nearly equal, and the aurora line 5577 A. about two to three times stronger than either of them. In the *red aurora*, the line 6550 A. was about 60 per cent of the aurora line, but the line 6300 A. was up to five times stronger. In the *sunlit feeble aurora rays* the line 6550 A. was more feeble than 5577 A. but the line 6300 A. about three times as strong[6].

Sonja Plates: In an *auroral arc* the intensity of the nitrogen bands 4278 A. and 3914 A. was about twice that of the aurora line 5577 A.; in the *sunlit aurora rays*, however, the intensity was increased to more than four times that of this line, an effect I had observed in 1929[7].

On January 7–8 this year, a new big aurora occurred and all my stations were in action the whole night. More than 700 good pictures were secured and a series of spectra. Among the pictures about 35 good sets were taken with the base-line Oslo–Trondheim. The results will be given later.

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[1] *Terr. Mag. Atmos. Elec.*, September 1936.
[2] *Poulkovo Astr. Circular*, No. 18 (1936).
[3] NATURE, 137, 778 (May 9, 1936).
[4] NATURE, 123, 82 (Jan. 19, 1929).
[5] *Geofysiske Publikasjoner*, 4, No. 7, 23.
[6] The great enhancement of this line was observed that same night by Vegard, NATURE, 138, 930 (Nov. 28, 1936).
[7] NATURE 1, 24, 263, (Aug. 17, 1929).

Acoustic Spectrum of Liquids

As is now well known, examination by means of a Fabry-Perot étalon reveals remarkable changes in the spectral character of monochromatic radiation when it is scattered within a dust-free liquid. Earlier studies in this laboratory[1] disclosed that the relative intensity of the undisplaced central line to that of the two Doppler-shifted companions appearing on either side of it varies greatly from liquid to liquid, being for example much larger in carbon tetrachloride than in toluene. The origin of the undisplaced central line has been until now one of the unsolved problems of the subject; its high intensity in the case of carbon tetrachloride and its practically complete polarization in this liquid as well as in toluene and carbon disulphide indicate that it cannot [illegible]ascribed to the depolarized scattering by optically [illegible]lecules.

Systematic studies have now been made with a number of liquids, including the following: acetone, carbon disulphide, toluene, water, formic acid, acetic acid, butyl alcohol, carbon tetrachloride, phenol and glycerine. The general result which emerges from this comparative study is illustrated in the accompanying Fabry-Perot patterns. Fig. 1 (*a*) is the Fabry-Perot pattern of the incident light, which is the 4358 A. radiation of a water-cooled low-density mercury arc lamp, while Fig. 1 (*b*), (*c*) and (*d*) are the patterns obtained respectively with the light scattered through 180° by the liquids phenol, butyl alcohol and acetone. It will be seen that the pattern given by phenol is indistinguishable from that of the incident radiation. A similar result has also been obtained with glycerine. With butyl alcohol, on the other hand, the Doppler-shifted companions are faintly visible, while with acetone, they are very conspicuous.

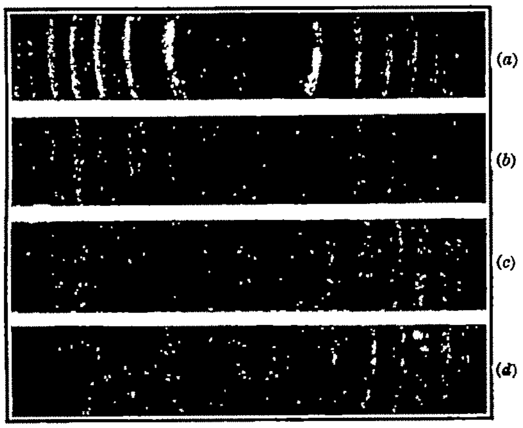

Fig. 1.

FABRY-PEROT PATTERNS OF INCIDENT RADIATION, 4358 A. (*a*), AND OF RADIATION SCATTERED BY PHENOL (*b*), BUTYL ALCOHOL (*c*) AND ACETONE (*d*).

It is thus seen that in highly viscous liquids such as phenol and glycerine, the sound waves of high frequency necessary for reflecting the incident light waves are conspicuously absent. The scattering of light within such liquids must therefore be ascribed to other causes, for example, relatively immobile fluctuations of density or clustering of molecules. The greater intensity of the Doppler-shifted components with such relatively inviscid liquids as acetone or toluene, on the other hand, indicates the existence in them of organized sound-waves as part of the thermal agitation. It appears reasonable to ascribe the unshifted central line obtained with such liquids to the existence of relatively immobile fluctuations of density or clusters of molecules on which the rapidly moving sound-waves are superposed. This is clearly suggested by the comparative study of the patterns obtained with various liquids, which indicates a progressive falling off in the intensity of the Doppler-shifted components with increased damping of high-frequency sound waves due to viscosity as given by the classical formula of hydrodynamics.

C. V. RAMAN.
B. V. RAGHAVENDRA RAO.

Department of Physics,
Indian Institute of
Science, Bangalore.
Feb. 14.

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[1] Raghavendra Rao, B. V., *Proc. Ind. Acad. Sci.*, (A), 1, 261, 473 and 765 (1934–35); 2, 236 (1935); 3, 607 (1936).

Ole Rømer's and Fahrenheit's Thermometers

IN my opinion, Dr. J. Newton Friend's recent article on "The Origin of Fahrenheit's Thermometric Scale"[1] contains some misunderstandings as to the nature of Ole Rømer's work on the thermometer, as will be shown in the following commentary.

Ole Rømer gives in "Adversaria" (printed in 1909) a detailed description of the construction of an "original thermometer" (that is, a standard thermometer) which was made about 1702 and filled with spirit. The particular feature of this thermometer lay in the principle according to which it was graduated, which made it possible to construct thermometers giving concordant readings, a problem which had not previously been solved. Rømer writes[2]: "When the thermometer is filled and closed, fix the point 7½ by means of snow or crushed ice, and the point 60 by means of boiling water". When these two points had been fixed, the volume between them was divided into 52½ equal parts, after which the zero point was determined by marking off 7½ parts of the same size below the freezing point.

It is therefore a misunderstanding of the facts when Dr. Newton Friend writes "Ole Rømer used this mixture" (ice and salt) "or a similar one (ice and sal-ammoniac) in obtaining his zero"; and "In checking his thermometer he used this temperature [the boiling point of water] and for convenience, possibly also for greater accuracy, the melting point of snow or crushed ice". This last statement is incorrect: the freezing point was the second fixed point, and was used as such, not "for convenience".

"Adversaria" contains no mention of any connexion between the zero of Rømer's thermometer and the temperature of a freezing mixture, and still less any statement that such a mixture was used for fixing the zero.

What then did Fahrenheit see and learn in Rømer's laboratory in 1708? He saw short thermometers for meteorological use graduated in such a way that they gave concordant measurements. According to Fahrenheit's description[3], this was done in the following way. The thermometers were first placed in melting ice and the position of the liquid in them marked. They were then placed in warm water—Fahrenheit calls it "blutwarm"—and the corresponding point marked and used as the second fixed point. One half of the distance between these two points was then marked out downwards from the freezing point to fix the zero (it is difficult to understand why Dr. Newton Friend writes, "How the zero was obtained is not definitely stated either in 'Adversaria' or in Fahrenheit's letter"), after which the distance between zero and the highest point was divided into 22½ equal parts. By means of this procedure 7½° came at the freezing point, and the temperatures 0° and 22½° bore the same relation to the freezing point as on the original (standard) thermometer. The temperature of the warm water *must* therefore have been 22½° Rømer (28·5° Centigrade), and not "blutwarm" as stated by Fahrenheit. The only way in which it could be ensured that the water actually had this temperature was by using the previously graduated standard thermometer, and the graduation of the latter by means of the two fixed points, *freezing point and boiling point*, was therefore also the basis for the graduation of Rømer's short thermometers.

After having seen Rømer's procedure, Fahrenheit understood the principle that the scales of thermometers giving concordant readings must be based on *two* fixed points, but he was less critical and less rational than Rømer in choosing these points. He retained the freezing point, measured in melting ice, as one fixed point, but he obviously wished to avoid the use of a standard thermometer for fixing the second. He had termed water of 22½° Rømer (28·5° C.) "blutwarm", and in this way conceived the idea of using a slightly higher temperature for the second fixed point, namely, body temperature measured "when the thermometer is placed in the mouth or arm-pit of a healthy man and held there until it acquires the temperature of the body"[4]. This temperature (about 36° C. or 26½° Rømer) is not particularly constant, and Fahrenheit therefore felt the need of a further fixed point as a check. It appears indirectly from a letter sent from Copenhagen to the Royal Society in 1709[5] that it had been discovered that the zero on Ole Rømer's thermometer "very nearly approaches the Point of Artificial Freezing". Fahrenheit must also have been aware of this, and therefore used the temperature of a freezing mixture for checking his zero. He admits that this temperature (like body temperature) is not quite constant, but his experimental skill enabled him to use the two not very reliable fixed points to check one another, and hence to make thermometers which were satisfactorily concordant according to the standards of the times.

The figures for the fixed points on Fahrenheit's earliest thermometers were:

0°; 7½°; 22½°; *as on Rømer's thermometers*, or 0°; 30° (= 4 × 7½°); 90° (= 4 × 22½°) by dividing the degrees into four parts. Later he altered these figures to

0°; 32° (= 4 × 8°); 96°, probably for convenience in calculation (as also suggested by Dr. Newton Friend).

Since the temperature 90° F. (corresponding to 26½° Rømer) is higher than Rømer's 4 × 22½°, Fahrenheit's degrees are larger than those of Rømer: hence if the graduation is continued in the same units, Fahrenheit's boiling point will be designated by a smaller number than Rømer's, namely, 212° instead of 240° (= 4 × 60°).

We thus see that Fahrenheit's scale is derived from that of Rømer. The honour of founding a great advance in temperature measurement is due to Rømer, but, like many of his other discoveries, it has passed unnoticed. Fahrenheit's skill in making thermometers enabled it to be put to general use, though in a somewhat incomplete form.

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[1] NATURE, 139, 395 (1937).

[2] For a detailed review, see Kirstine Meyer, NATURE, 82, 296 (1910).

[3] Quoted from "Daniel Gabriel Fahrenheit", by Ernst Cohen and W. A. T. Cohen-De Meester. *Verhandl. der koninklijke Akademie van Wetenschappen te Amsterdam.* Afdeeling Natuurkunde, Deel XVI, No. 2. Amsterdam, 1931. The authors have translated the letter from Dutch to German.

[4] *Phil. Trans.*, 33, 73 (1724).

[5] *Phil. Trans.*, No. 324 (1709); cf. NATURE, 82, 297 (1910).

IN historical matters there is always room for divergence of opinion when the principals concerned, long since passed away, have left behind insufficient details to enable us to reconstruct the entire picture.

I am sorry that Dr. Kirstine Meyer does not accept my suggestion that Rømer's zero was obtained with a mixture of ice and salt (or sal ammoniac). We are all agreed that Rømer chose the boiling point of water as his upper fundamental fixed point and named it 60°. Dr. Meyer would have us believe that, as his lower fundamental fixed point, Rømer chose the temperature of melting ice, called it 7½° and evaluated his zero "by marking off 7½ parts of the same size below the freezing point".

I cannot believe that the great astronomer could be so inartistic as to choose arbitrarily the curious figure of 7½ for his lower fundamental fixed point. This number, however, ceases to be curious if the scale had already been fixed with reference to a zero whereby the temperature of melting ice became an *incident* on the scale and not its *origin*.

Are we to believe, with Dr. Meyer, that it is a pure coincidence that Rømer's zero corresponds to the eutectic temperature of ice and salt—a mixture that was already well known in Boyle's time? I think the paper in the *Phil. Trans.*, to which Dr. Meyer refers, will bear quite a different interpretation from that suggested by her.

Further, are we to assume that Fahrenheit, who copied Rømer's scale—not surreptitiously, for he openly acknowledged it—and Rømer's methods in their entirety, did not also copy the method of obtaining his zero from Rømer?

Piecing all these points together, it appears to me that the balance of evidence distinctly favours the view expressed in my article, and I am extremely sorry to have to join issue with so great and well known an authority on Danish thermometry as Dr. Kirstine Meyer.

Having once devised his scale, there was nothing to prevent Rømer from preparing standard thermometers as described in "Adversaria", using as *control* points 60° and 7½° respectively. This is what one would expect, for the construction of a standard thermometer would naturally follow, rather than precede, the selection of the scale. Once the scale had been selected, any suitable control points could be used, as at the present time, in the graduation of standard instruments. Dr. Meyer has clearly confused this latter operation, as described in "Adversaria", with the invention of the scale itself, which is not described either in "Adversaria" or anywhere else so far as we know. Hence my suggestion as to its probable origin, and my statement which Dr. Meyer finds "difficult to understand".

I am sorry that Dr. Meyer is so critical of Fahrenheit's part, for Denmark owes much to Fahrenheit; without him Rømer's scale would undoubtedly have sunk into oblivion like that of Newton. Newton's scale was a much more convenient one and antedated Rømer's by at least a year; but Newton had no Fahrenheit to commercialize his thermometers and thus bring his scale into common use.

Personally, I wish Rømer's scale had also remained a historical curiosity and that the centigrade scale alone had survived. It would have saved much inconvenience to many of us.

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Bleaching of Visual Purple in Solution

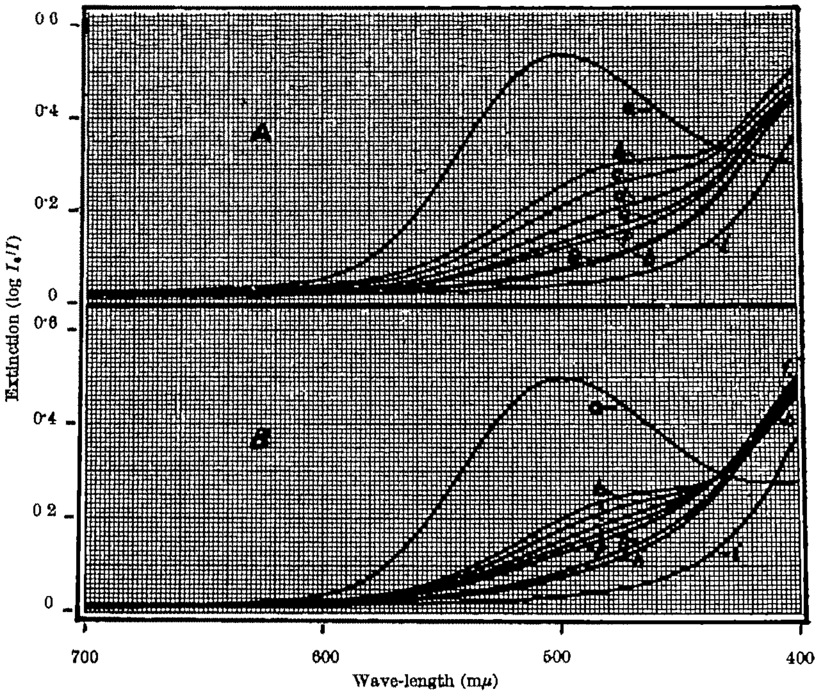
A NEUTRAL solution of visual purple exposed to bright light bleaches almost instantly to a deep orange colour, then more slowly to pale yellow. This transition has been believed to be wholly photochemical; the orange material a mixture of unbleached visual purple with the final yellow residue[1]. Both assumptions are mistaken: the orange photo-product is new pigment, which fades to yellow in complete darkness.

I have examined these processes with a recording photo-electric spectrophotometer[2], with which complete spectra were registered within two minutes, and in the case of visual purple could be completely retraced without perceptible bleaching.

Visual purple solutions from marine fishes (scup, sea robin, sea bass, killifish), summer and winter frogs, rabbits and rats behaved identically in these experiments. Typical data obtained with bull frog visual purple in 1 per cent aqueous digitonin, buffered at *p*H 6·9, are shown in Fig. 1. Half the preparation was measured four hours after extraction (*A*), the remainder one week later (*B*). The curves show the spectra of whole extracts, measured against an equal depth of distilled water.

The original solutions possess a single broad absorption band, maximal at 500 mμ (curves *a*). They were exposed for ½ minute to bright light (700 ft. cdles.) and the spectra immediately re-measured (curves *b*). The orange-coloured photo-product possesses a broad absorption band maximal at about 480 mμ, and higher absorption than visual purple itself below 430 mμ.

The solutions were left in position in complete darkness, and their spectra periodically re-measured, curves *b* at 1·2 minutes, *c* at 3·2 and 3·7, *d* at 7·2 and 8, *e* at 13·8 and 15·7, and *f* at 32·2 and 32·8 minutes (29·3° C.). (Times are from the beginning of irradiation to the recording or the extinction at 500 mμ. When two times are given, the first refers to *A*.)



At 35 minutes the preparations were re-irradiated as before for 40 seconds and their spectra recorded (curves *g*, 37 minutes). At 38·5 minutes they were exposed for a third time, and yielded curves *h* (40 minutes). Curves *f* to *h* show the bleaching of a small amount of visual purple, probably re-generated during the period in darkness[3].

Of the total fall in extinction from curves *a* to *f*, 31 per cent at 500 mμ and 42 per cent at 480 mμ are due to 'dark' processes. These may in turn be analysed into two components. One, a slow, general fall in the entire 'bleached' spectrum was discovered by Hosoya[4]. I have found it to appear clearly only in fresh preparations. It is prominent in *A*, recorded several hours after extraction, but has vanished completely from this preparation after a week's storage (*B*). The second 'dark' component, shown isolated in *B*, rapidly obliterates the initial 'bleached' maximum at 480 mμ, with simultaneous rise in absorption below 435 mμ. This is an invariable element of the bleaching of neutral visual purple solutions. In *B* it alone accounts for 19 per cent of the fall in extinction from curves *a* to *f* at 500 mμ, and 26 per cent of that at 480 mμ.

The final product of bleaching (curves *h*) is a relatively stable yellow material, the spectrum of which is slightly inflected at 405–410 mμ, and which absorbs more strongly than visual purple itself below 420–430 mμ.

Chase[5] has observed striking differences in the course of bleaching at various *p*H's. I find these to depend principally upon changes in the 'dark' components. In acid solution (*p*H 3·9) the initial photo-product possesses an almost symmetrical absorption maximum at about 440 mμ, which progresses slowly in light or darkness into the ultra-violet, leaving finally only the terminal absorption of a stable, deep yellow end-product. With decrease in acidity the 'dark' processes accelerate greatly. At *p*H 10·5 no 'dark' reaction has yet been detected, presumably because it is too rapid for measurement; irradiation yields almost immediately a stable, very light yellow material, the absorption of which still rises above that of visual purple below 410 mμ. The final product is really the same at all *p*H's; its colour varies reversibly with *p*H[5].

Under all known conditions, therefore, visual purple bleaches to new pigments. At 400 mμ, increases in absorption, the reverse of bleaching, are invariably observed. The common representation of the visual purple spectrum as the difference in absorption between unbleached and bleached preparations[6] is therefore physically meaningless.

The final yellow residue, extracted with benzine containing 1 per cent ethanol, yields all colour to the benzine. The yellow pigment, returned to buffered aqueous digitonin solution, possesses a spectrum similar to that of the whole 'bleached' residue (curves *i*). It exhibits the same *p*H colour changes as the entire residue. In chloroform, tested with antimony trichloride, it yields the deep blue colour and sharp absorption band at 664 mμ characteristic of retinene[7]. Though in the retina retinene is involved in further changes[7], it is the final product of bleaching in solution.

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[4] Hosoya, Y., *Arch. ges. Physiol.*, 233, 57 (1933).

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A New Blood Pigment: Pseudo-Methæmoglobin

IN addition to oxyhæmoglobin, methæmoglobin has been recorded in the plasma of blackwater fever patients by Arkwright and Lepper[1], Yorke, Murgatroyd and Owen[2], Ross[3] and Fairley and Bromfield[4]. In 1934 the latter observers[5] described an unnamed pigment closely allied to methæmoglobin in a case of blackwater fever. Spectroscopically it resembled methæmoglobin, but did not reduce with Stokes's reagent or ammonium sulphide. It produced a chocolate-coloured blood, a brown-coloured plasma, was absent from washed corpuscles and failed to appear in the urine. Specimens of plasma were sent to Prof. D. Keilin, who suggested that the pigment originated as some modification of methæmoglobin in which the globin portion of the molecule had undergone an irreversible change. The following year the same pigment was again encountered in this disease, and recently R. J. Bromfield and I went to investigate this question at the Malaria Laboratory of the League of Nations, Salonika.

Blood Pigments in Macedonian Cases of Blackwater Fever

As a routine procedure, the plasma and urine were examined on a Hartridge spectroscope set against artificially produced methæmoglobin, and the effects of treatment with Stokes's reagent, ammonium sulphide (10 per cent) and hydrogen peroxide (10 vols.) were noted. All these reagents disperse the α band of true methæmoglobin, but not that of the new pigment. Fourteen cases were investigated. The plasma contained oxyhæmoglobin alone in two mild cases, new pigment alone in two severe cases seen on the third and sixth days respectively, and new pigment and oxyhæmoglobin in the remaining ten. In not a single instance was methæmoglobin demonstrated.

The urine, on the other hand, never contained new pigment in demonstrable quantity. Oxyhæmoglobin was found alone in two instances and in association with methæmoglobin in ten others; in the two remaining cases the urine contained no blood pigments, though new pigment was demonstrated in the plasma. All the available data indicated that the new pigment did not traverse the glomerulus, and that urinary methæmoglobin was derived from oxyhæmoglobin during or after its passage through the tubules. Microscopic examination of the kidneys showed that the formation of new pigment protects them from the pathological effects induced by the renal excretion of hæmoglobin.

Finally, in a series of spectrograms taken for us by H. Foy, the centre of the α band of the pigment in the plasma always approximated to 6240 A., whereas that of the urine was constantly about 6300 A. Evidence regarding the duality of these pigments was thus complete.

Production of Pseudo-methæmoglobin in Vitro

The formation of methæmoglobin in sterile blood or hæmoglobin solution stored under ordinary conditions or after incubation at 37°–55° C. has long been recognized. To ascertain whether the new pigment could be produced *in vitro*, plasma from blackwater fever patients was incubated at 37°–40° C. for 48 hours with a concentrated solution of hæmoglobin prepared from laked corpuscles. The new pigment invariably resulted. But in controls, using normal plasma, we were surprised to find that the new pigment, and not methæmoglobin, appeared. The new pigment was also formed from a solution of methæmoglobin prepared by treating laked corpuscles with potassium ferricyanide when it was incubated with plasma at 37°–40° C. for 48 hours. The incubation of unlysed corpuscles and plasma produced neither methæmoglobin nor new pigment, while on incubating a solution of hæmoglobin alone, methæmoglobin formed.

These experiments prove that plasma has the power of converting extra-corpuscular hæmoglobin or methæmoglobin into the new pigment when incubated under appropriate conditions, and suggest that in any severe intravascular hæmolysis it is this new pigment, and not methæmoglobin, which is formed. Since 1864, when Hoppe-Seyler[6] first described methæmoglobin, this allied pigment has escaped recognition, and for this reason the name pseudomethæmoglobin appears to be a not inappropriate one.

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Effect of Testosterone Propionate on Mating

MUCH has been written recently about the effectiveness of testosterone in restoring the atrophic accessory glands of castrated rats, but little, if any, attention has been paid to its effect on mating behaviour.

Five rats were castrated at 30–50 gm. body weight, that is, well before sexual behaviour begins, and were kept isolated for nine weeks, when they were put with normal females. They showed no sexual behaviour. The following day they were again isolated and a course of eighteen daily injections of 0·5 mgm. testosterone propionate ("Perandren" Ciba) was begun. Development and hyperæmia of the penis was evident within a week of the beginning of treatment. Females were put into the cage eight days after the beginning of the injections and attempts at mating were observed. Two vaginal plugs, indicating that two males had mated and that their seminal vesicles and prostate were well developed, were found next day. After twelve days' treatment, the five males were separated and each given five females. Within five days all the males had mated (as determined by the occurrence of vaginal plugs), one of them repeatedly.

Prepubertally castrated male rats are not known to mate. They would in any case be unable to leave vaginal plugs, so that the results described above must have been due to the treatment with the testosterone propionate, which stimulated the development of the penis and the secretory activity of the accessory glands and induced mating behaviour. Since removal of the seminal vesicles and the prostate of normal rats does not eliminate the mating reflex[1], the appearance of this reflex is not likely to be a mechanical effect due to distension of the glands.

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Stimulating Materials obtained from Injured and Killed Cells

PREVIOUS work of ourselves[1] and others[2] has shown that ultra-violet radiation appears at times to stimulate cell division in micro-organisms, but that there is little consistency in obtaining the effect. To establish whether or not stimulation of metabolic processes occurs when cells are subjected to lethal ultra-violet irradiation, the respiration of yeast suspensions irradiated with full ultra-violet under various conditions was compared with that of controls. Again inconsistent results were obtained, but definite stimulation occurred in a number of cases. There then followed an investigation of various factors, such as *p*H, age of organisms, quality and quantity of radiation, etc., which might have accounted for the inconsistencies.

The results of these investigations suggested that the apparent stimulation of respiration might be caused by materials from the injured or killed cells which affected surrounding cells, and that the depression observed in many cases was the result of the killing of so many cells in the irradiated suspensions that too few were left to produce a respiratory effect equal to that of the control. To test this hypothesis, cells irradiated until they no longer respired were added to non-irradiated cells. Under these conditions, stimulation was uniformly obtained.

Following these results, suspensions of yeast were irradiated for a sufficient time to kill all the cells present, the suspensions were centrifuged and filtered through a Seitz bacterial filter, and the cell-free fraction and remaining dead cells added to separate suspensions of normal cells. The dead cells caused an average increase of about ten per cent in respiration (in terms of the technique used), while the cell-free extract produced an average increase of about fifty per cent. Further studies showed that cell-free extracts from cells injured or killed by X-rays, heat, or mechanical injury gave comparable results. The effect was not confined to micro-organisms—cell-free extracts from irradiated liver, kidney and embryo tissues, etc., also showed it.

Studies of the proliferation-promoting power and fermentation stimulation of some of the extracts were made, using yeast as a test organism. Definite stimulation was obtained in all cases. The preliminary results obtained thus far indicate that materials from different sources, prepared in different ways, show different orders of potency with regard to stimulation of respiration, proliferation and fermentation, suggesting the existence of at least three substances responsible for the effects. Some preparations were subjected to dialysis. The active materials passed through the dialyzing membrane, leaving inactive residues behind.

Experiments are under way with cell-free fractions, prepared by different methods from micro-organisms and tissues of various kinds, in which parallel respiration, proliferation and fermentation tests are being compared with the ultra-violet absorption spectra of the concentrates with the view of elucidating the chemical nature of the active components. Some of the materials resemble in their biological properties bios preparations from yeast and malt combings. The spectra, however, indicate wide variation in the chemical nature of the substances present. Which of the compounds the presence of which is indicated by the spectra are active materials and which are impurities remains to be determined. Some of the spectra show the presence of large quantities of nuclear purines and pyrimidines, the relation of which to the lethal action of the ultra-violet has already been noted[3].

We are particularly interested in the possible relation of these materials to the mechanism of tissue repair after injury and to the mechanism of malignant growth.

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Electrical Conductivity of a Supraconducting Sphere in the Intermediate State

A SPHERICAL single crystal of tin was placed in a magnetic field at a temperature below T_k. The electrical conductivity was determined (by measuring the current in a supraconducting circuit) for various directions of the current with regard to the magnetic field. It was found that the sphere remained supraconducting in the direction of the field up to field-strengths very nearly equal to H_k. In the direction perpendicular to the field, supraconductivity vanishes at field strengths near $2/3\ H_k$. In other directions supraconductivity is destroyed in the interval of field-strength between $2/3\ H_k$ and H_k.

It is well known that for a supraconducting sphere at field-strengths greater than 2/3 H_k the magnetic permeability μ is no longer equal to zero, while macroscopic measurements show that the sphere is magnetized homogeneously[1]. Peierls[2] named this the 'intermediate state' and assumed it to consist of supraconducting and normal regions. Landau[3] calculated that these regions have a definite structure and orientation depending on the external field and the field caused by the current.

Our experiments show that in the intermediate state the sphere possesses anisotropic supraconductivity and, when the direction of the current is parallel to the external field, can remain supraconductive right up to the field strength H_k, that is, even when μ is very near to unity.

A detailed report will be published shortly in *Sow. Phys.*

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[2] Peierls, *Proc. Roy. Soc.*, A, 155, 613 (1936).

[3] Landau, *Sow. Phys.*, in the Press.

Band Spectrum of Manganese Hydride, MnH

FOLLOWING on previous work in which we observed the spectrum of nickel hydride[1], NiH, in a high-tension arc between nickel electrodes in a flame of hydrogen burning in air, we have made similar experiments with other metals. With manganese, four bands with open rotational structure have been observed. The strongest band is in the yellow-green; it is degraded to the violet, and shows a rather complicated rotational structure; there is a strong head at λ 5678, and a fainter one at λ 5722. Bands in the green (heads at λ 5172 and λ 5205) and red (head at λ 6240) have a rather similar appearance, and the three bands may be considered tentatively as the (1,0), (0,0) and (0,1) bands of the same system. There is also a band in the blue; this is degraded to the red and has a simpler rotational structure than the other bands; its head is at about 4500 A.

The spectrum has also been produced in a discharge tube; in this the bands are rather masked by the molecular spectrum of hydrogen, but their production in this source, which does not contain oxygen or nitrogen, strengthens the assignment of the bands to MnH. (Feb. 24.)

Since writing the above, our attention has been attracted to a note on the spectrum of manganese hydride by T. Heimer[2], who has already recorded the three bands in the red, yellow-green and green which we described, and has made the same assignment of vibrational quantum numbers. In the blue, the very close band structure in the region 4700–4850 A. which Heimer records is not the structure which we described. The latter is much more open and forms a head at λ 4500. Further scrutiny of our plates shows that the band obtained by Heimer is also present. On the more strongly exposed plates the two structures run into one another and are possibly closely related.

The manganese atom has as its ground state the configuration

$$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2 \qquad {}^6S,$$

and it therefore seems likely that in the formation of MnH the ground-level will be either ${}^5\Sigma$ or ${}^7\Sigma$. If the rule of Heitler and London is obeyed, then only the ${}^5\Sigma$ level will be stable. Transitions involving a change of multiplicity do not produce strong band systems, and hence the only probable transitions are ${}^5\Sigma \rightarrow {}^5\Sigma$ and ${}^5\Pi \rightarrow {}^5\Sigma$. The bands in the yellow-green and blue, as seen on our spectrogram taken in the first order of a 20 ft. concave grating, appear to be too complicated for the first alternative, and the presence of branches of Q form favours a ${}^5\Pi \rightarrow {}^5\Sigma$ transition.

The lowest four terms of the Mn atom (excluding the ground state) are ${}^6D$, ${}^4P$, ${}^8P$ and ${}^6P$. The ${}^6D$ term could produce a ${}^5\Pi$ level for MnH, but since the change to the ground level requires that a $3d$ electron should be promoted to the $4s$ shell, this change seems improbable. Both the ${}^6P$ terms could, however, give ${}^5\Pi$ levels, and it seems likely that this is the case, one producing the system of bands in the yellow-green, and the other the blue band.

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[1] *Proc. Roy. Soc.*, A, 148, 312 (1935).

[2] *Naturwiss*, 24, 521 (Aug., 1936).

Spectrum of Mercury Chloride (HgCl) and Samuel's Theory of Linkage

ACCORDING to Samuel and co-workers[1], atoms of the second group of the Periodic System are chemically inert in their helium-like ground term ${}^1S$. Linkage becomes possible only in an excited atomic term. Among many diatomic molecules (oxides and chlorides) of this group, cadmium fluoride (CdF), from its emission bands[2], is claimed to be a very conclusive example of this kind of linkage. Other investigations on the spectra of the diatomic halides of mercury, cadmium and zinc[3,4], however, make it probable that the ground state of these molecules is built up from unexcited atoms.

On this point, I would refer to a hitherto not analysed spectrum of diatomic mercurous chloride (HgCl) vapour, stretching from λ 5600 A. to λ 3200 A. This well-known spectrum, if excited in a Geissler discharge, consists of an enormous confusion of bands and is, therefore, unsuitable for analysis. If excited by fluorescence, however, that is, by optical dissociation of triatomic mercuric chloride ($HgCl_2$) vapour with light shorter than λ 1900 A., the spectrum shows a much simpler band structure. Almost all the bands (more than a hundred in number) which appear in fluorescence and are degraded towards the red, fit very well into the following vibrational equation:

$$\text{I.}\ \left.\begin{matrix} v' = 0,\ 1,\ ..33 \\ v'' = 0,\ 1,\ ..11 \end{matrix}\right\} \quad \nu = 23372 + \left.\begin{matrix} (191{\cdot}5\ v' - 0{\cdot}50\ v'^2) \\ -\ (291{\cdot}9\ v'' - 1{\cdot}875\ v''^2) \end{matrix}\right\}\ \text{I}$$

$$\text{II.}\ \left.\begin{matrix} v' = 33,34,..\ 50 \\ v'' = 11,12,..25 \end{matrix}\right\} \quad \nu = 23372 + \left.\begin{matrix} (181{\cdot}75\ v' - 0{\cdot}35\ v'^2 + 159) \\ -\ (301{\cdot}85\ v'' - 2{\cdot}35\ v''^2 + 52) \end{matrix}\right\}\ \text{II}$$

The lower electronic state (v'') is identical with the ground state known from an ultra-violet band system of HgCl[4]. A rather sudden change of the anharmonicity occurring at high quantum numbers (at $v' = 33$ and at $v'' = 11$)—also observed in the band spectra of oxygen[5] and of chlorine[6]—makes it preferable to use two quadratic formula instead of a single cubic one. Formula I will be used for the evaluation of the zero band ν_0 and of the ground frequency; formula II for the calculation of the dissociation energies D' and D''. Thus we obtain (in electron volts):

$$\nu_0 = 2{\cdot}88 \text{ volts}, \; D' = 2{\cdot}91 \text{ volts}, \; D'' = 1{\cdot}20 \text{ volts},$$

and, from that, the atomic term $\nu_a = \nu_0 + D' - D'' =$ 4·6 volts, a value equal to the term difference $2^3P_0 - 1^1S$ (4·65 volts) of the mercury atom. This remarkable agreement supports strongly the assumption that the ground state of the HgCl molecule is built up from a Hg atom in its lowest term (1^1S)—and not from an excited one—and from a Cl atom also in its normal term. The same will presumably hold for the other diatomic iodides, bromides and chlorides of mercury, cadmium and zinc, the spectra of which are very similar to the spectrum of HgCl. Further work is needed to confirm that and to ascertain whether the fluorides of these metals behave in a different manner.

Experiments on the spectra of HgBr and HgI are in progress.

K. WIELAND.

Physikalische Anstalt,
Universitat, Basel.
Feb. 21.

[1] *Phil. Mag.*, **21**, 41 (1936). NATURE, **138**, 411 (1936).

[2] Asundi, Samuel and Zakki-Uddin, *Proc. Phys. Soc*, **47**, 235 (1935).

[3] Sponer, *Z. phys. Chem.*, B, **11**, 425 (1931). Oeser, *Z. Phys.*, **96**, 699 (1935).

[4] Wieland, *Z. Phys.*, **76**, 801 (1932) and **77**, 157 (1932).

[5] Birge, *Trans. Faraday Soc.*, **25**, 707 (1929).

[6] Elliott, *Proc. Roy. Soc.*, A, **127**, 638 (1930).

Gold Deuteride Bands

AN arc between gold poles in heavy hydrogen gas of high concentration at a pressure of about 12 cm. mercury was photographed in the second order of a 15-ft. concave grating. 723 AuD lines lying between λ 3370 A. and λ 4440 A. were analysed into eleven bands of a $^1\Sigma \rightarrow {}^1\Sigma$ system as, 2 → 0 (λ 3382), 1 → 0 (3502), 2 → 1 (3585), 0 → 0 (3646), 2 → 2 (3775), 0 → 1 (3872), 1 → 2 (3935), 2 → 3 (4005), 0 → 2 (4117), 1 → 3 (4183) and 0 → 3 (4384) vibrational transitions. The 1 → 1 band was of such low intensity that no single line of it could be identified.

Preliminary evaluation of molecular constants, based on the rotational energy function ending in the $J^2(J+1)^2$ term for both the $^1\Sigma$ states, and adjusted for the region of $J = 6 \sim 10$ to $J = 30 \sim 35$ in each vibrational level, has yielded the values given in the accompanying table, with calculated probable errors for the rotational constants.

MOLECULAR CONSTANTS OF AuD

	Lower $^1\Sigma$ state	Upper $^1\Sigma$ state
T_e	0	27644·1
ω_e	1634·98	1195·24
$x_e\omega_e$	21·66	34·81
$y_e\omega_e$	−0·0288	——
B_e	3·6413 ± 0·00008	3·041 ± 0·003
α	0·07608 ± 0·00002	0·1075 ± 0·001
D_e	$-0{\cdot}7090 \times 10^{-4} \pm 0{\cdot}0002 \times 10^{-4}$	$-0{\cdot}79 \times 10^{-4} \pm 0{\cdot}01 \times 10^{-4}$
β	$3{\cdot}36 \times 10^{-7} \pm 0{\cdot}04 \times 10^{-7}$	$-6{\cdot}2 \times 10^{-6} \pm 0{\cdot}4 \times 10^{-6}$

D_v of the upper $^1\Sigma$ state *decreases* with v in a markedly non-linear way, but as only three vibrational levels are found in this state, the most probable values of D_e' and β' for the linear formula are provisionally given in the table.

The electronic isotope shift from the corresponding AuH system (0 → 0, λ 3650 A.) is + 14 cm.$^{-1}$. Other isotope relations between the constants of the two molecules will be considered in a coming number of the Institute's publication (*S.P.I.P.C.R.*), together with frequency tables and other details of the observed deuteride bands.

SUNAO IMANISHI.

Institute of Physical and Chemical Research,
Komagome, Tokyo.
Jan. 30.

Correlation of Ionization Constants of Organic Acids with Dipole Moments

SINCE ionization constants and dipole moments are both measures of polarity, it is logical to suppose that a connexion will exist between them. Interesting results have followed an examination of the elementary possibility that the difference between the strengths of substituted and unsubstituted acids in the benzoic and phenylacetic series, and the dipole moments of monosubstituted benzenes (virtually the substituent groups), are simply related. The ionization constant values (K_{therm}) were all derived in this Department and the dipole moments were those employed by Dippy and Watson[1] in connexion with the logarithmic relationship observed previously. These sets of data possess the advantage of being comparable.

In the benzoic series the points representing *m*-nitro-, *m*-methoxy-, unsubstituted and *p*-methyl-substituted acids are distinctly colinear. A second straight line of much smaller angle can also be drawn through *m*-nitro-, *m*-chloro, *m*-iodo-, unsubstituted and *p*-methyl phenylacetic acids. In the benzoic acids the *m*-halogens show a small disparity (cf. Dippy and Watson[1]) but the abnormality has been so diminished in the phenylacetic acids that it is not distinguishable. The inclusion of the *p*-methyl acids, and not the *m*-acids, as at first expected, is especially important, and it must mean that the polar effect of the methyl group measured in toluene, is the effect of a *p*-methyl substituent, that is, the two permanent components (the inductive and mesomeric effects) are operative.

A fuller account of this relationship, accompanied by figures, will be published shortly.

J. F. J. DIPPY.

Technical College,
Cardiff. Feb. 24.

[1] *J. Chem Soc*, 436 (1936)

Electron Inertia as the Cause of Harmonics in Valves

THE Lagrangian form[1] of Benham's equation[2], connecting the total current density with the rate of change of acceleration of particles of charge e, mass m, moving in a one-dimensional, non-uniform* electric field, may be written, for electrons,

$$\dddot{x} = 2{\cdot}00_2 \times 10^{26} i \quad . \quad . \quad . \quad . \quad (1)$$

in which the numerical value of $\frac{4}{10}\pi\frac{e}{m}c^2$ is in dynes coulomb^{-1} gm.$^{-1}$ and i is in amp. cm.$^{-2}$. The electric field, which may vary with time in any manner, is proportional to $\ddot{x}$. Omitting the constant, and writing $q = \int i dt$, we obtain from (1), on integration over the interval $(t - t_0)$:

$$\ddot{x} = \ddot{x}_0 + q(t) - q(t_0) \quad . \quad . \quad . \quad . \quad (2)$$

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* The non-uniformity is caused only by the electrons themselves.

By differentiating equation (2) with respect to time at x constant, we find :

$$\left.\frac{\partial \ddot{x}}{\partial t}\right|_x = \left.\frac{\partial \dot{x}_0}{\partial t}\right|_x + i(t) - i(t_0)\left.\frac{\partial t_0}{\partial t}\right|_x$$

$$= \left[\frac{\partial \ddot{x}_0}{\partial t_0} - i(t_0)\right]\frac{\partial t_0}{\partial t} + i(t) \quad . \; . \; . \quad (3)$$

Equation (3) shows that the quantity $i(t) - \frac{\partial \ddot{x}}{\partial t}$ is related to its value at the plane $x = 0$ $(t - t_0)$ seconds earlier by the relation

$$i_c(x,t) = i_c(0,t_0)\left.\frac{\partial t_0}{\partial t}\right|_x , \quad . \; . \; . \; . \; . \quad (4)$$

(where $i_c(x,t)$ has been written for the quantity $i(t) - \frac{\partial \dot{x}}{\partial t}$, and clearly represents the electron convection current. If we perform three integrations of equation (1), we obtain the position x of a particle which started with a velocity $\dot{x}_0$ and acceleration $\ddot{x}_0$ at instant t_0 and travelled over the distance x in the interval $(t - t_0)$. This expression may then be differentiated with respect to t, keeping x constant. For a total current of the general form $\sum_{n=0}^{n=\infty} i_n e^{npt}0$, (where p may be complex in general), the value of the electron convection current ratio $\left.\frac{\partial t_0}{\partial t}\right|_x$ is then found to be as follows (5):)

$$\frac{\dot{x}_0 + \ddot{x}_0(t-t_0) + \sum_{n=0}^{n=\infty}\frac{i_n}{(np)^2}\left\{e^{npt} - e^{npt_0} - np(t-t_0)\,e^{npt_0}\right\}}{\dot{x}_0 + \ddot{x}_0(t-t_0) - (t-t_0)\left.\frac{\partial \dot{x}_0}{\partial t_0}\right| + \frac{1}{2}(t-t_0)^2\left\{\sum_{n=0}^{n=\infty} i_n e^{npt_0} - \frac{\partial \ddot{x}_0}{\partial t_0}\right\}}$$

The term $\left\{\sum_{n=0}^{n=\infty} i_n e^{npt_0} - \frac{\partial \ddot{x}_0}{\partial t_0}\right\}$ represents in all circumstances the electron convection current $i_c(0,t_0)$. In the space charge limited diode, the terms in $\dot{x}_0, \ddot{x}_0$ may be omitted without great error from the expression (5), provided the total transit time is not less than 4×10^{-10} seconds for a total current density of 100 in mA.cm.$^{-2}$. Then

$$i_c(x,t) = \sum_{n=0}^{n=\infty} i_n . \Upsilon_2(n\alpha) . e^{npt}, \quad . \; . \; . \quad (6)$$

where $\Upsilon_2(\zeta) = \frac{2}{\zeta^2}\left\{1 - e^{-\zeta} - \zeta e^{-\zeta}\right\}$ and $\alpha = p(t - t_0)$.

In order to see the significance of this result, let us suppose the total current to consist of zero and first order terms only. Then equation (6) reduces to

$$i_c(x,t) = i_0 + \underset{\longrightarrow}{\underline{i_1 \Upsilon_2(\alpha) e^{pt}}} \quad . \; . \; . \; . \quad (6a)$$

The arrow means that the term in question is not a pure sinesoid in view of variations in the value of $\frac{\alpha}{p}$ $(= t - t_0)$ about a mean value. Higher harmonics are thus contributed by the underlined term. The fundamental is obtained by writing $\alpha = \alpha_0$ in (6a), which gives the usual solution without reference to the ripple α_1. Similarly, the second order term is obtainable without reference to the ripple α_2 but requires the ripple α_1 to be known in addition to α_0.

Thus, not only has a considerable simplification been introduced into the calculation of the fundamental component, but also, by the present analysis, the calculation of second, third and even fourth harmonics of potential is made possible[3]. I have completed the accurate calculation of the second harmonic in the space charge and emission limited plane diodes, and I hope to make these available in the near future.

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[1] *Wireless Engineer*, 8, 96, 489, equation 5 (1931).

[2] *Phil. Mag.*, 2, 462, equation 5 (1931).

[3] See *Wireless Engineer*, 13, 155 (August 1936), for the relation between i_c and v in the case $n = 1$.

Phosphorescence of the Sea

THE well-authenticated phenomenon of streaks of phosphorescent water appearing in the sea[1] is doubtless due, in some way or other, to the agitation of phosphorescent marine organisms. In the past it has been ascribed, either to the effect of long rollers[2] or less commonly to porpoises[3] or schools of fish below the surface[4].

W. Schmidt's[5] observations on the so-called 'oil-patches' on water surfaces suggest a new interpretation. Under the influence of wind, a water surface divides itself up into ascending and descending areas, in the latter of which all small floating bodies collect. In lakes the descending areas often take the shape of long streaks, although there is no reason why other forms should not occur in the open sea.

If, therefore, luminous organisms collect in the descending areas, streaks of light might occasionally be formed. That the observed lines of phosphorescent water are at least occasionally formed in this way seems to follow from the fact that they have sometimes been observed to coincide with areas in which the water is especially calm. Thus L. C. Higgins[6] (South Atlantic. July 5, 1926) reported five bands stretching across the water "as far as eye could see" and added : "The phosphorescence seemed to make the sea thick and sluggish." Similarly, H. A. Standfeld[7] (China Sea, April 24, 1928) reported six streaks and remarked : "It was also noticed that the streak had an oily appearance on the surface of the water."

A similar interpretation is probably to be placed on the large patches of luminous water covering a few hundred square yards which have been recorded repeatedly. In a recent description by W. J. V. Branch[8], they have been stated to exert a calming effect comparable with that of light oils on water.

If this interpretation should be confirmed, observations on the shapes and sizes of phosphorescent marine areas should serve to throw light on the vertical movements of sea water.

R. E. D. CLARK.

St. John's College,
Cambridge.
Feb. 22.

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[1] Smith, H. T., *Marine Observer*, 8, 230 (1931).

[2] NATURE, 138, 278 (1936).

[3] *Marine Observer*, 6, 171 (1929) ; 9, 130 (1932).

[4] *Marine Observer*, 8, 79 (1931).

[5] NATURE, 137, 777 (1936).

[6] *Marine Observer*, 4, 126 (1927).

[7] *Marine Observer*, 6, 75 (1929).

[8] *Marine Observer*, 13, 47 (1936).

Occurrence of *Eucrangonyx gracilis*

IN NATURE of February 20, there appeared an interesting letter from Mr. G. I. Crawford recording the amphipod, *Eucrangonyx gracilis*, from the filter beds of the Metropolitan Water Board at the Lea Bridge Works.

It may be of interest to record that some years ago I received from Dr. Robert Gurney, of Oxford, an amphipod which was found in a glass of water drawn from the domestic supply of a house in Hackney. The only species with which I could identify the specimen was *Eucrangonyx gracilis*, but the occurrence appeared to me to be so unusual and puzzling that I refrained from recording the species pending confirmatory evidence in the shape of more material. It was impossible to trace the householder who found the specimen originally and it seemed possible, though not very probable, that the specimen may have had an entirely different provenance. Mr. Crawford's letter solves all my difficulties, and it is very satisfactory to have the little mystery cleared up. The specimen which I examined was undoubtedly *E. gracilis*, and its provenance the water supply of the Metropolitan Water Board.

W. M. TATTERSALL.

University College,
Cardiff.
March 11.

Points from Foregoing Letters

A DESCRIPTION of the spectra of 'northern lights', both red and the 'sun-lit', usually feeble, grey-violet auroras, simultaneously photographed from several Norwegian stations, is supplied by Prof. Carl Störmer. The height of the red auroras was mainly between 100 km. and 500 km., whilst some of the 'sun-lit' auroras had their summit above 800 km. and in one case reached 1,100 km. above sea-level.

Photographs showing patterns obtained by means of a Fabry-Perot interferometer with radiation scattered by phenol, butyl alcohol and acetone are submitted by Sir C. V. Raman and B. V. Raghavendra Rao. The pattern given by phenol is indistinguishable from that of the incident radiation and indicates, according to the authors, that in such highly viscous liquids the sound waves of high frequency necessary for reflecting the incident light are absent, while in the more fluid acetone the greater intensity of the components shifted by the Doppler effect indicate the existence of organized sound waves, as part of the thermal agitation.

Referring to the history of the thermometer, Dr. Kirstine Meyer quotes from Rømer's "Adversaria" to show that he used, as lower fixed point (7½° on his scale), the melting point of snow or crushed ice, and not a freezing mixture of ice and salt. Dr. Newton Friend agrees that Rømer used melting ice as control for his point at 7½°, but considers that his original scale must have been based upon the temperature given by ice and salt or ice and sal ammoniac, which closely agrees with the zero point on Rømer's scale.

Curves showing the changes in the absorption spectrum of a solution of visual purple after exposure to light, and afterwards on standing, are submitted by Dr. G. Wald. These, he considers, show the common belief, that the orange colour brought about exposure to light is due to a mixture of unbleached visual purple and final yellow product, to be mistaken. The orange colour, he states, is itself a new pigment which fades to yellow retinene in complete darkness.

Dr. N. Hamilton Fairley reports in the plasma of severe cases of blackwater fever a new pigment which hitherto has been mistaken for methæmoglobin. The pigment has never been found within the corpuscle, fails to appear in the urine, and by its spectrogram and a number of chemical reactions is readily differentiated from methæmoglobin. It may be readily produced *in vitro* by incubating a solution of oxyhæmoglobin and plasma for 48 hours at 37°–40° C. Pseudo-methæmoglobin is suggested as an appropriate name for the new pigment.

The effect of testosterone propionate in inducing mating behaviour in young rats which had been castrated when young (before the beginning of sexual behaviour) are described by Dr. H. A. Shapiro.

When living cells are injured or killed by ultraviolet light, they produce substances which stimulate respiration, etc., according to experiments by J. C. Fardon, R. J. Norris, Prof. J. R. Loofbourow and Sister M. V. Ruddy. From irradiated yeast, also from liver, kidney and embryo tissue active substances were obtained which could pass through a filter or dialysing membrane. Different orders of potency with regard to stimulation of respiration, proliferation and fermentation were observed, which suggests the existence of at least three substances responsible for the effects.

Experiments described by L. Shubnikov and I. Nadhutin show that a single spherical crystal of tin in the 'intermediate' supraconducting state (when the magnetic permeability is no longer equal to zero) possesses anisotropic supraconductivity. When the direction of the current is parallel to the external field, the sphere remains supraconductive even when the magnetic permeability is near unity; in the direction perpendicular to the field, supraconductivity vanishes at field strength 2/3 H_k.

Bands in the red, yellow-green, green and blue have been obtained by Dr. R. W. B. Pearse and A. G. Gaydon in the spectrum of an electric discharge between manganese poles in a hydrogen flame. These bands are attributed to manganese hydride, MnH. The nature of the electronic transitions are discussed in relation to the levels of the manganese atom.

The analysis of a band spectrum of mercurous chloride (HgCl) vapour, in Dr. K. Wieland's opinion, supports the view that the ground state of this molecule is built up from unexcited atoms. This does not agree with results from the spectrum of CdF obtained by Samuel and his co-workers, who suggest that the ground state of CdF, like that of all diatomic oxides and halides of the second group, is formed from a metal atom in an excited term only.

The molecular constants of gold deuteride have been calculated by S. Imanishi from the arc spectrum obtained between gold electrodes in heavy hydrogen gas.

W. E. Benham gives a simple electronic analysis yielding the electron convection current for any periodic total current waveform. The solution is in terms of the instantaneous electron transit time, and permits calculation of the *n*th harmonic in a valve if the transit time is known to the ($n - 1$)th order only.

Research Items

Religious Beliefs of Serbian Gypsies

Dr. Alexander Petrovič, in continuation of his studies of the Serbian gypsies (*J. Gypsy Lore Soc.*, Ser. 3, 16, 1–2) deals with religion and superstitions. The Serbian gypsies, who speak the Romani language, can be divided into two groups of a higher and lower culture. The first are permanent city-dwellers, while the latter have no permanent place of habitation. The former have adopted the religions and customs of other people, but with a difference. The beliefs of the second class appear to preserve some of the elements of the ancient gypsy religion. *Del* is God, the sky or heaven, or the clouds. *Del* is the unlimited space above the earth, and sends rain, snow, hail. Once *Del* was close to the earth. This was when life was good to live, and everything came easily. But *Del* was offended and moved away. *Dji* is the stomach or abdomen, and also the soul. If asked where the soul is situated, a gypsy will point to his navel; but if a physical condition of the stomach has to be described, they use *por.* *Dji* is also the heart. In Bela Crkva gypsy musicians use one word *odji* for both heart and soul. *Dji* is the centre of everything, the most precious part of anything, and also the breath of one's being. When a man dies "the soul (*dji*) escapes hence by the mouth". Coano "vampire", "ghost", is the word used also for the soul that goes out of the mouth when a man dies. As soon as a body was placed in the grave, the mourners used to throw earth on it and run away, and no one looked back, because the ghost would think he was being called and follow. The spirit of evil is *Beng*, who appears incarnate immediately his name is mentioned. The gypsies do not know if Good exists in the world, but they are sure that Evil does. *Kar*, "man", "male", and the male organ of generation brings luck. It is the creative and active principle. *Kar* is used in oaths instead of "God". In looking at their religion as a whole it must be emphasized that they are realists, and believe in what can be seen, for example, the identification of God and sky. *Del* gives but does not create. The creative principle is *kar*.

Kutchin Potlatch

Dr. Cornelius Osgood has attempted, as part of a study which will cover eventually the northern Athapascan area as a whole, a reconstruction of the culture, as it was about one hundred years ago, of the Kutchin, or rather of the several tribes known by that name, who inhabit the country from the region around the great bend of the Yukon River, eastwards into the valley of the Mackenzie, north to the littoral of the Arctic Ocean held by the Eskimo, and south to roughly lat. 65° north (*Yale Publications in Ethnology*, No. 14). His observations include an account of the potlatch, of which the performance was most fully celebrated among the Crow River Kutchin. It was given in honour of a person deceased, but at no other time or occasion. The donor, a relative, accumulated food and property for the purpose during the period of mourning. A period of one to two years might elapse, and the size of the potlatch would depend upon the wealth and influence of the persons involved, as well as on whether it was a time of plenty or scarcity. The primary purpose seems to have been the enhancement of family or personal prestige, as well as, in the background, the idea of reciprocity. The potlatch was generally held in a special ceremonial ground or enclosure. The fence served the purpose of apportioning the gifts, skins and so on, which were set out there on display. The duration of the potlatch correlated directly with the elaborateness of the display and the time required to consume all the food prepared. In a small potlatch, only the local population participated. In the larger, other tribes were invited to attend. Important or distant guests were formally escorted to a suitable reception, watch for their approach being kept night and day for some time. On arrival, the leader of each group made a suitable speech, and a welcoming reply was made. Dancing was a common activity during the ceremony. Speeches were made at intervals, and games and tricks played. The final act was the distribution of gifts, performed by a friend of the giver who was paid for his service.

Impaction of Man's Third Molar Teeth

Mr. Bowdler Henry and Dr. G. M. Morant give an account of a preliminary examination they have made of skiagrams showing man's wisdom teeth in the process of eruption (*Biometrika*, 378, Dec. 1936). As is well known, eruption of a tooth involves an elaborate series of growth movements not only in the tissues which surround a cutting tooth, but also in parts of the bony tissues at a distance. The growth movements which bring up the third molars—man's wisdom teeth—are particularly complicated, and are very apt to be delayed or arrested, particularly in western Europeans. The teeth most liable to arrest are the lower molars. The impaction of these may give rise to disorders so serious as to threaten the life of a sufferer. It would be a great advantage if a dental surgeon could tell, from the examination of dental skiagrams of young people, whether or not their wisdom teeth were likely to become impacted. Mr. Bowdler Henry has proposed certain methods, based on the examination of 622 skiagrams. His results have been examined statistically by Dr. G. M. Morant. They have determined to extend the investigation, but meantime certain hints are given which are likely to have a practical value for dental surgeons.

Sponges of the Panama Canal

Dr. M. W. de Laubenfels has recently compared collections of shallow-water, and mainly intertidal sponges, made by him at either end of the Panama Canal, during the summer of 1933 (*Proc. U.S. Nat. Mus.*, 83, No. 2993; 1936). Among a total of 31 species collected, 10 are restricted to the Pacific side, 15 to the Atlantic side, 6 being recorded from both sides. New species are described in the respective proportions of 4 to 16 on the Pacific side, and 6 to 21 on the Atlantic side; not as 5 and 7 respectively, as stated, apparently in error. With the exception of four strictly keratose species, including two Hircinimæ, from the Atlantic side, and one, *Aplysilla*, from the Pacific, all are siliceous species, the Calcarea not being represented.

The Teak Borer of Burma

THROUGHOUT the main teak-bearing areas of Burma, the timber suffers from the beehole or gallery caused by the larva of a large moth, *Xyleutes ceramica*. This insect is a member of the primitive family Cossidæ to which the familiar goat moth (*Cossus cossus*) of Britain and other European countries belongs. A survey of the injuries caused by the beehole borer has recently been made by Mr. D. J. Atkinson, forest entomologist for Burma. His account forms No. 1 of vol. 2 of *Indian Forest Records* (N.S.), Entomology (1936) wherein data are given for the mean incidence of the borer as affecting 1,001 trees taken from 56 localities. Average rainfall is a sound index of the probable severity of the damage: below the isohyet of 55 in., conditions become less favourable to the insect. It was also found that much of the naturally grown teak timber in Burma is more heavily infested than a great deal of the plantation timber. The faster growth of the latter operates to advantage, and serves also to accentuate the natural tendency for an increase in beehole borer damage towards the centre of the tree, and the faster the growth of the tree the greater the volume of comparatively borer-free timber which will be produced. Where conditions are suitable, heavy and repeated thinnings to encourage the volume increment, to outstrip the borer increment, are advised.

Storage of Pollen

THE possibility of storing pollen from one year to another has distinct advantages in horticultural practice. Hitherto, although methods have been devised for transplanting pollen over considerable distances, the maximum viability has not extended beyond the current season. B. R. Nebel and M. L. Ruttle (*J. Pom. and Hort. Sci.*, 14 (4), 347; 1937) have succeeded in keeping pollen of apple and sour cherry in store for more than two years, and their data indicate that similar longevity may be attained by pollen from pear, plum, sweet cherry and grape. The latter species have been stored for more than a year, but the experiments are as yet incomplete. The period of life of apple and sour cherry pollen stored at 2°–8° C. increases with decreasing humidity from 100 per cent to 50 per cent, the latter being the optimum. Apple pollen which had apparently lost its viability after being stored in the laboratory for five weeks was revived by storing at 2°–8° C. and 80 per cent humidity. Pollen from several common varieties of the species mentioned was used, and the success of the experiments should enable plant breeders to make crosses between varieties which flower in different seasons or are separated geographically.

Effect of Oxidizing Agents on Crop Production

PROF. V. SUBRAHMANYAN, C. R. Harihara Iyer and R. Rajagopalan, of the Indian Institute of Science, Bangalore, in a communication to the Editor, have directed attention to the possibilities of increasing crop production through judicious applications of chemical oxidizers, and have outlined the attendant chemical and biological changes. All crops showed increase in yield on both unmanured and manured soils. The oxidizing agents differed in efficiency, potassium permanganate usually being more active than either hydrogen peroxide or ferric oxide. Permanganate gave the best results when applied as a basal dressing, while manganese dioxide was most efficient as a top dressing. The crops also varied in their response to different oxidizers. Ammonia production in the soil was increased, and the oxidation of organic matter facilitated, but the biological changes consequent on the application of oxidizers were not pronounced. With permanganate there was an initial depression in the number of bacteria followed by a rapid rise after the fourth day. Soluble manganese salts applied to soil pass into an insoluble form and oxidation of organic matter occurs with the production of carbon dioxide, particularly on non-sterile soils. There is some evidence that biological activity is stimulated, resulting in greater production of carbon dioxide and increased plant assimilation. Manganese dioxide and permanganate gave the best results, manganous sulphate following next in order, while manganous carbonate was not much superior to untreated control. Pretreatment with lime was found to depress the yield, at any rate in the case of the eight varieties of tomatoes that were tried. In none of the cases was there any evidence of increased intake of manganese. The foregoing and other observations would suggest that although certain inorganic compounds may produce profound physiological effects in culture solutions, through purely ionic action, they act in a different way in the soil, this being particularly true of manganese salts, which are rendered insoluble in the soil.

The Structure of a Cellulose Wall

THE *Valonia* cell wall, of which a model is figured by Drs. R. D. Preston and W. T. Astbury in a recent paper (*Proc. Roy. Soc.*, B, 122, No. 826, March 3, 1937) must have been submitted to far more intensive study than the cell wall of any other individual cell. As a result, a most interesting and complicated structure is revealed. The cellulose chains in one of these layers form a system of meridians in the wall running from the base to the apex of the cell, and the chains of the alternate layers build a system of spirals closing down on the two 'poles' defined by the meridians. The X-ray photographs confirm the fibrillar structure suggested by the microscope, and it is now clear that the *Valonia* wall is built of alternating layers of differently orientated cellulose fibrils which cross each other at an angle of a little less than 90°. The major extinction position shown by the polarizing microscope bisects this angle approximately, though its position varies with the varying proportion of the two types of lamellæ. It is abundantly clear that the direction of the cellulose chains in a cell wall cannot be reliably determined by observations with a polarizing microscope alone. The authors discuss the involved problems presented by the deposition of such a wall by the growing cell. There seems no doubt that the patchwork appearance indicated in surface view on examination by the polarizing microscope is the result of the cracking of the outer layers by the continued volume expansion of the growing cell, but it is difficult to visualize a mechanism which should lead to the successive deposition of layers with cellulose chains crossing at an angle of nearly 90°.

The Aluminizing of Telescope Mirrors

On *Leaflet* No. 96 issued by the Astronomical Society of the Pacific, Dr. J. Strong of the California Institute of Technology, contributes a short article on "What Aluminium has done for the Reflecting Telescope". An account both of the history of the coating of mirror surfaces with aluminium and other metals by an evaporation process, and of the promising astronomical results obtained with reflectors that had been aluminized, has already been given in Nature (134, 522; 1934). The chief advantages of using aluminized mirrors in telescopes are: (1) the high degree of reflectivity and freedom from scattered light maintained over a considerable period of time, as compared with the life of a silvered surface; (2) the high reflectivity in the violet end of the spectrum where a silvered surface absorbs strongly. Thus, aluminium reflects 87 per cent of the incident light below wave-length 4100 A., whereas the reflectivity of a freshly silvered surface rapidly diminishes from 90 per cent at λ4100 to only 4 per cent at λ3150. Consequently, with an aluminized optical train, it is possible to photograph stellar spectra down to the limit of transmission of the earth's atmosphere at about λ3000. This latter property has enabled Wright at the Lick Observatory to discover new emission lines in the spectra of planetary nebulæ, while Duncan has found the existence of an outer envelope to the well-known ring nebula in Lyra. Another illustration of the value of aluminized surfaces is the fact that after the mirrors of the 60-inch and 100-inch reflectors on Mount Wilson had been aluminized, it was found that the resulting gain at the Cassegrain focus (involving reflections at three surfaces) was equivalent to one photographic magnitude, or about the increase in light grasp of the 100-inch as compared with that of the 60-inch. Although in the process of aluminizing smaller mirrors difficulties are sometimes encountered, Dr. Strong thinks that no unusual problem will be presented in aluminizing the 200-inch mirror when it is ready; the 36-inch Crossley reflector at the Lick Observatory and the two great telescopes at Mount Wilson have already been successfully treated.

Electricity in Mining

To the *Journal of the Institution of Electrical Engineers* of February, Prof. W. M. Thornton contributes an interesting review of the progress made in the use of electricity in mining during last year. A recent figure for the number of electric units consumed per ton of coal raised is 25. This includes the heavy pumping demands. In Northumberland and Durham alone, it has been estimated that 125 million tons of water are raised annually. This is enough to form a lake of 25 square miles in area and 6 feet deep. Underground haulage, for which an electrical drive is admirably suited, takes nearly as much power as pumping. But there are still 40,000 ponies employed in Great Britain on underground haulage. This may be compared with 64,000 ten years ago. Considerable improvements in the design of ventilating fans for collieries have recently been made, embodying the most recent theories of air screws. A 300-h.p. fan, in use at Dodworth colliery, has an 89 per cent efficiency—a remarkable performance. The flame safety lamp in its early days showed the presence of high proportions of firedamp by the gauze becoming red hot. In capable and trained hands it proved on the whole a trustworthy guide to the percentage of firedamp in the mine. But it cannot, in unskilled hands, be used to detect the safety limits of 1¼ or even 2½ per cent. Two forms of electric safety lamp have recently been fitted with a means of rapidly detecting 1–4 per cent of firedamp. One of these, the Gray 4-volt acid lamp, is coming into use, and is approved by the Mines Department. An interesting development is the electrostatic precipitation by the Lodge method of the finely divided tar fog in coal or coke-oven gas. Two 15,000 volt d.c. generators are mounted on insulators and connected in series. The negative terminal is connected to a wire grid and the positive to plates. On the application of the field, the fog becomes charged negatively, deposits on the positive plates, and falls. In one such plant about 6·5 million cubic feet are treated daily, and practically every trace of fog is removed. The currents used vary between one twentieth and one half an ampere

Synthesis of Fluorene Compounds

Further contributions to the study of diphenyl and its derivatives have been published by Prof. L. Mascarelli and his co-workers (*Atti Accad. Sci. Torino*, 72, 64 and 109; 1937). Of special interest is the behaviour of 2-4′-dimethyl-2′-aminodiphenyl, the preparation of which is described. When this substance is diazotized and the product boiled with water, an almost theoretical yield of 2-methylfluorene is obtained. This reaction provides a second example of the direct synthesis of a fluorene ring compound from a diphenyl derivative, which was discovered by Mascarelli in 1932. The trisubstituted diphenyl compound 2-6′-dimethyl-2′-aminodiphenyl, when subjected to a similar treatment, gives only a small yield of 4-methylfluorene. With a tetrasubstituted diphenyl derivative, no fluorene ring synthesis occurs. The subject is further discussed in a paper by Prof. Mascarelli (*Gazzetta Chimica Italiana*, 66, 843; 1936).

Colour Variation in the Equatorial Belts of Jupiter

Mr. A. Stanley Williams, a very assiduous observer of the planet Jupiter, contributes an interesting paper on this subject to *Mon. Not. Roy. Astro. Soc.*, 97, 2 (Dec. 1936) which deals with his observations from 1930 to the end of last year. His first paper on the subject, published in 1899, showed that the observations up to that date indicated a period of 12·08 years in the variation, and his second paper in 1930 gave a period of 12·5 years. The results of the last six years' work show that the period must be shortened to 11·86 years, the period of the revolution of the planet around the sun. The adopted elements of variation are: Standard epoch = 1838·52 + 11·86 E years. At the time of a standard epoch the North Equatorial Belt is at or near a minimum of redness, while the South Equatorial Belt is at or near a maximum. At intermediate epochs the colours of the belts are reversed from those just mentioned. As the computed date of the next standard epoch is 1945·2, when the North Equatorial Belt will be at or near a minimum of redness, and the South Equatorial Belt at or near a maximum, observations during 1945 and a year or two before and after are highly desirable.

The New Forest*

ORIGINALLY an old Crown forest, and nowadays the most extensive of these remnants of the old Royal forests, the New Forest, in Hampshire, comprises some 90,000 acres and is under the management of the Forestry Commissioners. The Forest comes under the designation of a true forest, though large areas consist of open heath-land subject to rights of grazing and so forth ; these limit planting and other forestry operations which would constitute the area a commercial proposition. Perhaps no other area of the type has received so much attention from Parliament, and numerous Acts have been passed for the administration of the law relating to it. The Acts of 1877 and 1879 may be said practically to have settled the Government policy *vis-à-vis* the forest, which is now regarded as a national playground ; the coming of the motor-car having enormously extended the area from which visitors now resort to the Forest. These factors are rendering its management, even from the sole point of view of maintaining its beauty for future generations, a delicate and difficult task.

Apart from the Forestry Commission, several bodies such as the New Forest Association, the Court of Verderers, the Scapa Society, the Council for the Preservation of Rural England and the New Forestry Advisory Committee constitute what may perhaps be best expressed as vigilant committees over the maintenance of the Forest in its pristine beauty.

Some of the difficulties confronting the management are portrayed in the annual report for 1936 of the New Forest Association. The objects of the Association are given as follows : "The preservation of the general picturesque aspect of the Forest and the old woods and the protection of the rights and privileges of the Commoners and of the Public in the enjoyment of the Forest." From the professional forester's point of view, some of these objects are conflicting, so far as the public are concerned. To give one instance, the preservation of the picturesqueness of the old woods, for example, the Mark Ash inclosure of old beech, famous during the past half century amongst artists and other lovers of scenic beauty. How is this old wood to be perpetuated ? The wooded parts of the forest, the beautiful inclosures of old broad-leaved trees, present analogous cases.

The New Forest Association has its own problems. One of the first mentioned would be scarcely understood by European Continental nations, accustomed to regard forests as economic commercial propositions. The matter in question is the spread of seedling fir trees coming up from blown seed. The spread of these young trees is said to be continuing at an alarming rate ; with the obvious result that their growth in height will interfere with the beautiful views over the open forest, which it is one of the objects of the Association to maintain ; whilst it is said that the presence of the trees diminishes the grazing area. The attention of the Forestry Commission has been directed to this, one of Nature's own acts. It is a curious anomaly to find man fighting against Nature in her effort to provide him with produce free of cost ; whilst elsewhere in the country the Commission is spending pounds per acre planting the very same type of tree. The cost of continually removing these young trees would, it is said, be considerable.

If one of the objects is to maintain the grazing, should not such work be undertaken by the right holders who own the grazing ? The Association suggests a special grant being made by Government ; but it is difficult to see how the expenditure of the tax-payers' money on such an object could be justified.

The Association has saved the Forest from pylons, but with the praiseworthy aim of making electricity more commonly available, poles and overhead cables are on the increase. The report alludes to litter dumping and the refuse left by visitors, and rightly considers that education and persuasion, of the old as well as the young, are the chief means by which litter may be gradually decreased.

The New Forest ponies present a problem. Within the Forest boundaries they are on their own ground. But of late years they have taken to straying outside the boundaries. In the days before the motor-cars on the roads had reached their present numbers, there were gates on the roads leading into the Forest. The value of these latter, nowadays always left open, has disappeared. The 'grid', so commonly seen at the entrance to drives of private houses, was suggested, but the County Surveyor expressed his opinion that his Council would not be prepared to make the grids. So this problem remains unsettled. Oil prospecting in the Forest has raised a scare, but nothing definite has yet transpired, save the fact that the Association would raise the strongest objection to the desecration of the Forest by such operations.

All the inclosures in the Forest have gates, a field gate and a small hunting gate alongside. These are all left unlocked. The Association quite correctly urges on the public always to close the gates on passing through ; or the courtesy of the Forestry Commission in leaving the gates open may be withdrawn.

Probably the most important part of the report lies in the remarks on the condition of the Forest, and these remarks will receive support from many who, though non-resident, are well acquainted with the Forest. As the report puts it : "The Council have for many years past viewed, with great concern and alarm, the great deterioration in the condition of the open and enclosed spaces of the Forest to which the public have access. They interpret the New Forest Act 1877 as laying down that the amenity of the Forest is the object of management, and that any consideration of profit should take a second place." It may be mentioned that in many parts of the Continent of Europe it is regarded as quite feasible to secure both objects by a correct management without a loss of amenity. But the present condition of parts of the Forest is reducing amenity and its use by the public and is equally uneconomic. The most glaring item in this want of management is the neglect of draining over areas of varying size throughout the region—a neglect which cannot be laid to the door of the Forestry Commission ; for it is the aftermath of the want of efficient management in these matters of a century or more.

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* New Forest Association. Annual Report and Statement of Accounts. Pp. 18+6 plates. (Brockenhurst: Capt Cecil Sutton, Hon. Sec, The Estate Offices, 1936.)

Disease Resistance in Plants

VOL. 3, No. 6, of the *Proceedings of the Indian Academy of Sciences* is devoted entirely to the papers submitted for the symposium at Coimbatore in October 1935 on "Disease Resistance in Plants". Interest in the contributions lies in methods of stimulating disease resistance. These are adopted as a result of investigations along the lines of inheritance of resistance, structural modification associated with resistance and physiological conditions associated with the plants' response to the disease. Thus in the case of sugar-cane, frequently attacked by mosaic, N. L. Dutt, Syed Abbas Hussainy and M. K. Krishnaswami; C. S. Krishnaswami, and others, have found it possible to breed resistant plants and that those with *Saccharum spontaneum* parentage are more resistant than others.

Other workers, investigating the wilt disease of cotton (due to attacks of *Fusarium* species), have found that environmental conditions are important factors in relation to susceptibility, and in particular soil management can control the disease. A striking example of this is furnished by the work of B. B. Mundkur, who shows conclusively that in the case of *Fusarium vasinfectum* the American variety could not attack American cottons on Indian soils, and will not attack Indian cottons in any circumstances, whilst Indian cottons are less susceptible to the Indian variety of *Fusarium* on American soils. It is interesting to note that American soil in affected districts is light sandy and acidic, whilst affected Indian soils are heavy clayey and alkaline. Soil conditions (mainly physical) have also been found by J. Madhusudan Rao and Yeshwant D. Wad to be responsible for development of leaf roll and red leaf in American cottons.

With reference to anatomical developments in relation to disease, B. P. Pal shows that in certain varieties of gram (*Cicer Arietinum* L.) which are affected by the cutworm, those which are relatively immune have large stem diameters and extensive development of woody tissues, while severely attacked varieties show a smaller stem diameter and poorly developed secondary wood.

In most cases work has been carried out under field conditions and in connexion with various growers, so that some very interesting statistics are possible in view of the quantity of material available.

Progress in Building Research

A PERUSAL of the report of the Building Research Board for 1935 recently issued by the Department of Scientific and Industrial Research (H.M. Stationery Office. 3*s*. 6*d*.) shows how elementary is our scientific knowledge of building technique. In his introductory survey of the recent work of the Board, Dr. R. E. Stradling, the director of research, suggests that a wrong emphasis has been given by concentrating on the engineering side, strength and stability of structure being studied to the neglect of other equally vital considerations associated with the "Efficiency of Buildings from the Standpoint of the User".

Recent developments have given special prominence to three of these problems, especially in connexion with slum clearance schemes. The increase of noises of all kinds and the influence of mechanical continuity, as adopted in modern construction, in causing a sound made at one point to be extended over a large area, have made the sound insulation problem serious and pressing. The results of earlier work on walls, partitions and floors, treated individually, have focused attention on the interaction of the several elements of a building, and this is now being investigated with the full realization of treating the building as a whole. Trials are in progress on a frame building, on the principle that the construction should be such as to confine the noise to the room in which it is made; and this is arranged as a box, built into, but acoustically insulated from, a structural framework. It is appreciated that unforeseen troubles may arise in the full-scale developments, but "these must be overcome for the need is urgent".

From the same source comes the difficult problem of bug infestation, in which the survey work carried out has shown that virtually every urban authority is more or less troubled with this problem. Dr. Stradling urges that the building industry should endeavour to contribute to its solution by preventing the formation of cracks and by devising a form of construction which will, when the need arises, admit of disinfestation by the poisonous gases at present used, without danger to the occupants of surrounding houses.

It is claimed that considerable advance has been made towards placing the investigation of fire resistance on a scientific basis by the provision of a fire-testing station at Elstree, where full-size building elements are tested and graded in accordance with the new specification. Arrangements have been made for a programme of research covering not only the investigation of different forms of construction but also of tests of proprietary systems with the view of issuing appropriate certificates.

In the demolition of Waterloo Bridge, opportunity has been taken to investigate the condition of granite after exposure for 120 years. The outer half-inch was found to be seriously affected, but no reason appeared to suggest that decay would have become apparent in the near future had the structure been undisturbed. Laboratory examination of Portland stone from St. Paul's Cathedral also showed that, except for surface portions, the material was sound and, with regard to the use of old stones, the report states that, in the case of the more durable kinds, provided an appropriate thickness is removed, these should prove as good as new.

Materials for cleaning buildings have been under review, and a number of proprietary preparations investigated. It is pointed out that it is inadvisable to use chemical methods, and that alkalis are equally as dangerous as acids. Examples of the deleterious effects of cleaning in stone walls, door jambs, etc., are quoted.

Work on the effect of firing conditions on the properties of bricks has shown that specimens fired to below 900° C. offered only a moderate resistance to disruption by the crystallization of soluble salts whereas, with one exception, all the clays tested proved satisfactory in this respect when fired to 1,000° C. The unsightly efflorescence on brickwork is caused by soluble magnesium compounds, particularly the sulphate, contained in the bricks, and the only certain method of its elimination is firing to a temperature of above 1,050° C.

The report also contains particulars of tests made on the heating, cooling and lighting of buildings. The notable difference in the temperatures inside a wooden shed, before and after whitening it, is shown in the results of one inquiry, while the diminution of the lighting of a room due to a balcony or neighbouring building is the subject of another. Particulars of the work carried out in conjunction with other bodies and on behalf of manufacturers, indicate the value of the scientific services rendered by the Building Research Board both to the industry and to the interests of the public.

The Machinery of the *Queen Mary*

THE ninth Thomas Lowe Gray lecture was delivered before the Institution of Mechanical Engineers on January 8 by Mr. John Austin, superintendent engineer, Cunard White Star, Ltd., and took the form of a description of the main and auxiliary machinery of the *Queen Mary*.

Mr. Austin pointed out that since the advent of steam propulsion, the trend of development in the design of Atlantic liners has been towards larger and faster ships, and the several commercial and technical considerations which determined the size and speed of the new vessel were explained. Before a decision was taken as to the type of machinery to be installed, a committee of eminent engineers was invited to advise the directors, and they unanimously recommended high-pressure water-tube boilers with superheaters and air-preheaters and, for propulsion, single reduction geared turbines as being most suitable by reason of their reliability, simplicity, lightness, efficiency and freedom from noise and vibration. To meet emergencies and to maintain the fortnightly schedule, a large reserve of steaming capacity was provided and, in relation to the normal power required, it is of particular interest to the engineer to note how much design of hull and propellers has improved. From the table of figures given, the *Lucania* of 1893 had a gross tonnage of 12,952, horse-power 27,650 and speed 21·9 knots. The *Queen Mary* has 6·2 times the tonnage, but only 5·7 times the horse-power, although her speed is 1·2 times that of the *Lucania*.

The arrangements to ensure economy and to obviate delays and damage are as complete as human ingenuity can make them. Salt-water detectors are fitted at every point where salt-water might leak into the feed-water system, and give audible and visible warning when the concentration reaches 2 grains per gallon. Automatic feed-water regulators ensure a steady water-level in the boilers. The adoption of the closed stokehold system of forced draught has obviated the need for massive air ducts, and maintains better ventilation and working conditions. Each boiler has a complete system of steam soot blowers, and the arrangement by which boilers and propelling machinery have been divided into two quite independent systems—only practicable in a ship of such large size and power—ensures that, in the event of breakdown in one section, the whole propelling machinery is not put out of action.

The steering and manœuvring of a ship of this size necessitates a rudder of large area and, this being of streamline unbalanced type, powerful operating gear had to be installed. The torque is supplied by four hydraulic rams acting on tillers projecting from the rudder-stock. For safety, the essential parts were duplicated and the pumps are driven by three electric motors each of 250 h.p., the switchboard of which is operated by servo gear of the electro-hydraulic type controlled by hydraulic telemotors working in conjunction with the steering wheel on the bridge.

Crystalline Structure of Cellulose

PROF. K. H. MEYER reviews in the February issue of the *Berichte der deutschen chemischen Gesellschaft* the evidence upon which the structure of the crystalline part of cellulose has been based, and suggests that certain alterations are needed in the accepted model which was constructed from X-ray intensity measurements carried out by Andress in 1929.

Fortunately, the existing calculations upon the dimensions of the micelles or crystallites remain for the most part undisturbed, since the latter are independent units and the cellubiose type of linkage is not challenged. But the grouping of the micelles needs reconsideration. Hitherto it has been assumed that they all run in the same direction.

There seems to be no valid proof that this is the case, and the fact that *precipitated* hydratcellulose possesses the same crystal lattice as that of the mercerized fibre makes it highly improbable that all the chains are similarly orientated. There is, in fact, no reason why an equal number of chains should not be formed in opposite directions by precipitation.

Moreover, the minor alterations in dimensions, which have resulted from new X-ray intensity measurements, show that the suggested new model, in which the crystallites are arranged to run alternately in opposite directions, is more in accordance with measurements than the older one. In particular, there is no longer any need for deviations from the tetrahedral angle in the side-chains, and the recalculated distance of 2·6 A. between hydroxyl groups of neighbouring chains, agrees well with the recent measurements by Bernal on hydroxyl distances.

It is known that a small amount of oxidation occurs in native cellulose and it is suggested that the resulting acid groups may esterify with neighbouring micelles. This may account for the resistance to methylation observed by Karrer to the extent of about 8 per cent of the hydroxyl groups. No information could be derived about the ends of the chains, but it is pointed out that in the new model the terminal aldehyde groups might lose their identity by forming glucosidic links with the terminal alcoholic groups of the other micelles to form giant rings.

Birmingham Conference on Industrial Physics

THE rapid development of industrial applications of physics to industry in recent years has brought with it the desire for opportunities for the interchange of ideas and for the discussion of the many and varied topics which have consequently arisen. The more enterprising industrialist also desires opportunities of learning of these latest developments in order to keep himself abreast of his competitors, especially those abroad. The Institute of Physics is endeavouring to meet this demand by founding branches both at home and overseas, and by holding periodic conferences on industrial physics. The first Industrial Physics Conference to be held took place in Manchester in 1935 (see NATURE, April 6, 1935, p. 555) and the second was held in Birmingham on March 8–20, the subject being "Optical Devices in Research and Industry".

The sessions were held in the University of Birmingham. The Conference was formerly opened by Mr. Walter Barrow, pro-chancellor of the University, and was presided over by the president of the Institute, Prof. A. Fowler. Following the established practice of the Institute, the lectures were all informal in character and were followed by discussions. Neither the lectures nor the subsequent discussions will be published, except the presidential address, which will appear in an early number of the *Journal of Scientific Instruments*; the title of this address was "Spectroscopy in Industry". The other lectures were: "Colorimetry, Spectrophotometry and the Inspection of Manufactured Products for 'Appearance' ", by Mr. R. Donaldson, of the National Physical Laboratory; "The Application of Electron Diffraction to Industrial Problems" by Prof. G. I. Finch, of the Imperial College of Science and Technology; "Industrial Uses of Photocells" by Mr. A. L. Whiteley, of the British Thomson-Houston Co., Ltd.; "Optical Gauges for Metrology and Engineering" by Mr. F. H. Rolt, of the National Physical Laboratory; "Polarimeters, Saccharimeters and Refractometers in Sugar, Jam-boiling and other Industries", by Mr. L. Eynon, of Messrs. Eynon and Lane, official analysts to the Sugar Association of London. The attendance at each of the lectures was excellent, averaging 325. Both the lecturers and those who took part in the subsequent lively discussions dealt with recent industrial applications of the various optical and allied devices and the associated problems, rather than with the technical details and underlying principles of the devices themselves.

On March 20 parties of Conference members were able to see the direct application of physics to industry in the Longbridge Works of the Austin Motor Co., Ltd., the engineering works of the General Electric Co., Ltd., and the Research and Development Department of the Mond Nickel Co., Ltd., as well as the associated works of Messrs. Henry Wiggin and Co., Ltd.

Twenty-three firms and research organizations were represented at an Exhibition of apparatus, instruments and books cognate to the subject of the Conference, which was held in the physics laboratories of the University. The Government's recognition of the importance of physics to industry was demonstrated by several exhibits contributed by the National Physical Laboratory and the Post Office Engineering Research Station. A special section of the exhibition was devoted to optical experiments of general interest, including many ingenious applications of photocells. The object of the whole Exhibition was to demonstrate the existence of apparatus and instruments designed on well-known physical principles for use in the workshop and factory. It was agreed, even by those familiar with the subject, that the wide range covered by the devices shown was considerably more extensive than is generally appreciated. Many instances were recorded in which responsible executives were enabled by this Conference and Exhibition to learn of the existence of devices which should prove of the utmost value in their factories. A limited number of copies of the catalogue of the Exhibition is still available from the Institute of Physics, London, S.W.7 (9*d.* post paid). The educational value of the Exhibition was appreciated by the local schools, and it was visited by parties of senior scholars from them. It is estimated that about 2,500 people visited the Exhibition during the three days that it was open.

Prof. J. A. Crowther, honorary secretary of the Institute, broadcast a talk about the Conference and Exhibition on the eve of its opening, and it also received extensive attention from both the lay and technical press. There was thus further confirmation of the fact that there exists a great demand for information about recent scientific discoveries and particularly their application to industrial and domestic problems.

No report of the Conference would be complete without recording the valuable contacts which resulted from bringing together physicists and industrialists, and the great help rendered by the authorities and members of the staff of the University of Birmingham.

HERBERT R. LANG.

Science News a Century Ago

Egyptian Mummies

The *Gentleman's Magazine* of April 1837 relates that "on March 6 at the close of a series of six very interesting and instructive lectures on Egyptian antiquities delivered at Exeter Hall by Mr. Pettigrew that gentleman unwrapped a mummy presented for the occasion by Mr. Jones of the Admiralty. The inscription on the outer case differed from that on the inner. Both stated the party to have been a female, but the names and genealogies were different, and the latter stated the mother of the deceased to be living when her daughter died. It might be that the wrappings would settle this point; which, however, they did not—for no name was found on them, as often occurs. The mummy was Greco-Egyptian, and embalmed after the ancient manner, the bowels being extracted by an incision on the left flank, and the brains probably through the nostrils, as the nose was much broken. The legs were separately bandaged, and the ankles bound by strips of painted linen, about half an inch in breadth. The figures were not hieroglyphic, but simply ornamental. Bands of the same kind surrounded the arms, which were crossed upon the breast; and a similar circle went round the neck, with a thin golden scarabaeus in front. On each knee was also a thin piece of gold, resembling the lotus-flower; over each eye the providential eye of Osiris of the same material, and another golden ornament upon the top of the ridge of the nose. The upper wrappers were not voluminous, and of coarse nankeen-coloured linen. Then came a complete envelope of asphaltus, and below that the usual disposition and extent of linen robes. On the soles of the feet were slight sandals, transversely striped, black, white, and red, exactly like those painted at the bottom of the inner cases. The finger- and toe-nails were gilt, and there were rings on the fingers."

Henslow's "Descriptive and Physiological Botany"

The first article in the *Athenæum* of April 8, 1837, contained a notice of Prof. Henslow's "The Principles of Descriptive and Physiological Botany". John Stevens Henslow (1796–1861) was professor of mineralogy at Cambridge in 1822–27 and professor of botany in 1827–61. It was he who recommended Darwin as naturalist to H.M.S. *Beagle*. "If any person," said the *Athenæum*, "doubts the truth of the opinion now prevalent, that Botany has of late years undergone a great revolution . . . he has only to compare the introductory work of Professor Henslow with that of Smith, which although now almost forgotten, was, only a few years since, a standard book upon the subject in this country. . . . As a genuine view of the state of opinions upon physiological and structural botany up to the year 1836, we regard the work of Professor Henslow as a valuable addition to our introductory books. It embraces all that is most worthy of the student, briefly expressed in a clear methodical style, and, in general, with a just distinction between those modern speculations which are founded upon exact observations, and those which are mere creations of an inventive imagination."

Prony's Absorption Brake

Under the heading "Dynamometric Check", the *Mechanics' Magazine* of April 8 said: "A Committee of the French Institute, composed of Messrs. Arago, Dulong and Poncelet, has gone through a series of experiments on the 'dynometric (or power-measuring) check', an instrument invented by Prony, and lately improved by M. de Saint Leger, mining engineer at Rouen, for the purpose of measuring with accuracy the power of steam-engines and the quantity of fuel they consume. A large party of members of the Institute and Chamber of Deputies, of professors, engineers, etc., were present at the investigation. The object of the experiments was to ascertain the practical exactness of the apparatus, and for this purpose a steam engine of twelve horse-power of M. Pauweis's manufacture was made use of. The result appeared to be perfectly satisfactory and the scientific world now waits, with some interest, the report of the Committee of the Institute."

Baron de Prony (1755–1839) the inventor of the friction dynamometer, was distinguished both as a mathematician and engineer. He was trained under Perronet at the Ecole des Ponts et Chaussées and himself in 1799 became the director of the school. During the Revolution he directed the preparation of an enormous series of logarithmic tables computed to fourteen, nineteen and twenty-five places of decimals, and under Napoleon superintended the operations in connexion with the regulations of the waters of the River Po, and the draining of the Pontine Marshes.

Societies and Academies

Paris

Academy of Sciences, February 22 (*C.R.*, 204, 533–624).

Henri Lagatu and Louis Maume: The possibility of measuring separately, at any period of growth, the feeding effect and improving effect of an application of manure. The method is based on the analysis of a leaf removed from the plant at regular intervals.

Edouard Chatton and Mme. Simone Villeneuve: The division of the mouth and the formation of the peristome in *Cyclochæta astropectinis*. Their immediate genetic continuity.

René Garnier: Two classical theorems of conformal geometry.

D. Mangeron: Certain problems at the polygonal boundary not totally characteristic for a class of partial differential equations of higher order.

M. Luntz: Alternating thermoconvective vortices in a thin layer.

Douchan Avsec: Thermoconvective vortices in superposed layers.

Albert Toussaint and Simon Strijevsky: The envelope curves of the yield for the best propelling screws.

Svetopolk Pivko: The flow of air in the plane of rotation of a supporting helix.

René Retel: Supplying fuel to a motor with combustion at constant pressure.

Assène Datzeff: The passage of corpuscles through potential barriers.

Bernard Kwal: The classical dynamics of the electron. Theory of prime functions and the true moment of the electron.

Pierre Vernotte: The simultaneous determination of the specific heat and the thermal conductivity of insulators. Method of the signal.

Jean Terrien: Stimulation of the CuCl bands by fluorescence in the vapour of cuprous chloride.

FRED VLÈS and ERWIN HEINTZ : The interpretation of the infra-red spectrum of the proteins. The qualitative and quantitative recognition of the constituent amino acids in the spectra of the proteins is in accord with Fischer's theory of the peptide structure of the proteins : it also supports to some extent the diketopiperazic theory of Abderhalden. It appears to be opposed to the polycyclic theories, which assume a structure where the amino acids are not preformed in the protein molecule.

PAUL SOLEILLET : The passage of the Zeeman phenomenon to the Paschen-Back phenomenon of hyperfine structure in the polarization of resonance radiations.

PIERRE AUGER and MME. GRIVET MEYER : The secondary effects of cosmic rays in free air and in the subsoil.

NARCUS BRUTZCUS : Contributions to the thermochemistry of the hydrocarbons.

ALBERT MICHEL-LÉVY and HENRI MURAOUR : A series of photographs of phenomena accompanying the detonation of an explosive taken at intervals of 0·00001 sec. From earlier experiments, the authors had drawn the conclusion that the intense luminous phenomena caused by the detonation of explosives are caused by the action of the shock wave on the surrounding atmosphere and not to the explosion gases. This view is confirmed by the photographs now described and illustrated.

RENÉ PARIS and PAUL MONDAIN-MONVAL : The influence of small quantities of metallic oxides on the crystallization of zinc borate.

PIERRE DONZELOT and JEAN BARRIOL : The oscillations of the carbon chain of the benzene molecule.

MAURICE BONZEL : The disturbances brought about by cold hardening on the dilatometric diagram of metals.

ADRIEN PERRET and ALBERT BANDERET : The relations between cyanide, cyanamide and nitride in some elements of the rare earth group.

MAX GELOSO and MLLE. EVELINE GIORDANO-ORSINI : The precipitation of copper sulphate by soda.

MARC TIFFENAU and PAUL WEILL : The dehydration of divinylglycol by sulphuric acid Transposition of the hydrobenzoin type with migration of the vinyl radical. Divinylglycol, dehydrated with 50 per cent sulphuric acid, gives mainly vinylcrotonic aldehyde.

PAUL RUMPF : The synthesis of the aminosulphonic acids in the fatty series. Introduction to their electrochemical study.

EDMOND URION and ERNEST BAUM : The catalytic and acid dehydration of divinylglycol. The temperature of the dehydration appears to be the main factor determining the nature of the aldehyde produced by the action of catalysts.

B. MARTIN : Curves of dispersion of the reflective powers of some natural tellurides.

PAUL GAUBERT : The diffusion under the action of heat of the colouring material in crystals of artificially coloured phthalic acid.

LOUIS ROYER : The thermoluminescence of certain crystallophyllian. and eruptive rocks of Algeria.

PIERRE COMTE : The Cambrian and Silurian series of Léon (Spain).

GEORGES CHOUBERT : The geology of the middle Moulouya and the eastern end of the Haut-Atlas.

CHARLES BOIS : Comparison between the values of the focal depth of earthquakes determined by means of Wadati tables and those obtained by means of Brunner curves.

GUSTAVE NICOLAS and MLLE. BERTHE AGGÉRY : The persistance of chlorophyll as a result of bacterial action.

EMILE MICHEL-DURAND : The alteration of the nucleic compounds of plants in the course of their extraction in a trichloracetic medium. Experiments proving that contact with a cold 10 per cent solution of trichloracetic acid produces a notable alteration in the nucleic compounds of the tissues.

RENÉ MORQUER : Morphogenic researches and vital concurrence in the Hypocreaceæ growing on vines.

MAURICE DE CARAMAN and CHRISTIAN CHAMPY : The supposed sterility of the tiger lily (*Lilium tigrinum*) due to its triploid nature.

GUSTAVE MALÉCOT : Some consequences of Mendelian heredity.

LUCIEN BALOZET : The evolutive cycle of *Brachylæmus suis*.

Amsterdam

Royal Academy (*Proc.*, 40, No. 1; 1937).

F. M. JAEGER : Relative and absolute spatial configuration of isomorphous, optically active, complex salts of trivalent cobalt and rhodium. (1) Comparison of the triethylenediamine and tricyclohexanediamine salts.

F. M. JAEGER and L. BIJKERK : Investigations on complex salts of racemic and optically active cyclohexane-1-2-diamines with trivalent cobalt and rhodium. (1) Trans-cyclohexane-1-2-diamine and its fission into optically active antipodes.

J. BÖESEKEN and E. DE ROY VAN ZUYDEWIJN : Some properties of unsaturated sulphanes.

C. U. ARIENS KAPPERS : The spread of primitive humanity and its links with the more differentiated races as revealed by cephalic and cranial index curves.

P. J. HARINGHUIZEN and D. A. WAS : Investigation of thin layers of tin and other metals. (3) The interaction between metals and lubricating oils. Corrosion tests on copper, tin and lead in lubricating oils. The viscosity, surface tension and acidity of the oil are not influenced by reaction with the metal.

D. SCHEPEL : The number of lattice points on and in the neighbourhood of certain curves.

H. FREUDENTHAL : Manifolds and their representations.

N. ARONSZAJN : The lacunæ of a polyhedron and their relations to Betti's groups.

H. G. BUNGENBERG DE JONG and L. W. J. HOLLEMAN : Examples of stable unmixing in binary systems : salt and water. The bichromate of novocain in water shows the phenomenon of stable unmixing at 74° C. (co-existence of two liquid layers).

E. GORTER and L. MAASKANT : (1) The spreading of protamine insulinate. (2) The spreading of urease and Bence-Jones protein.

S. DE BOER and A. BROUWER : The action of medicines on auricular fibrillation. (2) The action of hydroquinidine, quinidinum purissimum, hydroquinine and quininum purissimum on auricular fibrillation.

I. M. KOLTHOFF : Ageing of fresh precipitates in contact with a liquid medium. The irreversible flocculation of colloids.

Sydney

Royal Society of New South Wales, December 2.

H. G. Raggatt: Probable late Silurian age of Serpentine, Condobolin-Trundle District, N.S.W. The dominant rocks of the Condobolin-Trundle district are cleaved argillaceous sediments which fossil evidence indicates are Silurian in age. Devonian rocks overlie the Silurian with marked unconformity. Serpentine and other basic rocks are found intruding the Silurian and cleaved in like degree. Pebbles of serpentine are found in basal Devonian (Middle to Upper) conglomerates. It seems probable, therefore, that the Serpentine was intruded during the late Silurian diastrophism.

R. G. Giovanelli: Energy distributions in the spectra of some gaseous discharge tubes. A spectroscope having been fitted with a wedge-shaped slit, the continuous spectrum was compared with black-body radiation, and found to have a colour temperature of about 5000° A. The energies in the lines were determined in terms of continua, and the total luminosities associated with the lines and continua compared.

H. Finnemore and D. K. Large: Cyanogenetic glucosides in Australian plants (6). *Goodia lotifolia*. An unstable cyanogenetic constituent. *Goodia lotifolia* Salisb. the so-called clover tree, yields in the fresh condition 0·14 per cent of hydrocyanic acid, corresponding to 0·86 per cent on the material dried at 100°. When dried in the air for two days, about 75 per cent of this was lost; the rate then slows down and after about a month only a trace is present. Museum specimens are therefore negative. Steaming for ten minutes removed more than 99 per cent of the acid present. The acetone extract on careful drying and washing with dry ethyl acetate yielded the glucoside of parahydroxybenzaldehyde, recognized after its hydrolysis with emulsin by its constituents and by the hydrolysis of its phenyl hydrazone. Associated with this glucoside was an unstable cyanogenetic material, possibly its cyanhydrin, which continuously gave off hydrocyanic acid, the richest sample contained 2·9 per cent, the whole of this being removed by ten minutes' steaming.

A. R. Penfold and F. R. Morrison: The occurrence of a number of varieties of *Eucalyptus radiata* (*E. numerosa*) as determined by chemical analyses of the essential oils (2). A tree planted from the seed of *Eucalyptus radiata*, Variety *A*, threw two stems from the one root system. The leaves and terminal branchlets were separately examined, when the essential oils were found to differ from one another not only in yield, but also in chemical composition. This provides definite confirmation of the contention that a species described as *Eucalyptus Lindleyana*, Variety *stenophylla* by W. F. Blakely in 1934 does not exist, for the evidence shows that *E. radiata* (*E. numerosa*) and Blakely's variety *stenophylla* have been found growing together on one and the same plant. This observation will exert a considerable influence not only on the economics of the eucalypts, but also upon the botanical classification of this important group of trees.

H. J. Hynes: Species of *Helminthosporium* and *Curvularia* associated with root-rot of wheat and other graminaceous plants. It is pointed out that seven distinct species of *Helminthosporium* have been isolated by various workers from foot-rot-affected wheat in different countries. Of these, three have been isolated and studied by the author from Australian material. The morphological characters of isolates of each of these species are discussed, and it is pointed out that as a result of K. B. Boedijn's new classification in which the small-spored species of *Helminthosporium* are included, the species *Helminthosporium M.* should now be designated as *Curvularia ramosa* (Bainier) Boedijn, and *H. tetramera* as *C. spicifera* (Bainier) Boedijn. The principal features of the new genus, *Curvularia*, are outlined.

Vienna

Academy of Sciences, December 17.

Frances G. Wick: Triboluminescence. Triboluminescence may be due to electrical discharges through the air around the crystal, or to radiation from centres in the crystal. These centres may be produced by X-rays, or they may be a characteristic of the crystal itself. In the latter case, they can be destroyed only by pulverizing the crystal.

Hanne Lauda: Decay of the latent image on the photographic plate. The decay of the latent image is greater at high temperatures, at high intensities of illumination, and for low densities.

Kasimir Graff: Colorimetric measurement of stars down to mag. 6·3 between 10° and 40° S. Decl.

S. Reisch: Galvanomagnetic method of measuring small displacements. The displacement is communicated to a coil of bismuth wire in a magnetic field, and the resulting change of resistance is measured.

G. Koller and H. Czerny: Limonin, the bitter principle of orange seeds.

Karl Federhofer: Normal vibrations of an axially compressed circular cylindrical shell.

K. Karas: Normal vibrations of non-uniform strings.

January 14.

F. Wessely and K. Jentzsch: Bitter principle of Columbo wood (5). Methylation of columbin.

Julius Pia: Tectonics of the Prague Dolomites (South Tyrol).

Alfred Jelinek: (1) Mechanics of periodic mountain winds. (2) Production of periodic mountain winds by thermal fluctuations.

A. Burger and E. Ekhart: Daily circulation of the atmosphere in Alpine regions.

Josef Priebsch and H. Kramer: Effect of temperature on cosmic rays. Observations at Hafelekar (2,300 m. above sea-level) with an unscreened Steinke apparatus show that there is a temperature effect with even the softest cosmic rays. The sign of the correlation coefficient, however, changes during the course of the year, being positive in summer and negative in winter. Observations with a screened apparatus give a negative correlation coefficient throughout the year.

F. Heritsch: Rugose corals from Timor, Djoulfa and the Salt Range, with notes on the stratigraphy of the Permian.

January 21.

Georg Koller and Hertha Russ: Constitution of solorinic acid.

K. W. F. Kohlrausch and R. Skrabal: Studies of the Raman effect (64). Cyclopentane and cyclobutane carboxylic acids and their derivatives.

Franz Bukatsch: Influence of the thermal waters of Bad-Gastein on the assimilation of carbonic acid by various water plants.

Herbert Haberlandt: Luminescence of fluorites and other minerals (3).

Emil Hauck: Cranial form of the coyote (*Canis latrans*).

Forthcoming Events

Monday, April 5

VICTORIA INSTITUTE, at 4.30.—Dr. E. W. G. Masterman: "The Dead Sea and the Lost Cities of the Plain".

SOCIETY OF ENGINEERS, at 6.—Inaugural Meeting. B. B. Tarring: Presidential Address.

Wednesday, April 7

INSTITUTION OF HEATING AND VENTILATING ENGINEERS, at 7—(at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Dr. W. F. Bewley and E. S. Shoults: "Some Problems in the Heating and Ventilation of Glasshouses".

Thursday, April 8

ROYAL ASIATIC SOCIETY, at 4.30—(at the Royal Geographical Society).—Dr. Ernest Mackay: "Further Excavations in the Indus Valley".

Friday, April 9

OIL AND COLOUR CHEMISTS' ASSOCIATION, at 7—(at the Manchester Ltd. Restaurant, Cross Street, Manchester).—Annual General Meeting.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR SCIENTIFIC OFFICER (physical chemistry) at the Torry Research Station—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S W.1 (April 13).

HEAD OF THE ENGINEERING DEPARTMENT in the Hull Municipal Technical College—The Director of Education, Education Offices, Guildhall, Hull (April 17).

ASSISTANT (Grade III) in the Air Defence Experimental Establishment, Biggin Hill, Kent—The Superintendent (April 17).

LECTURER IN MATHEMATICS in University College, Dundee—The Secretary, The University, St. Andrews (April 30).

PROFESSOR OF GEOLOGY in the University of Bristol—The Registrar (May 1).

TWO ASSISTANT LECTURERS IN MATHEMATICS in the Royal Holloway College, Englefield Green, Surrey—The Principal (May 1).

RESEARCH ASSISTANT IN FRUIT PRODUCTS at Long Ashton Research Station—The Registrar, The University, Bristol.

ASSISTANT (Grade II) in the Royal Airship Works, Cardington—The Superintendent (April 9) (quote Ref. B.351).

Official Publications Received

Great Britain and Ireland

Empire Economic Union. The British Colonial Empire and the German Claim. Pp. 33. (London: Empire Economic Union.) 6d [83

University of Oxford: Bureau of Animal Population. Annual Report, 1935–36 Pp. 48. (Oxford: University of Oxford.) [83

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1935. Vol 70, Part 2: Prices and Supplies of Agricultural Produce and Requirements in England and Wales. Pp. ii+103–191. (London: H M. Stationery Office.) 1s. 6d. net. [93

Mui Tsai in Hong Kong and Malaya. Report of Commission (Colonial No. 125.) Pp. ix+314. (London: H.M. Stationery Office.) 5s. net. [93

Memorandum presented by ULAWS to the Select Committee on Agriculture (Damage by Rabbits) of the House of Lords, with Selected Supporting Statements. Pp. 32. (London: University of London Animal Welfare Society.) 1s. [103

National Institute of Agricultural Botany Seventeenth Report and Accounts, 1935–36. Pp. 29. (Cambridge. National Institute of Agricultural Botany.) [113

Society of Chemical Industry. Chemical Engineering Group. Proceedings, Vol. 18, 1936. Pp. 172. (London. Chemical Engineering Group.) 21s. [123

Philosophical Transactions of the Royal Society of London. Series B, No 542: On the Nervous System of the Starfish *Marthasterias glacialis* (L.). By J. E. Smith. Pp. 111–173 (London: Harrison and Sons, Ltd.) [123

Fourth Annual Report of the New Commonwealth Society and Institute, 1935–1936. Pp. 80. (London: New Commonwealth Society.) [153

Reports of the Progress of Applied Chemistry. Vol. 21, 1936. Pp. 875. (London: Society of Chemical Society.) [163

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1936, presented to the Annual Meeting, February 8th, 1937. Pp. 48+7+8 plates. (York. Yorkshire Museum) [173

Researches published from the Wards and Laboratories of the London Hospital during 1936. Pp. iii+20 papers. (London: H. K Lewis and Co., Ltd.) 7s. 6d net. [173

Other Countries

Bulletins of Indian Industrial Research. No. 5. Improved Reflex-Copying By N. Kasinathan. Pp. iv+7. (Delhi: Manager of Publications.) 4 annas; 5d. [83

Nigeria. Report on the Forest Administration of Nigeria, 1935. Pp 30 (Lagos: Government Printer; London: Crown Agents for the Colonies.) 2s 6d [93

U.S. Department of Agriculture. Technical Bulletin No 556: Soil Conservation Reconnaissance Survey of the Southern Great Plains Wind-Erosion Area. By Arthur H. Joel Pp. 68+14 plates. (Washington, D C.: Government Printing Office.) 25 cents. [103

Jamaica. Annual Report of the Department of Science and Agriculture for the Year ended 31st December 1935 Pp. ii+91+iv. (Jamaica: Government Printing Office.) [103

Koninklijk Nederlandsch Meteorologisch Instituut No. 102, Mededeelingen en Verhandelingen 39: Het Klimaat van Nederland. E Verdamping. Door Dr. C. Braak. Pp. 50. 0 40 fl. No. 106a, Ergebnisse aerologischer Beobachtungen, 24, 1935. Pp. iv+40. 1 50 fl. No. 108, Seismische Registrierungen in De Bilt, 22, 1934. Pp. viii+156. 0.70 fl. No. 115: Oceanographische en meteorologische Waarnemingen in de Chineesche Zeeën en in het Westelijk Deel van den Noord Stillen Oceaan. 2: Maandkaarten voor Juli–December (1910–1930) Pp. 48. 7 50 fl. ('s-Gravenhage: Rijksuitgeverij.) [113

Bernice P. Bishop Museum Occasional Papers. Vol. 12, No. 4: Check List of Pacific Pycidæ. By Richard Kleine. Pp. 8. Vol. 12, No. 5. New Species of Hawaiian Panicum and Eragrostis. By Leo D. Whitney and Edward Y. Hosaka. Pp. 6. Vol 12, No. 6: Check List of the Cicindelidæ of Oceania. By Walther Horn. Pp. 12. Vol. 12, No. 7: Transfer of the Papuan Gouldia to the Genus Psychotria. By Harold St. John. Pp. 4 Vol. 12, No. 8: A Revision of the Hawaiian Species of Labordia described by H. Baillon. By Harold St. John (Hawaiian Plant Studies, 4.) Pp. 12. Vol. 12, No. 9: New Species of Portulaca from South eastern Polynesia. By Karl von Poellnitz. Pp. 6. Vol. 12, No. 10: The Ampagioid Weevils of Southeastern Polynesia (Coleoptera, Curculionidæ). By Elwood C. Zimmerman Pp. 38. Vol. 12, No. 11: Cladocera of Mauna Kea, Hawaii By Masuzo Ueno. Pp. 10. Vol. 12, No. 12: Termites of Southeastern Polynesia By S. F. Light and Elwood C. Zimmerman. Pp. 12. Vol. 12, No. 13: Geology of Lehua and Kaula Islands. By Harold S Palmer. Pp. 36. Vol 12, No. 14: The Staphylinidæ (Coleoptera) of the Mangarevan Expedition. By Malcolm Cameron. Pp. 10. Vol. 12, No. 15: Miscellaneous Hawaiian Plant Notes, 1. By F. Raymond Fosberg. Pp. 12. Vol. 12, No. 16: The Hawaiian Geraniums. By F. Raymond Fosberg. Pp. 20. Vol. 12, No. 17: Cryptorrhynchinæ of the Austral Islands (Coleoptera, Curculionidæ) By Elwood C. Zimmerman. Pp. 20. Vol. 12, No. 18: Ants from the Society, Austral, Tuamotu and Mangareva Islands. By William Morton Wheeler. Pp. 18. Vol 12, No. 19: Some Compositæ of Southeastern Polynesia (Bidens, Coreopsis, Cosmos and Oparanthus). By Earl Edward Sherff. Pp. 20. Vol. 12, No. 20: Cryptorrhynchinæ of Henderson, Pitcairn and Mangareva Islands (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 8. Vol. 12, No. 21: A Cryptorrhynchid from Maroturi (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 4. Vol. 12, No. 22. Orochlesis of Fiji (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 10. Vol. 12, No. 23. Cryptorrhynchinæ of the Society Islands (Coleoptera, Curculionidæ). By Elwood C. Zimmerman Pp. 48 Vol. 12, No. 24: Vegetation of Flint Island, Central Pacific. By Harold St. John and F. Raymond Fosberg. Pp. 4. Bulletin 141 Fijian Plant Studies. By Albert C. Smith. Pp. ii+168. (Honolulu: Bernice P. Bishop Museum.) [123

Memoirs of the Indian Museum. Vol 11, No. 4: Diplopoda of India. By C. Attems. Pp. 133–323 (Calcutta: Zoological Survey of India) 5.14 rupees; 9s. 6d. [153

Canada Department of Mines and Resources Mines and Geology Branch, Bureau of Geology and Topography: Geological Survey. Memoir 204 Gold-Bearing Deposits on the West Coast of Vancouver Island between Esperanza Inlet and Alberni Canal By M. F. Bancroft. (No. 2432.) Pp. ii+34. (Ottawa: King's Printer.) 25 cents [153

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1936 (No. 2423.) Pp. iii+54. (Ottawa: King's Printer.) 25 cents. [153

Catalogues, etc.

pH Cambridge Recorders and Electrode Systems. (Folder No 56.) Pp. 6. (London. Cambridge Instrument Co., Ltd.)

Moll Recording Microphotometers. (MF 37.) Pp. 12. (Delft: P. J. Kipp and Zonen.)

A Catalogue of Rare and Valuable Books. (Catalogue No. 609.) Pp. 68. (London: Francis Edwards, Ltd.)

Wild-Barfield Heat-Treatment Journal. Vol. 2, No. 12, March. Pp. 45–58+iv+4 plates. (London: Wild-Barfield Electric Furnaces, Ltd.)

Nickel, W.11: The Extraction of Nickel, with Special Reference to the Mond Process of Nickel Refining. Pp. 16. (London: Mond Nickel Co., Ltd.)

Soviet Russia Travel Handbook for 1937. Pp. 32. Visit the Soviet Union. Pp. 36. (London: Intourist, Ltd.)

A Catalogue of Books on Early Medicine and Surgery. (No. 531.) Pp. 44. (London: Bernard Quaritch, Ltd)

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No. 3519 SATURDAY, APRIL 10, 1937 Vol. 139

University College of Science Physics Dept. 92, Upper Circular Rd, Calcutta

Science and Politics in India: a Contrast

FROM year to year the Indian Science Congress, like the annual gatherings of the British Association, presents to the public both in and outside scientific circles a survey of recent contributions, chiefly by its own nationals, to the general stream of progress in scientific research and intellectual development. How far this is borne out by the proceedings of the recent Congress held at Hyderabad may be judged, in part, from the summaries of the presidential address and of the addresses of the sectional presidents which appear in another part of this issue of NATURE (see p. 638).

It is the privilege, as well as the responsibility, of certain of the sciences that they should bear more directly than others upon human well-being; and while it may be admitted that a too narrow concentration upon an immediately practical issue cannot but be harmful in the long run, in world conditions as they have now existed for some few years past, the activities of men of science have tended more and more to be submitted to the touchstone of their contact with current realities. Without in any degree abrogating the supremacy of the pursuit of knowledge for its own sake, it is more insistently and more constantly demanded that, as science in its origin arose out of practice, so as a return for the place now conceded it in the organization of modern life, it should contribute guidance in the diagnosis and solution of the problems of society.

Obvious as these reflections may seem, when applied to the conditions of European society, on turning to the consideration of conditions in India, they convey a warning and a moral. In contrasting, as is inevitable, the academic atmosphere of the Science Congress with that of the political arena, it is difficult to feel that the advantage in grasp of reality does not lie with the former.

The inauguration of the constitution followed on popular elections of a magnitude unprecedented, which gave a majority in six out of the eleven autonomous provinces, into which British India is now divided, to the Congress party. This sweeping victory, for it is nothing less, has been attributed to organization. This party alone, working on lines somewhat similar to those of a British election, was able to put directly before the rural elector the policy of reform and social amelioration which it proposed to pursue. When, however, the victorious party was brought to the practical test, it would seem, in the eyes of most reasonable individuals, to have proceeded to stultify itself by refusing to accept office in those provinces in which the electoral results had laid that responsibility upon it. The patent division of opinion on the wisdom of the course followed as between the leaders of the party and the general body of the Indian Congress, whatever attempts may be made to obliterate it later, gives to the whole situation an air of unreality, which unfortunately tends to confirm the view that with many, though not perhaps with all, the policy of agrarian reform, which has been so widely paraded, is no more than a pawn in the game.

The need for reform in India, and more especially agrarian reform, is so great and so insistent, that eventually, when once the elector has grasped the relation of his vote to political power and social reform, that power will be placed continuously and consistently in the hands of those who are able to give a practical demonstration of their grasp of what has been termed here the realities of the situation. At present, it is anticipated that Congress will attempt to throw upon the Government the onus of its failure to carry out its policy of social amelioration. In the recent election, many of the voters, it is stated, have suffered from the delusion that in voting for Congress they cast their vote against the Government. As was once said on another continent, "You cannot fool all the people all the time". The sincerity of Congress will be put to a severe test, if and when measures of reform are put forward by the coalition Governments set up in those six provinces where the Congress party is in the majority, and must needs vote for or against such measures of reform.

In the atmosphere of intrigue and legalistic argument which has followed the appointed day, it is something of a relief to turn once more to the findings of science and to enter upon the realm of fact. A rapid glance through the reports of the Indian Science Congress addresses now available will show how far the various branches of science, as studied in India and represented in these addresses, for the most part in the nature of general surveys, are alive to the vital problems of the population, of which the speakers themselves form part. It is indeed the vastness of this population which makes it essential that scientific methods of study should be applied to its problems. It has been pointed out on many occasions that even the functions of Government in India, now in the hands of the natives of India themselves, cannot be carried out efficiently without the knowledge of the varied racial and cultural discriminations revealed by anthropological studies.

To some extent provision for this has been made by the reservation of areas mainly inhabited by aboriginal or jungle tribes for the administration of the Governor; but the knowledge which must temper administration of the jungle tribes, must equally inform the whole of agrarian reform. No form of life is so impatient of change, so conservative, as the agricultural; and as Dr. Venkatraman pointed out in his presidential address, which deserves the careful attention of all who are interested in the future of India, there are few individuals throughout the whole of that sub-continent who are not affected more or less directly by the life and well-being of the Indian village. How vital the effect of the condition of the Indian village and the village agriculturist may be on the future of this great country is foreshadowed by the president of the Agricultural Section, when he points out that India at present produces two thirds only of the food-stuffs it requires. It is perhaps no rash prophecy to suggest that the future of India rests not with the party which shows itself most adroit and subtle in manipulating the political machine, but with that body of opinion which is most ready to accept the findings of science and to adapt them to the needs of the people in the amelioration of social and material conditions.

Air Raid Precautions

The Protection of the Public from Aerial Attack a Critical Examination of the Recommendations put forward by the Air Raid Precautions Department of the Home Office. By the Cambridge Scientists' Anti-War Group. Pp. 127. (London: Victor Gollancz, Ltd., 1937.) 2*s*. 6*d*. net.

IN this book, the authors—a group of anti-war scientists at Cambridge—have published a slashing attack on the recommendations put forward by the Air Raid Precautions Department of the Home Office for the protection of the public, and they offer scientific evidence to show that these measures are entirely inadequate.

The chief criticisms made in the book are as follows:

(1) 'Gas-proof' rooms prepared according to the instructions given in the Air Raid Precautions handbooks are not gas-tight; and the results of the tests that were made by the authors show that, assuming the air outside contains enough mustard gas to kill a man in an hour, it would penetrate such rooms in sufficient concentration to kill him in three hours. Besides, millions of people live in such conditions that they are unable to set aside a room as a gas shelter.

(2) A privately manufactured gas mask costing 17*s*. 6*d*. (not the type which the Government proposes to issue) was tested, and although it was found to be fairly satisfactory, the complaint is made that no mask can give complete protection against mustard gas because the latter affects the whole surface of the body.

(3) Incendiary bombs would be used in such numbers that the present fire brigade system would be inadequate to deal with the resulting fires.

(4) No protection for children under five years of age has yet been proposed.

Some of these criticisms seem to have been premature, for immediately after the publication of the book the Government announced its intention of organizing a fire-fighting force of 200,000 men, as well as auxiliary fire stations; and it also stated that a number of possibilities for the protection of young children against gas were being examined.

It is not clear why a privately manufactured gas mask was put through tests: this can scarcely have been in order to prove the ineffectiveness of the Government pattern; and to point out that no mask can give protection to the whole surface of the body from mustard gas vapour was surely unnecessary. No one, of course, would expect it to do so, any more than he would expect a bowler hat to keep his feet dry on a wet day. The recommendations made to meet the danger from mustard gas are to keep under cover so as to avoid direct contamination from the liquid sprayed from the air, and to remain in a home shelter, made as gas-proof as the circumstances permit, until the danger is over. What more can be expected? It would, of course, be possible to issue a complete suit of oilskins to every member of the public and to exchange them for clean ones whenever contamination was suspected; but this is a procedure which would not be regarded as reasonable or practicable by ordinary men.

It is true that in many of the poorer homes completely gas-proof shelters can only be provided with great difficulty; but that is no reason why the remainder should not be protected, or why the attempt should not be made to carry out the instructions so far as possible. The degree of protection can be increased in every case, whatever the circumstances, and it is not necessary to 'set aside' a room for the purpose, as anyone can see for himself by visiting the specimen gas-proof room at No. 17 Aldermanbury, E.C.

However, it is the results of the authors' experiments on the gas-proof rooms which I think will cause chief surprise and public interest. In the tests made, four rooms were 'sealed' in the manner recommended by the Home Office, and carbon dioxide gas was released in quantities calculated to produce concentrations of 5 per cent in each one; and it was found by measurement that half the gas had leaked out in 2¼, 2¼, 3¼ and 9¼ hours respectively. The authors conclude, but not by direct experiment with the same gas, that leakages into the room from outside would take place at the same rate, and that it occurs in little streams of air blowing to and fro in the small holes and tiny cracks in the plaster, bricks, doors, etc.

Theoretically, of course, gas can penetrate almost any material, but experiments showing the rate of leakage *from the open air into a gas-proof room* would have been of far greater interest to everybody who takes an interest in air raid precautions.

When questioned in the House of Commons about these remarkable results, the Government spokesman, after consulting his own scientific advisers, stated that the experiments themselves depended on academic assumptions, and that the deductions made from them had been interpreted on purely theoretical lines and had been proved to be open to grave criticisms. He went on to say that the experiments on which the Government recommendations were based had been conducted with actual war gases liberated under practical conditions, and with particular regard to the circumstances in which gas can be discharged from aircraft, and the measures proposed would be effective in affording a very great measure of protection to the public. He might have added that his own scientific advisers were the same men who had carried out thousands of experiments with poison gases during the Great War and had been engaged on chemical defence problems ever since. I have no connexion whatever with the Air Raid Precautions Department of the Home Office and am not concerned in its defence; but I am being consulted by numbers of business concerns who desire to organize their air raid precautions on the lines recommended by the Home Office: I believe that the recommendations are generally sound and reasonable, and it is important that public confidence in these measures shall not be shaken unnecessarily.

Many readers of NATURE will recollect the steps that were taken during the Great War to safeguard the shelters in the forward areas against gas: gas attacks were a daily experience, especially during the later stages of the War, and every shelter and dugout in the forward area was 'gas-proofed' precisely in the manner recommended by the Home Office—that is, by stopping cracks, hanging up curtains, providing 'air locks', and so on; and these measures were proved to be so effective in actual practice by all the armies engaged that in planning gas attacks with shells, clouds from cylinders, or projector and trench mortar bombs, no attempt was made to employ tactics designed to penetrate the protection thus afforded. (The group of Cambridge scientists would perhaps suggest that a still greater degree of safety could have been obtained by stopping the war altogether.) The victims of gas attacks were for the most part men who were caught unawares, or were compelled by the nature of their duties to remain out in the open; and this would also be the experience of civil populations subjected to aerial gas bombardment. Some of our dense gas clouds penetrated far behind the German front line, but because of the precautions adopted we never heard of civilians suffering serious inconvenience on account of them. For example, vegetation in the gardens of Lille was often bleached by our gas, but the inhabitants were warned of its approach by the ringing of bells, and they took refuge in the top rooms of their houses and closed all the windows and doors. Nor did these gas attacks cause them sufficient discomfort to create resentment: the wife of the mayor of one of these towns, after its reoccupation by the British army, told us that she had always had German officers billeted on her and that they feared gas more than anything else: "Give them gas all the time," she said, "and then more gas."

The authors of this book in their destructive criticism seem to ignore the fact that some degree of protection is better than none, and their conclusions would carry greater conviction to the ordinary man in the street but for the suspicion that scientific theories may sometimes be perverted for political ends.

As one who has had, perhaps, more experience of the stark realities of gas warfare than anyone else, and has studied the reports of thousands of field tests carried out by British, French and American gas experimenters as well as witnessed many of the tests personally, I do not believe that anything approaching a concentration of 5 per cent of gas can be established in the open air by an aerial or any other kind of bombardment. Such a bombardment, to have any appreciable success, would have to be sustained and systematic, and I cannot believe that it could continue for a period of three hours over, say, London without interference. Anything less would be ineffective except in the most exceptional atmospheric conditions: in comparatively open spaces, such as the neighbourhood of Imperial Chemical House, gas would drift away and be dissipated at a rate varying with the prevailing air currents; while in circumstances most favourable to it, say, in the City, with its tall buildings and narrow courts and lanes, the dispersion of gas clouds by movements of the air would be delayed, but most of the blocks here are well provided with basements and strong-rooms which are shelters within a shelter, so that even if all the windows were shattered, gas in any harmful quantity could be excluded by gas-proofing the staircases and lift shafts and by providing air-locks in the manner recommended. As for gas penetrating brick and concrete walls from the open air outside, this is no doubt theoretically possible, but in my own shelter, provided that the sealing is carefully carried out, I would be content with a good strong wall-paper—let alone the brick wall to which it is attached.

This book can do nothing but harm. It suggests no better defensive measures than those recommended by the Home Office, while it is calculated to destroy confidence in them and to create panic. Nor can it have the slightest effect in stopping war: there is probably no reasonable individual in Great Britain who would be willing to make war at the present moment, except in the case of absolute necessity imposed upon us by the 'mad dogs' of Europe; and if that necessity should arise, let us hope that we will not be deterred from our duty to ourselves and to posterity by contemplating its horrors—still less by exaggerating them.

C. H. Foulkes.

Maps through the Ages

The World in Maps:
a Study in Map Evolution. By Prof. W. W. Jervis. Pp. 208+4 maps. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1936.) 7*s.* 6*d.* net.

DESPITE the increasing interest in maps now manifest, no one in Great Britain has yet undertaken a really comprehensive work on all sides of the subject, such as was attempted in Germany some years ago by Max Eckert. The present modest effort makes no pretence of filling the gap, its aim being rather to provide the intelligent layman with a general introduction to the subject. Apart from the width of the survey, it does not go greatly beyond previous attempts of a popular kind, and it, of course, has no claim to vie with the excellent books on the technical side of map-making now available.

The arrangement of the book shows some lack of system. It begins with chapters on practical matters, such as the indication of scale and direction, projections, topography and relief, with an attempt to trace the evolution of method from early times. Then follow two chapters on the maps and map-makers of medieval and early modern times, while the last part is concerned with requirements and methods of map-production at the present day, including a chapter on national map departments. The historical side of the subject is kept prominently in view through most of the book, and it is perhaps permissible to deal chiefly with this in the following comments.

The author certainly displays a fairly wide acquaintance with the maps and methods of the past; but he is too often betrayed into statements which show that his knowledge is but superficial, and that he has imperfectly digested what he has taken from other writers. Also he has missed some of the more important authorities on certain points; for example, his perfunctory treatment of the history of the prime meridian takes no account of Mr. W. G. Perrin's excellent summary of the subject. In places he seems to have reproduced the jottings of his note-book with little attempt at arrangement or revision. Thus in Chapter viii there are two inconsistent references, separated by a few pages, to Christopher Saxton's large map of England, one passage having evidently been written before, the other after, the acquisition by the British Museum of a unique early copy. A good many statements are misleading, to say the least, and the following instances are but a few out of many. It is scarcely true that Münster's maps were standard for a century; that Mercator invented the Southern Continent; or that Blome was a publisher "of very high repute". On reading that Moses Pitt's English Atlas was a "good attempt to rival Dutch Cartography", one would scarcely realize that the actual basis was entirely Dutch. Instances of slipshod language abound. We find Portolani, Reinels treated as singular, Mappa Mundi as plural, and there are many misspellings of names—Duningsby for Dunningley, Wauermann for Wauwermans, Zugler for Ziegler, Philpott for Phillott, and others. The chronological list of maps makes an imposing show, but it contains many errors, including the astonishing statement that the Rome map of the British Isles of 1546 was "made by Speed"—then unborn. Both in this list and the extensive bibliography, better judgment might have been shown in selecting the entries.

The chapters on modern map-making are not perhaps open to such serious criticism, and the views expressed seem generally judicious, as when the advantage of the 'dot' system to represent distributions is stressed. This part may be of use to those desiring a general view of the subject without going deeply into it.

One can only regret that the author should have been so hasty in publishing his notes, for he would no doubt be capable of better things with further study and more care to verify his references. The publishers have added a series of outline sketches of early maps, mostly taken from previous publications of the firm, and not linked to the text by any commentary. E. HEAWOOD.

Probability: Theory and Applications

Elements of Probability
By Prof. H. Levy and L. Roth. Pp. x + 200. (Oxford, Clarendon Press; London: Oxford University Press, 1936). 15*s*. net.

THIS is an interesting book. Its main interest lies in the endeavour of the authors to keep throughout a clear distinction between three different fields of study, all in some way interrelated and each forming a partial approach to the general problem of probability: (1) a mathematical theory (the authors add, "of arrangements" which I should prefer to omit), (2) the frequency of actual occurrences of an event in repeated trials and (3) the psychological expectation of a participant. The authors are primarily interested in (1), and assume the definition of mathematical probability as follows:

"If there is a group of N letters consisting of n letters a_1, n_2 letters a_2, ... and n_r letters a_r, the probability of a letter specified as belonging to the class $a_1, a_2, \ldots a_r$ being a letter a_s is n_s/N."

In other words, the probability of an object A, possessing a property B, is defined as the proportion of those objects A which actually possess the property B.

I am not exactly clear about the opinions of the authors given on pp. 22–23. One way of interpreting them is that it is impossible to build up a mathematical theory of probability both rigorous and useful, starting with some conveniently formulated axioms forming a mathematical model of what is known or assumed about the processes of mind, connected with expectation. If the authors mean to affirm this, I cannot share their opinion.

Practical applications of the theory of probability built up on the above definition require the construction of a mathematical model of the practical situation studied, involving a class of objects subdivided into several sub-classes.

The definition quoted is, of course, not new. It is adopted in many recent publications and is taught in many lecture theatres. But usually it is soon forgotten and the succeeding development of the theory is carried out in terms of 'experiments', 'frequencies', etc. It is true that such expressions, having no immediate relation to the definition, stand for something else, reducible to this definition. However, the process of reduction is not so easy as one may imagine, and the student is frequently led to a confusion of (1) with (3) or with (2) respectively.

It may be useful to illustrate this point. Suppose that a bag A contains three balls, one with 1 and two with 2 written on them. Besides the bag A there are two more bags, one distinguished by the number 1 and the other by 2. The bag 1 contains five balls, of which one only is black. The bag 2 contains seven balls of which exactly four are black. We perform an experiment consisting in two drawings of balls. First we draw a ball from the bag A, next we draw a ball either from bag 1 or from bag 2, according to what was the number on the ball drawn from A. The question asked is, What is the probability of ultimately drawing a black ball? If this problem were given to an average undergraduate, he would probably immediately produce the correct answer, 47/105. If he started his studies in probability with a definition similar to that given by the authors, he would agree that this number represents the "proportion of things A having the required property B". But if the definition in terms of the proportion was not followed by a special training in distinguishing between (1), (2) and (3), he would find difficulty in explaining what exactly are these "things A", what may be their total number and what is their "property B". Confronted with these questions, the student would be surprised to discover that he was not clear about the whole problem which seemed to be so simple. It is this surprise, contrasted with the quiet attitude to the obtained result 47/105, which indicates that in the process of reaching it, the student had in his mind not the definition of probability assumed, but some more or less vague ideas concerning frequencies or psychological expectation: the confusion of (1) with (2) or (3) which the authors try to help to avoid.

The book under review is very valuable because the authors consistently apply the definition quoted so as to accustom the reader to the basic idea involved. They go so far as to reword the usual theorems of summation and multiplication of probabilities, Bernoulli's Theorem, etc., constantly referring to the idea of proportion. However, the usual wording, in terms of experiments, has become customary partly because of its convenience. Therefore, after training the reader for a period, the authors return to the traditional terminology, pointing out that this should be accepted as a convention.

It is difficult to say whether the new wording of usual theorems introduced by the authors is a success. I personally use the definition adopted by the authors, and I recognize the necessity of rewording the theorems, but I use another way of speaking, in terms of "things A" and their "properties B". Which of the two is more convenient is probably a question of taste, but it may be useful to give an example. The multiplication theorem as given by the authors, reads:

"If P_1 is the probability that an object belongs to the sub-class a_1 of classes $a_1, a_2, \ldots . a_r$ and P_1, is the probability of its belonging to the sub-class A_1, of the classes $A_1, A_2, \ldots . A_s$ (which are exclusive to $a_1, a_2, \ldots, a_r$), then the probability that it belongs to the combined class a_1A_1, is p_1P_1."

It seems to me that the following statement is somewhat simpler:

"The probability, $P\{BC/A\}$, that an object A possesses the two properties B and C is equal to the probability, $P\{B/A\}$, that it possesses the property B, multiplied by the probability $P\{C/AB\}$ that an object A which possesses the property B possesses also the property C."

Incidentally, this wording makes it easy to introduce the conception of stochastic dependence which is somewhat neglected by the authors.

The original definition, applicable in cases when the set of objects considered is finite, is later extended to cover the case of continuity. The obvious method of extention in terms of the measure of the sets of points has not been adopted by the authors, probably because of the elementary character of the book.

Two long chapters are given to the theory of arrangements. In another two chapters, occupying altogether 100 pages, the authors discuss various problems relating to statistics. One of these, concerning selective sampling (pp. 146–165), seems to deserve special attention of the reader. Throughout the book, there are many interesting examples and illustrations.

I have noticed a few minor lapses. Thus, for example, after having shown accurately that the variance of the binomial is npq, the authors describe (page 142) the expression $\sqrt{npq}$ as the mean value of $|r-np|$, which is, of course, not exact.

In conclusion, I should like to mention a short but very interesting historical introduction, preceding the main part of the book. It brings out how all aspects of probability are historically interlocked in scientific method and social practice, and so presents a united background against which the various partial analyses can be appraised.

J. NEYMAN

Faune de France

30: Cestodes. Par Prof. Ch. Joyeux et Dr. J. G. Baer. (Fédération française des Sociétés de Sciences naturelles: Office central de faunistique.) Pp. iii+613. (Paris: Paul Lechevalier et fils, 1936.) 200 francs.

TAPEWORMS are psychologically nasty animals, but they are relieved by attractive life-histories. The elongated worm with its many segments lives in the gut of vertebrates and breaks off its hind divisions (proglottides), passing them out with the fæces of the host. These are full of ripe eggs which are shed on to the ground or into the water. Then comes along some animal which swallows them. Reaching its stomach, they bore through its wall to rest as rounded bladder worms (cysticerci) in its body, where they may swell up forming cysts of fluid, into which may project one or more heads. They, if eaten by their first host, attach themselves by their heads to its gut wall and bud off segments to form elongated tapeworms, which in turn repeat the life-cycle. Occasionally one host serves for both worm and cysticercus; many have both stages in vertebrates, but probably the majority have their cyst stage in some invertebrate, species being enumerated in jelly-fish, worms, crustaceans, insects and molluscs.

Settled rules as to these and other biological matters will be sought in vain in this catalogue of more than 2,000 species, for the life-histories of many are unknown, and this number probably does not represent half the species found in France. Clearly allied species of vertebrates commonly have the same tapeworms; but this may well be a question of similarity of food, since quite distantly related animals feeding on the same food often have the same worms. We might like to think of the evolution of the worms and of their hosts going on together, but, while encouraged by the unsegmented and presumably primitive *Gyrocotyle* and *Amphilina* being restricted to *Chimaera* and the sturgeon, this does not seem to be the case. *Gyrocotyle*, anyhow, is exceptional, as it is often found in the mud frequented by *Chimaera*.

In any event, this monograph, when studied, suggests all kinds of problems, both physiological and evolutionary, and should be in the reference library of every zoological and medical department. It is illustrated by 569 most useful line illustrations and gives all the necessary data both as to the parasites and their hosts.

Beiträge zur Mineralogie von Japan

Begründet von T. Wada. Neue Folge, 1. Herausgegeben von T. Ito. Pp. vii+xviii+259. (Tokyo: Imperial University, 1935.)

NOT a great deal has been written about the minerals of Japan. The earliest information about them is contained in the treatise written by the late Prof. T. Wada, of which an English translation by T. Ogawa appeared in 1904. A second edition followed, but only in Japanese. Inasmuch as supplements speedily became necessary in order to keep the information up to date, Prof. Wada began in 1905 a series, under the general title of "Beiträge zur Mineralogie von Japan", which was to consist of original papers on Japanese minerals written in either German or English; the latter language, however, was invariably selected by the contributors. The series came to an end in 1915, and Prof. Wada died in 1920.

The present volume is intended by the author, the director of the Mineralogical Institute of the Imperial University of Tokyo, to be the first of a new series of contributions, which ultimately will be used in the preparation of the third edition of Prof. Wada's treatise. Despite its German title, the text is in Japanese, but there is a good summary in English, and throughout the text ordinary letters and numerals are used to denote the crystal faces, so that the reader need not know Japanese to cull information from the pages. The volume is dedicated to the memory of the late N. Fukuchi, who was lecturer in mineralogy at the Imperial University, and did much work on Japanese minerals; his portrait forms the frontispiece.

The volume comprises seventy-six original contributions, together with an introduction descriptive of the two-circle method of measuring crystals and denoting the positions of their faces. There are two indexes: in Japanese with English equivalent, and vice versa. The summary is provided with its own pagination and index. A map showing the localities mentioned adds greatly to the value of the volume.

Les rites secrets des primitifs de l'Oubangui

Par A.-M. Vergiat. (Bibliothèque scientifique.) Pp. 212+32 plates. (Paris: Libr. Payot, 1936.) 25 francs.

M. VERGIAT, an experienced observer and skilled recorder with the camera of native life and custom in more than one part of Africa, has taken advantage of the opportunity afforded by a botanical excursion to the French Congo to investigate the esoteric beliefs and rites of the tribes of the region. More fortunate than most Europeans who attempt, usually with indifferent success, to penetrate these *arcana*, he won the confidence of a native sorcerer, who accompanied him when he was collecting botanical specimens, and passed on to him much of his knowledge. For this indiscretion, it would seem, the informant paid the penalty with his life. In the meantime, however, the author had not only acquired a detailed knowledge of the religious and spiritual beliefs of the people, but also had secured full particulars of the initiation ceremonies and circumcision rites practised at puberty, as well as of the ceremonial of admission into the principal secret societies. His account of the female ceremony of clitoridectomy, which is illustrated by photographs, is exceptionally full. In recording such matters as these, the author no doubt has good reason for making no explicit statement as to how such valuable detailed information was obtained.

As a botanist, M. Vergiat was much interested in the plants used in native magic and medicine. Of these, he gives detailed lists with identifications.

Pigments Associated with the Fatty Tissues of Plants and Animals*

By Prof. I. M. Heilbron, F.R.S., and A. E. Gillam.

THE fat-soluble pigments (lipochromes) which form the subject of the present survey, comprise a sharply defined class of yellow to violet-red compounds not only widely distributed in flowers and fruits, but also met with throughout the whole of the animal kingdom. In virtue of the fact that the first of these pigments to be obtained in crystalline form was isolated from carrots, they are commonly known as carotenoids. As a group they are characterized further by their insolubility in water, by their sensitivity to atmospheric oxygen, which readily bleaches them, and by the deep blue coloration which they give with sulphuric acid. In addition to its occurrence in the carrot, the most typical member of the group, carotene, is invariably found with chlorophyll in all green foliage, being also associated with another yellow consitituent to which the name xanthophyll was originally given. Despite the wide distribution of these two pigments in Nature, it must be emphasized that they, in common with other members of the group, occur only in very minute amounts in living matter. Thus the fresh carrot contains only about 0·1 per cent of carotene, whilst in fresh grass the order approximates only to 0·01 per cent carotene and 0·02 per cent xanthophyll.

Although carotene was originally isolated so early as 1831, the first work of real chemical significance in this field was due to Willstätter and his collaborators who, during the years 1906–14, effected the isolation of several of the more important carotenoids in crystalline form and established their empirical formulæ. It was thus found that carotene was a hydrocarbon having the formula $C_{40}H_{56}$ and that it was isomeric but not identical with lycopene, the pigment of the ripe tomato. Similarly, leaf xanthophyll was shown to have the formula $C_{40}H_{56}O_2$ and to be very similar to, if not identical with, the yellow pigment of egg yolk, then known as lutein. Another interesting member characterized at this period was a still more oxygenated pigment, fucoxanthin, $C_{40}H_{56}O_6$, which was obtained from *Fucus vesiculosus*, a member of the brown seaweeds.

The further development of the chemistry of the carotenoids languished until 1928, when Zechmeister, Cholnoky and Vrabely proved, by means of quantitative catalytic hydrogenation, that carotene contains eleven ethenoid linkages giving rise to a saturated perhydrocarotene of formula $C_{56}H_{78}$, from which it can be deduced that the pigment itself must contain two cyclic systems. In a similar manner, Karrer and Widmer ascertained that lycopene absorbs thirteen molecules of hydrogen yielding a paraffin hydrocarbon $C_{40}H_{82}$, a result which shows that the pigment must by acyclic.

The next important development in our knowledge of the carotenoids came about when Kuhn, Lederer and Winterstein reintroduced the method of chromatographic analysis, as a means of separating and purifying the individual pigments of plant tissues. So early as 1906, the Russian botanist Tswett had shown that substances such as calcium carbonate or powdered sucrose, when packed in vertical columns, have the power of absorbing pigments from their solutions in non-polar solvents such as light petroleum, and that with a mixture of pigments the constituents orient themselves as coloured zones or bands at various positions on the column, depending upon the strength of adsorption of the individual components. On applying this technique to ordinary carrot carotene, it was found that the pigment could be separated into two distinct components, the optically inactive β-carotene and the dextrorotatory α-carotene. The former is adsorbed above the latter when the chromatogram is developed by washing with light petroleum. Of these two isomerides, β-carotene generally predominates, although in palm oil carotene there is as much as thirty per cent of the α-isomer.

Shortly after this discovery, the presence of a third isomer, γ-carotene, was disclosed under conditions which serve to emphasize the elegance of this technique, which more than any other has contributed to the recent rapid progress in this field. Commencing with 35 gm. of commercial crystalline carotene (equal to about 6 cwt. of raw carrots) Kuhn and Brockmann subjected it to chromatographic adsorption and observed a small pigmented zone above that of the β-carotene in the column. After many adsorptions they ultimately succeeded in isolating from the collected upper zones 34 mgm. of the γ-isomeride, with which amount they were able to study its physical, chemical and biological properties and so advance a structural formula for the compound—a remarkable example of the delicacy of modern chemical technique.

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* Expanded from a Friday evening discourse at the Royal Institution delivered by Prof. I. M. Heilbron on February 12.

A further interesting and important point in connexion with chromatography is that not only does it provide us with a readily accessible method for the isolation of minute amounts of specific pigments, but it provides in addition a means of differentiating various classes. Thus the hydroxylated carotenoids (or xanthophylls as they are now generally called) are all much more strongly adsorbed than the hydrocarbon pigments ; moreover, the degree of adsorbability is proportional to the number of hydroxyl groups.

Another criterion determining the position of adsorption in the column is the number and disposition of unsaturated linkages. This is illustrated by the fact that lycopene, γ-carotene, β-carotene and α-carotene are retained on the adsorption column in descending order, which corresponds partly with the total number of ethylene linkages in their molecules and partly with the length of the conjugated system. This latter effect is evidenced in the β- and α-carotenes, both of which contain eleven double bonds. In the former, however, these are all conjugated, whereas in α-carotene only ten are so arranged. Table I (due to Winterstein) illustrates these general principles :

TABLE 1.

RELATIVE ADSORBABILITY OF VARIOUS CAROTENOIDS FROM LIGHT PETROLEUM SOLUTION

Strongest adsorbed	Fucoxanthin	$C_{40}H_{56}O_6$	Alcohols	$CaCO_3$
	Violaxanthin	$C_{40}H_{56}O_4$		
	Taraxanthin	$C_{40}H_{56}O_4$		
	Flavoxanthin	$C_{40}H_{56}O_3$		
	Zeaxanthin	$C_{40}H_{56}O_2$		
	Lutein	$C_{40}H_{56}O_2$		
	Rhodoxanthin	$C_{40}H_{50}O_2$	Ketone	Al_2O_3
	Physalien	$C_{72}H_{116}O_4$	Esters	
	Helenien	$C_{72}H_{116}O_4$		
	Lycopene	$C_{40}H_{56}$	Hydrocarbons	
	γ-Carotene	$C_{40}H_{56}$		
Weakest adsorbed	β-Carotene	$C_{40}H_{56}$		
	α-Carotene	$C_{40}H_{56}$		

The separation by chromatographic methods alone of a complex mixture of pigments such as is often met with in Nature, is an extremely complicated procedure. Fortunately, however, it can frequently be simplified by carrying out a preliminary partition between two immiscible solvents such as light petroleum and 90 per cent methyl alcohol, when it is found that hydrocarbon pigments and esters pass into the petroleum layer (epiphasic pigments), whilst those pigments containing free hydroxyl groups pass preferentially into the alcohol (hypophasic pigments).

Another physical property of great diagnostic value in the study of carotenoids is that of light absorption. It is a well-established principle that with an increasing number of conjugated unsaturated linkages in a molecule, the absorption maxima become progressively displaced towards longer wave-lengths. This is exceptionally well exemplified among the carotenoids, which are characterized by well-defined triplet absorption bands, and the closest possible correlation exists between the position of the bands and the number and character of the conjugated centres. These effects are shown in Table 2.

TABLE 2

EXAMPLES OF THE EFFECT OF UNSATURATION ON THE ABSORPTION SPECTRA OF TYPICAL CAROTENOIDS

Carotenoid.	Number of Double Bonds. *Conjugated*	*Unconjugated*	Absorption maxima in CS_2 (mμ)	
Rhodoxanthin	14(2C=0)	0	564	525
Lycopene	11	2	548	507
γ-Carotene	11	1	533	496
β-Carotene	11	0	518	485
α-Carotene	10	1	508	477
Violaxanthin	9	1	501	469

It is beyond the scope of this article to attempt to describe in detail the elegant investigations of Karrer, Kuhn, Zechmeister and their respective collaborators, which have culminated in the elucidation of the constitution of these pigments. The formulæ for the four hydrocarbon pigments are given on p. 614, and these represent the fundamental structures upon which a large number of naturally occurring oxygenated derivatives are built.

In Table 3 the hydrocarbons and the simpler xanthophylls which correspond to them are enumerated.

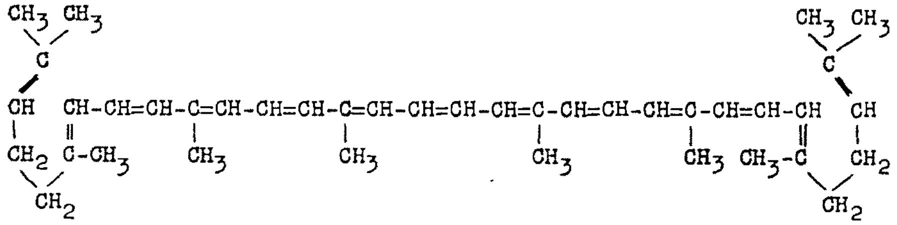
TABLE 3

RELATION BETWEEN THE HYDROCARBON CAROTENOIDS AND THE SIMPLER XANTHOPHYLLS

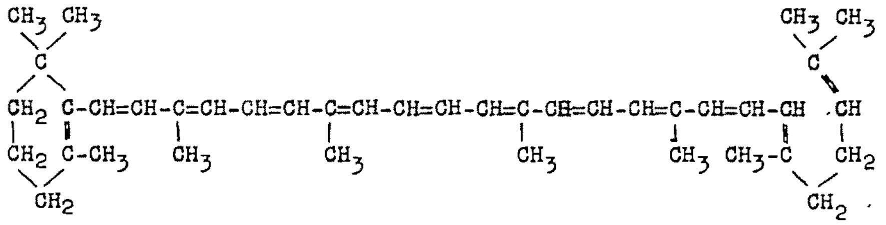
Hydrocarbon	Monohydroxy Derivative	Dihydroxy Derivative
$C_{40}H_{56}$	$C_{40}H_{56}O$	$C_{40}H_{56}O_2$
Lycopene	Lycoxanthin	Lycophyll
γ-Carotene	Rubixanthin	—
β-Carotene	Kryptoxanthin	Zeaxanthin
α-Carotene	—	Lutein

Of the various possible types of oxygenated carotenoids, alcohols are of most frequent occurrence, and of these it will suffice to mention a few of the more common. Leaf xanthophyll, which consists mainly of a pigment having the formula $C_{40}H_{56}O_2$, has been re-named lutein, and is actually a dihydroxy derivative of α-carotene, with which it is spectographically identical. The pigment of egg yolk, originally called lutein, has now been separated into lutein proper (leaf xanthophyll) and an isomeric pigment, zeaxanthin. This is a dihydroxy β-carotene occurring in small quantity in many leaves, berries and fruits, but most readily isolated from maize. The acyclic analogue lycophyll has recently been isolated from several species of *Solanum*. Of other xanthophylls mention may be made of flavoxanthin $C_{40}H_{56}O_3$, the yellow buttercup pigment, violaxanthin $C_{40}H_{56}O_4$, the yellow pansy pigment, and the isomeric taraxanthin from the dandelion.

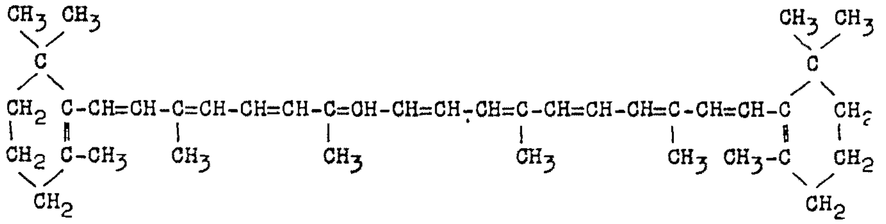
The pigments so far considered have all been representatives of the higher forms of plant life, but among the Cryptogams, lipochrome pigments also abound, especially among the Algæ. Recent work in this field carried out in the University of Manchester, has brought to light some interesting generalizations. It would seem that whereas carotene is common among all algal orders exactly as in the higher plants, a definite differentiation of pigment is met with in the various species of Algæ. As examples of this, the Phæophyceæ (brown Algæ) are all characterized by the presence of fucoxanthin, a pigment which is very easily distinguished by the beautiful colour which it gives with 25 per cent hydrochloric acid. Again, among the Cyanophyceæ (blue-green Algæ), a specific pigment, myxoxanthin, is seemingly common to all members of the group.



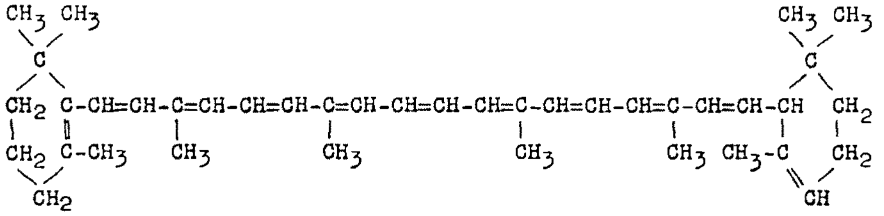
Lycopene



γ-Carotene



β-Carotene



α-Carotene

As already mentioned, the carotenoids are by no means confined to the plant world, but are met with throughout the animal kingdom, from the lowest types of life to man himself. Among the vertebrates, the carotenoids are absorbed from the food and consist therefore mainly of carotene and lutein. Zechmeister and his co-workers have recently made a close study of this subject, and have shown that certain interesting differences are to be observed among the higher animals; thus although the carotene-lutein ratio in grass is of the order 1 : 2, both the cow and the horse preferentially absorb carotene to the almost complete exclusion of lutein. Man, on the other hand, evinces no especial preference, and both pigments are found to be present in human blood serum, whilst in the pig, cat, dog and the rodents no carotenoids appear to be retained. The early experiments of Palmer have shown that birds accumulate xanthophylls, to the almost complete exclusion of carotene, in their blood and body-fat as well as in their egg yolk. It has also been shown by Brockmann and Völker that the yellow colour of the plumage of canaries is due to the presence of lutein, or a closely related transformation product, and is produced solely when this pigment is present in the food, for in its absence the feathers become white.

Turning now to the invertebrates, here a great diversity of carotenoids, distinct from those found in plant tissues, are met with. Among the Crustacea, the characteristic bluish colour of the live lobster is due to the presence of a labile chromoprotein, which breaks down at the temperature of boiling water liberating the free lipochrome, astacene. This pigment, which is a tetra-keto-β-carotene, $C_{40}H_{56}O_4$, is very widely distributed in aquatic animals, being found in the skin of goldfish, in starfish, in the flesh of salmon, etc.

Among other marine forms, the sea anemones also owe their brilliant colours to specific carotenoids of complex character; thus *Actinia equina* contains a very beautiful purple pigment, actinoerythrin, which is an ester; the free violerythrin, $C_{40}H_{58}O_4$, is characterized by the intense blue colour of its solution in organic solvents. Again, from *Anemonia sulcata* a still more oxygenated pigment, sulcataxanthin, $C_{40}H_{52}O_8$, has been isolated.

Carotenoids have also recently been discovered in bacteria. Thus the purple rhodovibrio bacteria have been shown by Karrer to contain a series of probably six closely related pigments. Of these, rhodoviolascin, $C_{42}H_{60}O_2$, has been clearly characterized, and constitutes the first known methylated xanthophyll.

(To be continued.)

The Earthquake Research Institute of Japan

By Dr. Charles Davison

THE first Japanese earthquake known to us occurred in A.D. 416. For many years, the chronicle of its successors is naturally incomplete, but, with the nineteenth century, the entries become more frequent; how full they are is evident from Omori's studies of the after-shocks of the great earthquakes of 1830, 1847 and 1854. With the Yokohama earthquake of 1880, the investigation of the earthquakes on modern lines began. Though not of great strength, the shock was the first to arouse the interest of the English professors then living in Tokyo. A few months later, the Seismological Society of Japan was founded by the late Prof. J. Milne, and the admirable work done by him and his colleagues during the next twelve years was continued and expanded by the Imperial Earthquake Investigation Committee and the Earthquake Research Institute.

For the next change, another earthquake was responsible, that of Mino-Owari on October 28, 1891. The widespread damage caused by this great earthquake led to the foundation in the following year of the Imperial Earthquake Investigation Committee, the aims of which were of a practical nature, namely, to discover, if possible, whether the occurrence of earthquakes can be foreseen, and to devise methods of lessening their destructive power. How great was the advance along the second line and how valuable were the contributions of the Committee towards our knowledge of earthquakes in general is clear from the journals that it published and especially from the long series of memoirs that appeared under the name of Prof. F. Omori.

In 1926, shortly after the publication of the valuable reports on the great earthquake of 1923, the Investigation Committee ceased to exist, and its place was taken by the Earthquake Research Institute, with its home, as before, in the Imperial University of Tokyo. Why the change was made is not quite clear, unless it was felt that the work could be carried on more satisfactorily by younger men. The aim of the new Institute was stated to be scientific research on earthquakes. The first director was Prof. K. Suyehiro, who, on his death in 1932, was succeeded by Prof. M. Ishimoto. In its first year, the staff of the Institute consisted of thirteen members, several of whom had been connected with the Investigation Committee. During the last five years, the number of active members of the Institute was thirty-nine.

When the volumes issued by the Institute are compared with those of its predecessor, two welcome features are manifest—the extraordinary increase in the number of students of pure seismology, and the large number of memoirs written by two or more authors. During the first three years, the new *Bulletin* appeared twice a year, but in 1929 and after it was issued quarterly. By the end of 1936, fourteen ordinary volumes were completed, as well as three supplementary volumes containing papers and reports on the Sanriku seawaves of 1933, the typhoon of 1934, and the Formosa earthquake of 1935. Altogether, the seventeen volumes include 504 memoirs by ninety authors and number 7,646 pages with 1,023 plates. In the first four volumes, three out of every five papers were written in Japanese with summaries in English or French; but, in the last ten volumes, the ratio, fortunately for Western readers, fell to one in five.

Since the Institute began its work, there have been four great earthquakes in the Japanese empire—those of Tango in 1927, Idu in 1930, Sanriku in 1933 and Formosa in 1935—and, on each of these, series of valuable reports are printed in the *Bulletin*. Other earthquakes of less, but still destructive, intensity are also described in one or several papers, such as the Etigo earthquake of 1927, the Kaga earthquake of 1930, the Noto earthquake of 1933, the Idu earthquake of 1934, the Siduoka earthquake of 1935 and the Kawati-Yamato earthquake of 1936. These are probably the most important Japanese earthquakes of the years 1924–36, but Western readers would be grateful if they could be supplied with an annual list of all the stronger Japanese earthquakes.

For an important section of the earthquakes, those that are sensible in Tokyo, the Institute provides valuable quarterly *Seismometric Reports*. In 1924, the capital was surrounded by a network of nine seismological stations at various distances up to 64 miles. By 1935, the number of stations had risen to thirteen, all within 83 miles of Tokyo. From the durations of the preliminary tremors at three or more stations, the position of the epicentre and the depth of the focus can be determined. During the twelve years 1924–35, the *Reports* contain the records of 766 earthquakes; thus, on an average, one earthquake was felt in Tokyo every 5·7 days. Of the total number, the position of the epicentre was estimated in 699, or 91 per cent, and the depth of the focus in 553, or 72 per cent. All the epicentres are plotted on small maps, annually for the first seven years, quarterly for the last five. Most of the shocks were of slight intensity, and only four reached destructive strength at any one of the stations.

Similar observations, though on a less extensive scale, are made whenever a great earthquake occurs. Immediately after the Tango earthquake of March 7, 1927, members of the Institute were dispatched to the central district, and portable tromometers were installed at three stations near the epicentre on March 11 and 12, by which 1,327 after-shocks were recorded by the end of July 1928. Of these shocks, many were very slight, but 520 were registered at three stations, and the position of the epicentre was found for 482 shocks, and the depth of the focus for 477. Again, soon after the remarkable earthquake swarm at Ito began in the spring of 1930, tromometers were erected at five surrounding stations and, later on, near the adjacent centre of the Idu earthquake of November 26, 1930. In both series, the earthquakes were so numerous, several hundreds sometimes occurring on one day, that no detailed list of them has been published.

In both the Tango and Ito districts, tiltmeters, designed by the present director, Prof. M. Ishimoto, were erected in the neighbourhood of the tromometers. It was found that, before even moderately strong shocks, a perceptible tilting of the ground was revealed by these instruments. Thus, it is not too much to hope that, before many years are past, such records may provide trustworthy forecasts of coming destructive earthquakes.

In no other country have re-surveys after great earthquakes been carried out with such frequency and method as in Japan. At the suggestion of the Institute, new lines of levelling were made by the Land Survey Department of the Japanese Army across the central areas no less than five times after the Tango earthquake of 1927 and the Ito earthquake swarm of 1930, and in many districts without the accompaniment of recent earthquakes. Re-triangulations of the central areas have been carried out after the Kwanto earthquake of 1923, and the Tango and Idu earthquakes. The repeated levellings in some districts have shown that the crust is broken up into blocks, 4–6 miles across, and that each block moves more or less independently of its neighbours. The mapping of the blocks is perhaps most detailed in the Boso peninsula and the Kwanto plain, both forming parts of the region displaced during the great earthquake of 1923.

Some of the phenomena of earthquakes have been closely studied, especially the remarkable seawaves of the Sanriku earthquake of 1933 and its predecessors, as well as the *kase-tunamis* or non-seismic seawaves that were raised by the great typhoon of 1934, and these studies have suggested precautions that, on future occasions, may lead to the saving of many thousand of lives. Luminous phenomena have been so widely observed with the Idu earthquake of 1930 and the Sanriku earthquake of 1933 that little doubt can now be felt as to their reality or their connexion, direct or indirect, with the earthquakes. Many curious and interesting observations have been recorded on the abundance of fishes caught after earthquakes, and on the relations between earthquakes and thunderstorms or the atmospheric pressure gradient. Though mainly concerned with theoretical studies, members of the Institute have also contributed to our knowledge of the vibrations of various types of buildings, of one story to eight stories in height. Many experiments have been made on artificial earthquake-waves, on the deformation of sand-masses by lateral pressure, and on seismic seawaves. The eruptions of volcanoes all over Japan have been investigated, especially those of the Komagatake in Hokkaido and of the Asama-yama in central Japan. Lastly, one of the most remarkable features of the fourteen ordinary volumes is the series of nearly one hundred mathematical memoirs, dealing as a rule with theoretical problems, but touching also on others of a more practical aspect in the vibrations of various types of buildings and the propagation of seawaves and seiches.

REFERENCES

Summaries of much of the work described above will be found in the following pages of NATURE: Earthquake Research Institute, **119**, 256; **125**, 868; **130**, 232, 772; reports on Japanese earthquakes, **122**, 36, 976–977; **123**, 295–296; **124**, 633; **129**, 404, 766–767; **132**, 681; **134**, 31, 820; **137**, 240; **138**, 171, 353, 1063; earthquake-swarms, **126**, 326, 971; **131**, 136; seismometric reports, **134**, 329; **136**, 919; **138**, 252; crust-displacements, **119**, 254; **126**, 923–924; **130**, 440; **132**, 356; **134**, 940; **135**, 273–274; **136**, 993; **137**, 281, 1000; tilting of the ground, **119**, 869; **124**, 633; movements of crust-blocks, **129**, 321; **133**, 536; luminous phenomena, **128**, 155; **129**, 27; **130**, 969; frequency of sunspots and earthquakes, **126**, 895; vibrations of buildings, **129**, 693; typhoon of 1934, **136**, 544; eruption of Komagatake, **126**, 487.

Obituary Notices

Sir James Currie, K.C.M.G., K.B.E.

It is with deep regret that we have to record the death of Sir James Currie. Sir James had gone to Cambridge to attend a conference on animal pathology, and was staying with Mr. Will Spens, the master of Corpus Christi College. He retired at 11 p.m. on March 16, and on the following morning was found dead in his room.

Sir James had a distinguished career of public service, and, as he would have wished, died in harness. Son of the Rev. James Currie, principal of the Church of Scotland Training College, he was educated at Fettes (where he played in the first Rugby XV and the first cricket XI), and he obtained an exhibition at the University of Edinburgh and a scholarship at Lincoln College, Oxford, in 1888. After going down, he gained teaching experience at one of the schools of the Scottish Education Board in Edinburgh, his native town. His great opportunity came in 1899 when he joined the Egyptian Education Service. He embraced it magnificently. In the following year he was appointed principal of the newly founded Gordon College in Khartoum and director of education in the Sudan.

As a start, Currie formed a school for the training of the Sudanese as teachers. Inspired by Lord Cromer, many of whose attributes he possessed, he soon won his way into the hearts of the Sudanese. He was appointed a member of the Governor-General's council, and his work in the Sudan was perhaps his greatest achievement.

Relinquishing his posts in 1914, Currie returned to England, where he went in for farming; but during the Great War, in 1916, he undertook, as director of the new Labour Supply Department, the training of munition workers, and in 1918 he joined the Ministry of Labour, again in a voluntary capacity, as controller of the training department. He originated the idea of Government instructional factories, and when he retired, early in 1921, more than 25,000 disabled ex-service men had passed through his hands.

In the same year Currie was appointed director of the Empire Cotton Corporation, and a year later a governor of the Imperial College of Tropical Agriculture, to the chairmanship of which he succeeded in 1927, after the death of Sir Arthur Shipley.

Scientific men were needed for the development of cotton-growing within the Empire, and Sir James initiated the system of scholarships for post-graduates tenable at the College in Trinidad, an example which was followed later by the Colonial Office under the Milner-Lovat Committee's scheme. Much work had to be done. As E. H. C. wrote in *The Times*: "Cotton was to be grown in a dozen different countries, each with a different climate and different conditions. There would be no uniform cotton seed which would suit each and all. First must come research in each country, experimental farms, trials of various seeds, knowledge of constituents of soils. So, just as he had first to train teachers in the Sudan before he could have schools, he must now concentrate on soil-chemists and plant-breeders before he could have seed which would not bankrupt Colonial farmers. No other man in the Empire would have seen this so clearly or have understood so well how to give practical effect to what he saw."

Sir James was also a governor of the Imperial College of Science and Technology, a member of the council of Marlborough College and chairman of the directors of Dauntsey School. To the Cotton Corporation and the Imperial College of Tropical Agriculture especially, his experience of education and research and his great powers of administration proved of inestimable value.

Sir James possessed exceptional strength of character. He had also a rich fund of humour, and this often found expression in original though apposite comments which relieved the monotony of many meetings which he attended. All who worked with him and for him, loved him and will treasure his memory.

Sir James was made C.M.G. in 1912 and a K.B.E. in 1920, and was promoted to K.C.M.G. in 1933. He was married in 1913 and is survived by his wife, Hilda Beatrice, daughter of the late Sir Thomas Hanbury of La Mortola, Italy.

Dr. Elihu Thomson

By the death of Elihu Thomson on March 13, the world has lost one of the greatest of the pioneers of the practical applications of electricity. He was born in Manchester, England, on March 29, 1853, but his father, who was a skilled mechanic, emigrated to Philadelphia, Pa., in 1858. He was educated there and attended the Central High School, a well-known technical college. His love for experimenting and invention was probably inherited from his father. At first his chief interest lay in chemistry; after he had served his time as an analyst at a factory he returned to the High School to teach chemistry and retained this post for ten years until 1880.

Prof. M. B. Snyder tells how one day in 1875 Thomson transmitted ether disturbances from the first floor of the building to the sixth floor, where his detector was a brass door knob and an ordinary lead pencil. When the apparatus on the first floor was working a stream of delicate sparks passed between the point of the pencil and the knob. This happened twelve years prior to Hertz's celebrated verification of Maxwell's theory.

In 1880, Thomson went to New Britain, Conn., as electrician for the American Electric Co., and two years later in conjunction with Edward J. Houston founded the Thomson-Houston Electric Co. at Lynn, Mass. In 1892, this company was merged with the

Edison General Electric Co. to form the General Electric Co. (America), the largest manufacturing company of electrical equipment in the world. Thomson retained his post as director of the large laboratory at Lynn, which was renamed after him, the Thomson Laboratory.

Thomson made more than seven hundred inventions, some of which have led to great developments and many theoretical discoveries. He discovered that the resistance of the electric arc varies inversely with the current. He was the first to utilize a magnetic field to move the electric arc, a method which is used in magnetic blow-out switches and electric safety valves. A notable discovery was that a copper ring placed in front of an A.C. magnet was strongly repelled, a fact which he applied to the development of repulsion motors which are much used in industry. He was the pioneer of high-frequency apparatus, making the first dynamo of this type in 1890. In 1886, he invented the art of electric welding by the resistance method. The art of welding has developed very rapidly since this date. Ships, buildings, bridges, etc., are now being welded instead of being riveted and bolted. It has also proved of great value when designing aeroplanes and large motor vehicles. His inventions show great novelty of design. The Thomson-Houston dynamo for arc lighting had a spherical armature, cup-shaped field magnets and a three-part commutator. He made most useful contributions to the field of radiology and was the first to make stereoscopic X-ray pictures.

In 1884, Dr. Thomson married Miss Mary Peck of New Britain, Conn., by whom he had four sons. Mrs. Thomson died in 1916, and seven years afterwards he married Miss Clarissa Hovey of Boston and lived at Swampscott near Lynn, where he continued his inventive work.

Elihu Thomson received many honours for his electrical and scientific work from countries all over the world. He made many friends when he was president of the International Electrical Congress at St. Louis in 1904 and of the International Electrotechnical Commission which met in Turin in 1911. The writer remembers how feelingly Elihu Thomson spoke of Prof. Silvanus Thompson when a portrait of the latter was presented in 1923 to the Institution of Electrical Engineers. He said that he felt that the late Prof. Silvanus Thompson was in many respects nearer to himself than any other man. He was successful not only in electrical work, but as an optician, a musician and an artist he had also attained distinction. He felt that in his own way he was humbly following in Thompson's footsteps.

When he was presented with the Kelvin Medal in 1924 by the leading engineering institutions in Great Britain, Elihu Thomson said that Kelvin was his ideal, as an influence and example that was not to be estimated by ordinary standards. Kelvin was lovable as a man, and unequalled as a scientific expert. Thomson regarded him as the earliest and greatest electrical engineer. In 1924, the University of Manchester, his native city, conferred on Thomson the honorary degree of doctor of science. At the festivities which took place at the World Power Conference in 1924, he and Mrs. Thomson took a leading part and were esteemed by everyone. Since then, many of us have received at Christmas time from them beautiful photographs of their garden taken in natural colours by a new method invented by Thomson. He will be missed by his many friends all over the world.

A. R.

Baron de Stael Holstein

WE regret to record the death of Baron de Stael Holstein, well known as an Oriental scholar, which is reported to have taken place recently in Peking at the age of fifty-seven years.

Baron de Stael Holstein was formerly one of the largest landowners in the Russian Baltic States; but on being dispossessed by the Revolution, he took up his residence in Peking, where he devoted himself to the study of Sanskrit and Buddhism, of which he had long been an ardent follower, adding to them Tibetan and Chinese. In so doing, he was anxious to bring about a better understanding of the Buddhist canon among the Chinese themselves, and for the furtherance of this object founded, with the co-operation of Harvard University, the Sino-Indian Institute, in which Tibetan lamas were engaged for instructional purposes, but at the same time initiated into Western methods of critical scholarship. With the assistance of American benefactions, he brought together a remarkable collection illustrating Buddhist iconography. His eminence as an Oriental scholar was recognized by the University with which his Institute was connected when he was called to Harvard for a time to occupy the chair of Sanskrit. His literary output was considerable, his work of most enduring value being the publication of a number of Buddhist texts.

Dr. F. P. F. Ransom

DR. F. P. F. RANSOM, who died on February 23 at the age of eighty-seven years, studied pharmacology as a young man in Halle and Marburg with von Behring and H. H. Meyer. They studied immunity, and the pharmacology of tetanus toxin and diphtheria toxin. They obtained evidence that these toxins passed from the periphery to the central nervous system in the trunks of nerves. Ransom also showed that the toxic effects of saponins were largely due to their affinity for cholesterol, and made an active cell-free cholera toxin.

At the age of sixty years, he was elected to a Beit fellowship, and, with Dixon in Cambridge, demonstrated the action of sympathetic and parasympathetic nerves on the bronchi. From 1912 until 1924 he held first a readership and then a chair at the London School of Medicine for Women, and published papers on the effect of caffeine on seeds, on alcohol, chloroform, pilocarpine and other subjects. His wide knowledge of pharmacology was always at the disposal of his colleagues, and he will be remembered as a kind, modest and courteous friend. He spent his last years in retirement in Somerset, and kept up his interest in pharmacology in spite of failing eyesight.

News and Views

Sir William Beveridge, K.C.B.

THE presence in Oxford of Sir William Beveridge, who will return there as master of University College next October, will greatly strengthen the young but vigorous Oxford school of philosophy, politics and economics. No head of a House there, with the exception of Mr. H. A. L. Fisher of New College, has had so brilliant a combination of an academic and public career. At Balliol, where Sir William was an undergraduate, he distinguished himself in mathematics, classics, philosophy and law. Later, he became a fellow of University College. In London he has had a wide experience as administrator, first in the Civil Service and, since the War, as director of the London School of Economics and Political Science. For many years he was at the Board of Trade and the Ministries of Munitions and Food, and there became a great and resourceful authority on problems of labour, unemployment and industrial insurance. To him more than to any other is due the organization in Great Britain of 'Labour Exchanges'. He has latterly been chairman or member of several important commissions or tribunals dealing with industrial wages and insurance. For the last eighteen years he has been a senator of the University of London and was vice-chancellor in 1926–28. He is still comparatively young. His resource and energy, and his wide knowledge of men and affairs, can now be devoted to Oxford for many years.

Social and Economic Problems for Solution

THE group of 150 distinguished public men and women of all schools of democratic public opinion who eighteen months ago published an essay in political agreement in a book called "The Next Five Years" have now submitted a narrower "Programme of Priorities" to cover a period of five years—that is, the lifetime of a Parliament ("A Programme of Priorities". Pp. 12 (Oxford: "Next Five Years Group", 1937.) 3*d*). The programme is a practical plan applicable to the political and economic situation of England to-day and is submitted for discussion by all those who see the importance of a common effort to serve the nation and strengthen its influence in the world at this critical time. A number of its proposals, such as an extended housing programme by widening the definition of overcrowding, the extension of the milk-in-schools scheme to all elementary schools, or the raising of the school leaving age to fifteen years without exemptions, merely require the tightening of legislation.

OTHER proposals which are put forward in the pamphlet give concrete expression to present tendencies in the Government or to authoritative recommendations in Commissions and reports already submitted to it. They include the provision of national parks and playing fields, recreational and cultural amenities in connexion with slum clearance and new housing estates, agricultural marketing Acts administered by appointed bodies entrusted with the duty of considering the interests of the community as a whole, the expansion of the national health insurance panel system into a public medical service, the pensioning and removal from the live register of elderly persons who have been unemployed for five years, the location of industries, measures to restore and maintain the personal qualities of the unemployed in the Special Areas, public development schemes, the co-ordination of transport, the freeing of trade by the overhaul of the tariff system, etc., the expediting of the new Factory Act, control over undesirable speculative methods of finance, further State aid for social and economic research and the encouragement of the shorter working week and annual holidays with pay. Under international relations the programme includes a proposal to all European countries to set up a fact-finding commission to examine outstanding problems such as Colonial questions, access to raw materials, the lowering of trade barriers and positive economic co-operation, currency co-ordination, racial minorities and claims to changes in territorial *status quo*, as well as renewed efforts to establish a system of collective security, the limitation, reduction and supervision of armaments and the rebuilding of the League of Nations as the main and consistent object of British policy.

The Social Credit System

UNDER the title "Poverty and Over-Taxation; the way out", the Marquis of Tavistock has published a further account of the Social Credit system (Coventry: *Prosperity* Office, 1937. 6*d*.). Among seven reasons given for the failure of the present financial system, he stresses the way in which science and machinery are destroying the need for human labour, but are increasing the output of real wealth in goods. Because the machine does the work of several hundreds of people, it becomes more and more difficult every year to find work for everyone, and no cure for poverty can be found by attempting to give everyone a paid job in industry. The effect of machinery and fresh scientific inventions is to destroy the demand for human labour, and although new industries are started, fewer and fewer people are needed. Apart accordingly from the necessity of education for leisure, it is urged that the State should direct the banking system to create and issue, *not* in the form of debt, as much money as is required to enable the citizens of the country to buy at a price fair to sellers all that they desire of what industry and commerce can produce or import. Of the three main items in the reform necessary to make money the servant of industry, aiding the consumption and production of goods, the first is the abolition of the Gold Standard and of any gold basis for the issue of money, since it is goods and not gold which give value to our money. It is suggested that under a policy of National Dividends, a man unable to find work would still be able to live in reasonable comfort without being a burden on others and he would be able to help the man at work by being in a position to buy his goods. It would still pay a man to get work if he could, as wages would be paid extra to National Dividends and a natural check to living on National Dividends would operate because their amount depends on the country's production of goods.

Japanese Institute for Science of Labour

In view of the importance which labour is commonly regarded as possessing in Japanese competition, the annual report of the Institute for Science of Labour, which was transferred from Kurasiki to Tokyo at the end of 1936, is of considerable interest. The report indicates that much of the work of the Institute follows the lines of work of the National Institute of Industrial Psychology in Great Britain. Among a number of completed researches mentioned in the report are those on the clothing of farmers, syphilis morbidity in villages, psychological qualifications for textile workers, an examination of vocational testing methods, studies on manual dexterity and on the physical fitness of employees, studies on motions and positions in working, on repetition work, psychological differences between skilled and unskilled workers in a weaving factory. Some of the physiological work is on lines similar to that pursued by the Industrial Health Research Board in Great Britain as, for example, the investigations on environmental conditions, such as climate, the effect of occupational activities on basal metabolism, the metabolism of heavy muscular labour or the physiological studies on walking, but in addition the Institute has completed a preliminary research on the daily protein requirements of the nation. Occupational diseases and the prevention of accidents have also received attention, and it is interesting to note from abstracts of publications of the Institute included in the report that scientific workers in Japan are now advocating on scientific grounds raising the minimum age of juvenile labour to at least fourteen years, with special protection up to eighteen years of age.

National Research Laboratories, Ottowa

The National Research Laboratories at Ottawa now employ about 190 workers organized in five divisions: agriculture and biology; chemistry; physics and electrical engineering, mechanical engineering including aeronautics; and research information, with which is associated a national scientific library service. A review of the year's work recently issued for the National Research Council of Canada stresses the increasing service which is rendered to industry; much of the work carried out in the Division of Biology and Agriculture forms part of large co-operative research projects, mainly in collaboration with the Department of Agriculture but also with the universities and similar organizations. A low-temperature laboratory has been equipped, and physical conditions for dechilling boxed poultry without condensation have been established. Research on malting barley is being carried on in co-operation with industry, and a comprehensive review of the literature on chemical weed killers is being published as a guide to research in this field.

The Division of Chemistry is in organized relations with the laundering and dry-cleaning industry, the asbestos industry, the manufacture of basic refractories, and to a slight extent the woollen and sugar industries. In an investigation on the chemical principles in certain groups of wild plants native to Canada, a method of synthesizing certain plant hormones which stimulate plant growth, including root formation on cuttings, in a remarkable way, was discovered. An extremely efficient distillation column was built in the laboratories during the year and its application in the oil-refining and synthetic chemical industries, the coal tar industry, etc., is being investigated. The snow resistance of aircraft skis has been thoroughly investigated by the Division of Mechanical Engineering, as well as the stalling of heavily tapered wings on modern aircraft. A new heating system for refrigerating cars has been developed, as well as a new machine for converting aerial photographed information into a map. Radio methods in weather forecasting are being investigated, the Physics and Engineering Division is also giving a considerable amount of attention to the development of new or improved methods or instruments for measuring sound absorption, gauges, voltage in X-ray work, grading of colours for fastness, etc.

Educational Research in the United States

Educational research in the United States proceeds on a scale never hitherto approached in that or any country. Some idea of the volume of work in this field may be gathered from a "Bibliography of Research Studies in Education, 1934–35", issued from the United States Office of Education (Washington: Govt. Printing Office. 25 cents). Herein are listed 2,971 studies reported by 145 institutions, including 384 doctors' dissertations, 2,368 masters' theses and 219 studies reported as faculty research. An introductory note mentions the following as "especially timely topics" of some of the theses; apprentice training, business depression, correlation of school subjects, crime prevention, exploratory courses, leisure-time activities, open forums, orientation courses, teachers' strikes, rehabilitation of the disabled, traffic schools, new systems in several foreign countries. Another favourite subject for educational research in America is the technique of reading. Fifty-two of the studies listed deal with investigations such as the measurement and improvement of silent reading among college freshmen. It seems to be not unusual for a reading test to form part of the college entrance examination, and it has been found that many students are seriously handicapped in their work by remediable faults in their modes of reading. Within a day or two of the publication of this bibliography appeared No. 1 of vol. 24 of the University of Colorado Studies containing abstracts of 136 theses for higher degrees. An analysis of the subject headings of the theses affords further evidence of what might almost be called the rage for educational research prevalent in some American universities, for no fewer than 47 of the theses are devoted to research in this field.

Records of Bushman Art

THE Department of the Interior of the Union of South Africa and the Commission for the Preservation of the Natural and Historical Monuments, Relics and Antiquities of South Africa have issued an official circular inviting the co-operation and assistance of members of the public in recording and preserving examples of Bushman rock-painting and drawing. In asking observers to forward such records to Prof. C. van Riet Lowe, as director of the Bureau of Archæology at Johannesburg, the circular points out that although the existence of a large number of such examples of Bushman art is already known, it is certain that the list is by no means complete, while time, exposure to weather, as well as acts of vandalism are obliterating many of them year by year. In order that the records may be as complete as possible, the circular enumerates the data which are essential for the purpose of accurate record, as well as for archæological study, and gives instructions on the best methods of taking photographs and squeezes in varying conditions. The circular, as received, is accompanied by an excellent and extremely instructive map, showing the distribution of the known sites on which examples of the paintings and engravings have been recorded, as well as sites which have been proclaimed for preservation by the Commission for the Preservation of Natural and Historic Monuments.

Fire Precautions in Electrical Stations

SERIOUS fires from electrical plant in power stations are fortunately rare in Great Britain, but during the last few years there have been several disastrous fires both at home and abroad, and so the paper on fire precautions by F. C. Winfield read to the Institution of Electrical Engineers on February 11 is a useful one. In electrical supply it is recognized that the maintenance of this supply is the outstanding requirement. This is usually done by duplicating all the principal cables supplying the current, and also some of the plant. Since all electrical plant is subject to the two risks of fire and explosion, this provision does not secure the desired maintenance of the supply unless measures are taken to ensure that such duplicates cannot be simultaneously impaired. It is necessary therefore to provide physical separation of electrical duplicates by dividing them up in separate buildings or enclosures. Brick walls and reinforced concrete construction have excellent fire-resisting properties. Pitched roofs supported by steel trusses should be protected by a fire-resisting inner ceiling. All windows should be of wired glass and all internal doors of fireproof self-closing design. The development of the oil-less circuit and breaker on the Continent is a step in the right direction. An important factor in fighting an oil fire is the dense black smoke, which impedes or prohibits access to the seat of the fire. This is a very serious consideration in dealing with fires which occur in the inner regions of large power stations. For this reason it is recommended that all large transformers or heavy switch-gear should be mounted in separate buildings or in chambers opening to the outer air and sealed off from the inner side. Unfortunately, no practical method of routine testing has yet been devised by means of which the failures that produce fires can be anticipated.

Underwater Power and Telephone Cables

IN the course of developing underground cable networks, the engineer has sometimes to negotiate waterways and harbours. For large waterways three methods are used. The first is to make a special cable tunnel. But the expense of construction is heavy, and is only justified when a large block of main cables has to be taken across. Examples of this type are the crossings under the Thames at Barking, Deptford and Battersea and underneath the Tyne at Newcastle. The second method is to dredge a trench in the river bed in which the cables are laid directly, and the third method is to lay them in the bed of the waterway without recourse to dredging. The second method is, when practicable, preferable to the third method, especially in navigable waterways, where the ships' anchors damage them. In certain cases, owing to the width of the waterway or because the nature of its bed renders dredging impracticable, the third method is employed. In the Engineering Supplement to the *Siemens Magazine* of March, it is pointed out that when this is done in running or tidal waters, a new problem arises. No matter how carefully the cable is laid, it may at any time, due to the shifting of the bottom, be left suspended between two points. In this condition, it is subject to high-frequency vibrations set up by the current. These vibrations are very harmful to the lead as they rapidly produce inter-crystalline fracture and failure due to ingress of water. Messrs. Siemens have successfully combated this trouble by a special type of cable. A rubber hose protection is applied between the lead sheathing and the armouring. This damps out harmful frequency vibrations before they reach the lead.

Progress in Marine Radio Communication

THE first practical application of radio provided communication with ships at sea over distances and under conditions which made all other forms of communication impossible. More than thirty-five years have elapsed since that first application, and marine radio still remains unique for this particular purpose, so important to commerce and so essential to safety. In no other field, except that of air transport, is radio irreplaceable by other forms of communication. A general survey of the present state of the art of marine radio communication was given at a meeting of the Wireless Section of the Institution of Electrical Engineers on March 3, when Commander F. G. Loring and Messrs. W. L. McPherson and W. H. McAllister presented a paper entitled "A Survey of Marine Radio Progress, with Special Reference to R.M.S. *Queen Mary*". The first section of the paper comprised a short summary of progress during the last five years, with particular reference to the nature and volume of traffic, the types of communication involved, and the increasing use of direction-finding equipment by navigators. Next the types of equipment fitted in cargo vessels and the smaller class of passenger vessels were described. An account was then given of the radio problems encountered in the 'express steamer' class of vessel, and the paper concluded with a detailed description of the radio station of R.M.S. *Queen Mary*, the latest representative of its class. This installation comprises four transmitters and nine or ten receivers ; the control room can handle four independent duplex circuits, and provision is made for high-speed transmission and reception, and simultaneous communication on both telegraphy and telephony with both sides of the Atlantic. The results of the experience obtained with this equipment have shown that in spite of the difficulties peculiar to ship installations of this character, by careful engineering, a good approach can be made to the operating efficiency of a large land station.

Use of Diesel Locomotives in Mines

IN coal and metalliferous mines, as the working faces advance from the shafts, there is a desire to transport workmen to within easy reach of their working places and there is a large field of usefulness open to safe and convenient locomotives suitable for this purpose. Electric trolley, compressed air, storage battery, benzol and Diesel locomotives have been used, and it is interesting to note that tests have been carried out by the Ruhr Testing Station officials which show that Diesel locomotives are safe for use in mines. An investigation has been carried out by Messrs. George S. Rice and F. E. Harris of the United States Bureau of Mines, and a report has been published under the title of "Diesel Mine Locomotives—Development and Use in European Coal Mines" (a Publication of the Department of the Interior, United States Bureau of Mines, November, 1936). It is stated in this report that provided a reasonable amount of air is circulated along the roadways where these Diesel locomotives are in use, dangerous percentages of carbon monoxide do not occur if the machines are maintained in a good working order. These locomotives are being used in American mines, and they are being substituted for benzol locomotives in mines in Germany, Belgium and France. At a colliery in Scotland, a Diesel locomotive has been on trial since 1935. Another large colliery company in Yorkshire is contemplating using Diesel locomotives for carrying men from the pit bottom to points near the face, and the necessary investigations are at present being made. In Great Britain special permission is required to introduce internal combustion engines into mines by Section 58 of the Coal Mines Act, 1911, which prohibits the use of these engines in underground workings without permission.

Air Survey

THE Air Survey Committee grew from a suggestion of the Army Council in 1919, and now includes representatives of the War Office, Air Ministry, Admiralty, Ordnance Survey and Department of Scientific and Industrial Research. The Committee's second report (Report of the Air Survey Committee No. 2. H.M. Stationery Office. 4*s*. net) reviews at length the methods of air survey and the apparatus at present available. A useful appendix analyses the cost of air survey. Conditions, of course, vary, and the estimate is based on the existence of an air survey organization on a permanent basis undertaking operations on a large scale. It is assumed that the area is undeveloped and consequently difficult for land transport. Under these conditions the cost of the survey is estimated for an area of one million square miles which would entail six years work for completion of the air photography. For this, five aircraft in action and one in reserve would be required. This fleet could do 2,000 hours of photographic flying each year. The total cost, which of course includes the cost of photographic material, works out at twenty-three shillings per square mile, but considerably more if a smaller area is surveyed, rising to 180 shillings per square mile for an area of 500 square miles. These must be taken as average figures, and the cost would be much higher in urbanized areas. The production of the maps is additional to these costs.

Works of Charles Darwin in Russian

THE fiftieth anniversary in 1932 of Charles Darwin's death was marked with perhaps greater solemnity in the U.S.S.R. than elsewhere, since both Engels and Lenin adopted and popularized Darwin's evolutionary idea. Until that time, only more or less abbreviated translations of Darwin's works had been available to Russian readers, and most of them were out of print. It was therefore decided that a new translation should be published, which had to be the most complete of all editions of Darwin's works existing in any language. The preface to the first volume, published in 1935 by the State Publishing House for Biological and Medical Literature, Moscow and Leningrad, points out the necessity for such an edition, particularly at the present time when "the economic crisis and the political and spiritual reactions caused by it, not only call for a complete oblivion of Darwin, but when the bourgeoisie, in its futile struggle against darwinism, more and more often invokes the darwinism's decrepit antithesis—religious teachings on the creation of the world".

ACCORDING to the plan, the edition will comprise twelve volumes, and will include the translations of all books, and all papers by Darwin, except some highly technical ones from which only excerpts will be published. Every separate work will be supplied with an introduction by an expert in the particular problem, who is in many cases responsible for the actual translation, or for editing it, as well as for commentaries that serve to explain various points, to bring up to date the nomenclature of plants and animals, etc. The first volume that appeared in 1935 contains the "Journal of Researches, etc." supplemented by the "Diary" (as published by Norah Barlow); the second, printed in 1936, includes a series of zoological works, the book on earthworms, and a series of geological works, especially that on the formation of coral reefs. The editorial work is done very thoroughly, but the appearance of the book leaves much to be desired, as the paper (particularly in the first volume) is of indifferent quality, affecting the illustrations, which are reproduced mostly from original English editions. When (and if) all the promised twelve volumes are published, it will be possible to judge the whole enterprise in greater detail.

Recent Acquisitions at the Geological Museum

THE Geological Museum has recently put on exhibition two new dioramas illustrating the occurrence and exploitation of gold ore at the Lake Shore mine in the Timiskaming District of Ontario. This mine is the largest gold producer on the American continent, and one of the most important in the world. One of these dioramas introduces a new technique, in illustrating the geological structure to a depth of 4,500 feet, as well as the general surface topographic features. The dioramas have been presented by Mr. Harry Oakes, who originally staked the property. Among other recent additions to the collections are a jade hei-tiki, carved by the Maoris, the gift of H.M. Queen Mary; a very extensive collection of polished Italian marbles, presented by Mr. Percy C. Webb; and a magnificent group of deeply coloured amethyst crystals from Brazil, loaned by the managers of the Royal Institution. The Geological Society of London has presented a group of large pillars of basalt, from the Giant's Causeway in Antrim; an *Ichthyosaurus* from the Lower Lias of Barrow-on-Soar; a very fine slab of Wenlock Limestone with *Periechocrinus moniliformis*, etc., collected by the late Earl of Dudley; and a beautiful specimen of *Pentacrinus briareus* Miller from the Lias of Lyme Regis, collected by Sir H. T. de la Beche, the first director of H.M. Geological Survey. Within recent months, the Museum has added to its permanent exhibits on economic geology displays on abrasives, moulding sands, refractory materials, and other subjects of industrial interest.

Codes Used in Weather Forecasts

"WIRELESS WEATHER MESSAGES, 1937" (Publication M.O. 252, tenth edition. London: H.M. Stationery Office. 1*s*. 6*d*. net) has the sub-title "Particulars of Meteorological Reports issued by wireless telegraphy and wireless telephony in Great Britain, Gibraltar, Malta, Middle East and Iraq", and this defines its scope. It incorporates changes in some of the specifications of the International Code used for meteorological messages that were adopted at the International Meteorological Conference held at Warsaw in September 1935, changes which came into operation on January 1, 1937. There are two sections giving, respectively, details of the codes used for weather forecasts for aviators and details of the codes used for messages giving special information supplementary to routine reports for aviation. These sections follow the main body of the publication dealing with the main transmissions from shore stations and ships. In spite of some economy of space that has been introduced in setting out the details of individual transmissions, this publication now contains about ninety pages, and its growth in recent years corresponds with that of aviation and of the international exchange of meteorological information.

Carnegie Trust for the Scottish Universities

THE Carnegie Trust for the Universities of Scotland has recently published its report for 1935–36. Grants to universities and extra-mural institutions amounted to £51,460, expenditure on assistance in payment of class-fees to £53,971, grants under the Trust's scheme for endowment of research to £17,880. The progress of recovery from economic and industrial depression in Scotland is reflected in the exceptional number of resignations of fellows and scholars due to their appointment to paid positions. Of thirty-two fellows and scholars in chemistry, organic and physical, fifteen resigned, some almost at the commencement of their appointment periods. Another indication of prosperity is the sharp rise in the amount of voluntary repayments by former recipients of aid from the Trust. These repayments amounted to £2,362, the largest amount so received by the Trust since 1928–29, and only exceeded in that year and 1926–27. The aggregate amount of such repayments since the inauguration of the scheme in 1901 is £38,000.

Rearing Marine Organisms in the Laboratory

THE *Aquarist and Pond-Keeper* of January–February 1937, besides a number of other interesting papers, contains an article by Mr. Douglas P. Wilson, naturalist at the Marine Biological Laboratory, Plymouth, on the plunger jar for rearing marine organisms. This is a piece of apparatus much used in the Plymouth Laboratory, originally planned and used by Mr. E. T. Browne for rearing medusæ, the main idea being to create a definite rhythmical movement in the aquarium by means of a glass plate, the plunger, manipulated by a siphon. All workers at Plymouth are familiar with the plunger jar, and it is now used in many laboratories. Numerous well-known researches have been successfully conducted by its aid; echinoderms, molluscs, crustaceans, worms, have all been reared, and it is fit that the plunger-jar should be introduced to all those who wish to keep marine animals. Mr. Wilson, who has himself reared successfully several sea-worms from the egg, describes how this can be done.

Annual of the Astronomical Observatory, Madrid

THE receipt of the usual annual astronomical handbook from Madrid ("Anuario del Observatorio Astronómico de Madrid") in the unusual circumstances that exist to-day in Spain, calls for at least a brief comment. The 1937 handbook contains current tabular matter that is likely to be of general use to observers in Spain—astronomical elements, tables of sunrise and sunset and of moonrise and moonset (in each case for Madrid), planetary phenomena, solar and lunar eclipses, positions of the principal nebulæ and double stars, etc. A set of monthly charts is included to illustrate the night-skies as seen by an observer at Madrid, and a concluding chapter describes the use of wireless time-signals for the dissemination of standard time and the application of the signals to longitude determinations.

Société Astronomique de France (1887-1937)

THIS year, the Société Astronomique de France celebrates its fiftieth anniversary, and the January issue of *L'Astronomie* recounts the circumstances of its inception on January 28, 1887, owing chiefly to the efforts of M. Camille Flammarion. The aim of the new society was to foster in France an interest in astronomy and to establish a link mainly between non-professional astronomers in all parts of the country. The society now has a membership of 5,000, and includes astronomers from many countries; it possesses an observatory in Paris which members may use, and records its regular meetings and general activities as well as publishing papers in its monthly periodical, *L'Astronomie*. We welcome this opportunity of extending our congratulations.

The Pasteur Institute of Southern India

MAJOR IYENGAR, director of the Pasteur Institute of Southern India, Coonoor, has issued his annual report for the year ended March 31, 1936. The number of patients who underwent a full course of treatment at the Institute was 433, and 102 patients received incomplete treatment for various reasons. There were no deaths from hydrophobia among those treated at the Institute. In addition, more than 14,000 courses of antirabic vaccine were issued to outlying centres. Details of the course of treatment are given; Semple's carbolized 5 per cent sheep vaccine was in use throughout the year, prepared from Paris fixed virus.

Announcements

PROF. HEINRICH WIELAND, professor of chemistry at Munich, has been elected a corresponding member of the Physico-Mathematical Section of the Prussian Academy of Science.

SIR HARRY LINDSAY, director of the Imperial Institute, has been nominated as president of the Association of Special Libraries and Information Bureaux, (ASLIB), for the year 1937–38. The Association will hold its fourteenth Annual Conference at Gonville and Caius College, Cambridge, during the week-end beginning September 24. Particulars may be obtained from the Secretary of the Association, 31 Museum Street, London, W.C.1.

MR. T. G. ROSE has been appointed general director of the National Institute of Industrial Psychology, to collaborate with Dr. C. S. Myers, the principal, who will retain the position held by him since the inception of the Institute sixteen years ago.

LORD SNELL will open the Studio of Animal Art in the Zoological Gardens of the Zoological Society of London, Regent's Park, N.W.8, on April 21 at 2.30.

A BUST of Prof. Babes, founder of the first Pasteur Institute in Bucharest, who died ten years ago, was recently unveiled in Bucharest, when memorial addresses were delivered by Profs. Bacalogliu, Ciuca, Manicatide, Marinesco and Proca.

THE thirty-ninth annual conference of the Institute of Public Cleansing will be held at Margate from June 14–18. Further information can be obtained from the honorary secretary of the Institute, 160 Buckingham Palace Road, S.W.1.

AN International Conference on "Esperanto in Modern Life" will be held in Paris on May 14–17. Participation in the Conference is free. Further information can be obtained from the secretariat, Conférence Internationale (L'Esperanto dans la Vie Moderne), 34 Rue de Chabrol, Paris, 10^e.

THE thirty-fifth annual session of the South African Association for the Advancement of Science will be held at Windhoek, South-West Africa, under the presidency of Lieut.-Colonel C. Graham Botha, on July 5–10. Further information can be obtained from Dr. C. F. Juritz, Department of Agriculture, P.O. Box 3, Capetown.

A COMMITTEE has been formed by the French Air Ministry to deal with the requirements of the air force and to secure the best possible adaptation of the human organism for military aerial navigation. The functions of the committee will be first to express opinions on biological and medical problems brought before it by the Air Minister, and secondly to supply the Minister with useful suggestions regarding biological questions relating to military aviation.

THE triennial award of the Coopers Hill War Memorial Prize and Medal will be made this year by the Institution of Electrical Engineers, which invites members to submit for consideration a paper on any subject coming within the scope of electrical science or electrical engineering and their applications. Further information can be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 634.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Effects of Traces of Metallic Ions on Monolayers

IN a recent communication to NATURE[1], Prof. W. D. Harkins and Dr. R. J. Myers have directed attention to the effects of minute traces of metallic ions on the behaviour of monomolecular films at the surface of aqueous solutions.

It may be of interest to investigators in these fields to add that the effects of such traces of impurities are not always confined to modifying, to a greater or less extent, the physical characteristics of the films, but may on occasion play a predominating part in chemical reactions taking place in the films. While treating with reserve all results on unbuffered aqueous solutions, since marked changes in the characteristics and reactivities of films of various types can be effected by small changes in the pH of the underlying solutions, profound effects on the reactivity of molecules in the boundary state can on occasion be observed due to the presence of even slight traces of metallic ions, especially nickel or copper.

The importance of minute traces of metallic ions is clearly demonstrated in the examination of photochemical reactions in monolayers[2,3,4]. In the case of the photochemical hydrolysis of monolayers of stearic anilide on $5N$ sulphuric acid substrates, it has been found that the velocity of an anomalous 'fast' reaction was reduced to a normal value by the addition to the substrate of potassium cyanide in a concentration of the order of $M/2000$. In the photochemical decomposition of monolayers of α-hydroxystearic acid on $N/100$ sulphuric acid substrates, probably with splitting off of carbon dioxide, the unsensitized process appears to occur only with radiation of wave-lengths shorter than 2400 A., but sensitization to the wave-length 2537 A., isolated by means of a monochromator, can be produced by the presence of sub-analytical quantities of nickel ions; for example, 3γ of nickel in 500 c.c. of substrate for a film of area 100 sq. cm. Evidence was obtained that sensitization occurred only after the formation of a complex which appears to consist of one molecule of α-hydroxystearic acid and one nickel atom. Further, it is probable that the photochemical oxidative and hydrolytic changes in monolayers of proteins, such as ovalbumin, can be sensitized to wave-lengths greater than 3350 A. by traces of nickel and copper, although the possibility of unsensitized processes at these long wave-lengths cannot be entirely excluded.

On occasions the source of copper contamination has been traced to the distilled water, and in this it can be estimated by its catalytic activity on alkaline sulphite oxidation.

The effects due to the adventitious presence of traces of the alkaline earths are much less marked when the films are on acid substrates, as Langmuir has pointed out. However, some years ago, Dr. A. H. Hughes, working in this Laboratory, found that ferric ions even in $N/100$ hydrochloric acid, would affect films of myristic acid both with respect to the state and phase boundary potential of the film; ferrous ions, on the other hand, in the same substrate at concentrations of 1·2 gm. ferrous sulphate ($FeSO_4.7H_2O$) per litre had no appreciable effect until oxidized by hydrogen peroxide. The ionic concentrations in these cases were of a different order of magnitude from those which we have considered above.

Similarly, in the case of stearic acid monolayers on $N/100$ hydrochloric acid, an increase of phase boundary potential of 55–60 millivolts is produced by the presence in the substrate of ferric ions in concentrations greater than $M/5000$. No changes were observed with copper, nickel, cobalt, chromic or ferrous ions, even in concentration of $M/300$ in the substrate. Monolayers of α-bromostearic acid on $N/100$ hydrochloric acid show an increase of phase boundary potential, and solidification, on addition to the substrate of ferrous ions in a concentration of $M/1000$, but only in the presence of hydrogen peroxide; $M/10,000$ solutions of lead acetate lower the phase boundary potentials of films of α-bromostearic acid by 30 millivolts.

In contrast to the case of stearic acid, films of α-bromostearic acid at pH 2 and pH 6 show no changes on addition of ferric ions to the substrate. While nickel and chromic ions produce an increase of phase boundary potential of films of α-hydroxystearic acid at pH 2, no changes are observed with these ions in the case of stearic acid and α-bromostearic acid. At pH 6, monolayers of ovalbumin show an increase of phase boundary potential on addition to the substrate of copper ions in concentration $M/3000$; nickel, ferric and uranyl salts are without effect even at much higher concentrations.

Since the chemical reactivities of the substances forming the films, as well as the physical characteristics of the films themselves, are so greatly affected by these metallic impurities, we have for the last few years made a practice of attempting to eliminate them by using glass or quartz troughs, employing a mica boom for the Langmuir balance and paying especial attention to the distilled water and the purity of the buffer salts. We may mention that we have not been uniformly successful in eliminating, on every occasion, all traces of metals which act as catalytic or photosensitizing agents, and believe that our experiments are especially affected by copper in so far as the activity is destroyed by the addition of potassium cyanide.

The profound modification of the chemical properties of the monolayers of widely different compounds produced by the presence of extremely small traces of active substances including metallic ions is probably of great biological significance. The phenomena described are characterized by a sensitivity and specificity which is remarkably similar to that of many pharmacological actions. We wish to suggest that these methods may offer a means of approach, not only to the problem of the oligodynamic action of metals, but also to the elucidation of more general aspects of the action of drugs and the mechanism of photo-biological sensitization.

J. S. Mitchell.
E. K. Rideal.
J. H. Schulman.

Colloid Science Laboratory,
Cambridge.
March 16.

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[1] Nature, 139, 367 (Feb 27, 1937).
[2] Schulman, see Rideal, *Kolloid Z.*, 61 218 (1932).
[3] Rideal, *Proc. Roy. Soc.*, A, 155, 684 (1936).
[4] Rideal and Mitchell, *Proc Roy. Soc.*, A (in the press).

In a recent issue of Nature, Myers and Harkins[1] directed attention to the possibility of considerable errors arising in experiments on monomolecular films where small quantities of ions are introduced from the glass vessel or the metal trough. Experiments which we have carried out recently at University College, London[2], show that corresponding errors may arise in the measurement of interfacial tensions as a result of the presence of minute quantities of ions in the distilled water. Thus when using ordinary laboratory distilled water, minima were obtained in the interfacial tension-concentration curves for sodium cetyl sulphate against various oils, the interfacial tension with 0·05 per cent sodium cetyl sulphate being several hundred per cent higher than the minimum which occurred at about 0·015 per cent. Similar results were obtained with sodium salts of other long-chain acids. On using very good conductivity water (specific conductivity $0{\cdot}1 \times 10^{-6}$ ohm.$^{-1}$ cm.$^{-1}$ or less) these minima were no longer found. The ordinary distilled water evidently contained small quantities of a cation which strongly depresses the interfacial tension of such systems, its effect being greater in the lower concentrations of long-chain salt.

The effect of salts in lowering the interfacial tension of oil against solutions of the salts of long-chain acids seems to depend primarily on the valency of the cation. Thus in a particular case (with 0·005 per cent $C_{17}H_{33}CON(CH_3)CH_2CH_2SO_3Na$) the concentration of salt required to diminish the interfacial tension from 6·25 to 1·0 dynes/cm. was 0·32 *N* sodium chloride, 0·003 *N* calcium chloride and 0·00005 *N* lanthanum chloride. The effect is independent of the nature of the anion, and is therefore analogous to the Schulze-Hardy rule for the precipitation of colloids. The influence of calcium salts has previously been observed by Harkins and Zollman with sodium palmitate[3]. In our experiments we have the same influence even when a long-chain acid with a soluble calcium salt is used.

On increasing the concentration of the salt the interfacial tension at first drops and then reaches a value which shows no further decrease. The higher the valency of the salt, the lower are these final values.

It would seem that the influence of the cation is in reducing the repulsion between the heads of the long-chain ions adsorbed at the interface, so allowing a closer packing in the interfacial film, with a consequent further lowering of the interfacial tension.

If our theory is correct, that the effect is primarily dependent on the valency of the ion with charge opposite to that of the long-chain ion, a corresponding effect, dependent on the valency of the *anion*, would be expected with such substances as cetyl pyridinium chloride adsorbed at the interface. Unfortunately, it was necessary to discontinue the research before this could be investigated.

Conmar Robinson.

British Leather Manufacturers'
Research Association,
London.
March 14.

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[1] Harkins and Myers, Nature, 139, 367 (Feb. 27, 1937).
[2] Robinson and Selby, unpublished.
[3] Harkins and Zollman, *J. Amer. Chem. Soc.*, 48, 69 (1926).

Acute Mercury Poisoning in a Respiration Chamber

In the Laboratory of Zoophysiology we have a steel chamber of 27 cubic metres capacity, which is generally ventilated at a rate of 20 cub.m. per minute at pressures from the atmospheric down to 200 mm., corresponding to a height of 10 km.

In certain experiments it is used, however, without ventilation as a closed chamber in which the air is simply circulated, the oxygen supply being sufficient for two persons over twenty-four hours or more. In one such experiment, the effect of 4·5 per cent carbon dioxide had been studied over 19 hours without any symptoms beyond a pronounced hyperpnœa, but when it was desired to repeat this experiment and extend it over several days, the subjects became ill with bronchial irritation, violent coughing and severe headache after a few hours and had to break off.

In the night a few hours later, the condition became worse, with increased temperature, dyspnœa and nausea. After three days, a stomatites affection supervened lasting two weeks, and the dyspnœa and fatigue by muscular exertion lasted for months.

Experimental animals (guinea pigs, rats and mice) were killed by the air in the chamber in 24–48 hours with severe pulmonary œdema.

A careful analysis showed that the symptoms were due to mercury poisoning from droplets spilled on the floor. Pulmonary symptoms became pronounced only when hyperpnœa was produced (by carbon dioxide), but in the absence of this the animals developed œdema and hæmorrhagia of the lower gut and died in three to four days instead of one to two days. When the air in the chamber was not artificially mixed, the animals would remain alive for several days more. Even when the chamber had been cleaned out and every visible trace of mercury removed, symptoms of mercury poisoning could still be produced in one to two weeks, and the last invisible traces had to be removed by long-continued ventilation.

It is evident that mercury in a non-ventilated or poorly ventilated room can become very dangerous, especially at high temperature, when the air is kept well mixed and when the subjects are breathing deeply, as with muscular work. It would appear that even in ordinary rooms in which mercury is spilled occasionally and can become finely divided and distributed by floor scrubbing, the air can become sufficiently poisonous to cause mild chronic symptoms in persons spending much of their time in such rooms, and this note is published mainly to warn against such danger.

A full account of the experiments will be published in *Skand. Arch. Physiol.*

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Ammonia Formation in Shed Blood and a Characteristic Deaminase of the Blood Stream

APPLYING a method[1] for determining the blood ammonia by which forty determinations may be easily carried out in a few hours on 1 ml. samples, certain curious facts have been discovered. As is well known, ammonia forms in shed and sterile blood, and it has been shown to begin from zero concentration[1]. In a further study here, it has been observed that the formation goes in a succession of well-marked stages. Five such have been observed over the 24 hours. Such phasic formation has been observed for the rabbit, man and bird, appearing in the blood from each individual but at somewhat varying times, so that averaging the results from many animals will smooth out the curve of formation.

The following gives a summary of the phases as they appear in oxalated and sterile rabbit's blood (whole or laked) at room temperature.

	Duration (min.)	Conc. reached (γN%)
1st phase	0–5	50
2nd phase	5–45	200
3rd phase	45–100	400
4th phase	100–200	700
5th phase	240–400	1600

These figures are only very approximate, since occasional delays of upwards of an hour or more may occur before the appearance of a phase, the blood ammonia remaining constant the while. The optimum *p*H for the formation is about 8·7, though at 9·1 it is only a little less. The formation is also much influenced by saline concentration and practically ceases with 5 per cent sodium chloride. A reversal effect has been observed on the acid side and is being investigated.

During a study of the effect of adding a large number of different amino compounds to shed blood, a very potent deaminase of adenosine has been discovered therein. This would seem universally distributed, if we may judge from its appearance in the blood of man, fowl, frog and the lug worm (*Arenicola*). Its concentration in rabbit's blood is such that small quantities of adenosine added to shed blood (laked) are deaminated to within 60–90 per cent of the maximum in five minutes, the blood being maintained at *p*H 6·7 (most suitably by such a buffer as maleic acid owing to the specific action of the phosphate). This deamination rate occurs at room temperature and with a blood dilution of 1 : 3. The blood concentration of the enzyme is sufficiently high in the rabbit to suppose that all the adenosine deaminase previously found in muscle and liver[2,3,4] may have been really contained in the residual blood in these tissues.

By comparison with adenosine, adenylic acid (from muscle) added to laked blood is practically untouched after several hours, unless buffered towards the acid side (maleic acid buffers) and even then very much more slowly than adenosine. In fact, just as the adenylic acid deaminase may be described as the special deaminating ferment of muscle, so adenosine deaminase may be regarded as characteristic and apparently universal for the blood stream, and appears both in plasma and in red corpuscle.

It has also been shown here that the nucleated corpuscle of the fowl can deaminate adenine, guanine and cytosine readily at room temperature.

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[1] Conway, E. J., *Biochem J.*, **29**, 2755 (1935).

[2] Gyorgy, P., and Rothler, R., *Biochem. Z.*, **187**, 194 (1927).

[3] Schmidt, G., *Z. physiol. Chem.*, **179**, 243 (1928).

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A Simple Aromatic Œstrogenic Agent with an Activity of the Same Order as that of Œstrone

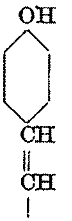
IT has previously been shown that the phenanthrene nucleus is not an essential part in the molecule of an œstrogenic substance[1], since the full œstrus response could be produced by the injection of substances so simple as 4 : 4′-dihydroxy diphenyl. Further experiments with compounds of this type have been made, and the following table indicates the potency of some new substances.

TABLE 1.

Substance	Dose in mgm.	Percentage positive
4 · 4′-Dihydroxy dibenzyl ..	100	100
4 : 4′-Dihydroxy stilbene .	10	100
,, ,, ,, . .	5	60
4-Hydroxy stilbene	10	100
,, ,, ...	5	40
Stilbene	25	100
4 . 4′-Dihydroxytolane ..	10	100
,, ,, .	5	80
4-4′-Dihydroxy diphenyl ether .	100	100
4-Hydroxy-phenyl cyclohexane ..	100	80

In view of the activity of stilbene, it was decided to experiment with substances containing only one benzene ring, and it was found that so simple a compound as *p*-hydroxy phenyl ethyl alcohol was capable of producing a full œstrus response in 60 per cent of animals when injected in doses of 100 mgm.

A much more potent substance, however, was found to be the phenol derived from the essential oil anethole. This substance, namely, *p*-hydroxy propenyl benzene, or anol, was found to possess a very high degree of activity.



In each case the material was administered dissolved in 3 c.c. of sesame oil, and was given in six injections, morning and evening during three days. The rats were smeared on the morning of each day, and on the fourth and subsequent days were smeared at midday and in the evening in addition. *p*-Hydroxy propenyl benzene when administered in this manner was found to be active in doses from 100 mgm. down to 0·001 mgm. Thus 1 γ is capable of producing a full œstrus response in 100 per cent of the animals injected. The amount of œstrone required to produce a similar response in these animals is in the region of 1·γ. It can be seen, therefore, that this simple substance has an activity approaching that of the naturally occurring hormone, œstrone. It is also interesting to note that the benzoylated compound is active. (The benzoate of *p*-hydroxy propenyl benzene crystallizes from alcohol in plates, m.p. 124° C. and gave on analysis C = 80·4 per cent, H = 6·0 per cent; $C_{16}H_{14}O_2$ requires C = 80·6 per cent, H = 5·9 per cent.)

It is as yet too early to discuss the theoretical importance or therapeutic application of these observations, but the fact that the potency is so high brings a new importance to the investigation of synthetic œstrogenic agents.

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[1] Dodds and Lawson, NATURE, 137, 996 (1936)

Cyclical Fluctuations in Œstrin Threshold

Cyclical changes in the accessory reproductive organs of female mammals have been ascribed entirely to cyclical fluctuations in the secretion and interaction of the ovarian hormones. Fluctuations in the latter are controlled by the anterior lobe of the pituitary.

Experiments in which œstrogenic hormone has been injected into the same female rhesus monkeys over a period of two years show that a new factor must be taken into account in the explanation of rhythmical changes in the accessory organs. It appears that the threshold of a monkey to œstrogenic stimulation varies cyclically. The least constant daily dose of œstrogenic hormone that is required to influence the uterus sufficiently for the cessation of injections to be followed by a phase of uterine bleeding, or that is necessary to maintain the uterus in a phase of growth, is not necessarily the same on different occasions. In one experiment, phases of uterine bleeding occurred at regular intervals of from five to seven weeks in a spayed immature monkey that was injected daily with 100 I.U. of œstrone for a period of a year. The rhythmical rise in the œstrone-threshold must be due either to the cyclical liberation into the blood stream of a substance (possibly from the pituitary) which in some way neutralized œstrone, or to an inherent cycle in the threshold of the tissues. It is of interest that these fluctuations were revealed not only by mature animals, but also by one that had not reached puberty at the time its ovaries were removed.

The pronounced mid-cycle fall in the degree of œstrogenic stimulation in the menstrual cycle is correlated with the removal of water from both the uterus[1] and the sexual skin[2] (a considerable amount of water may be removed from the sexual skin). The further dehydration of the uterus at the time of menstruation[1] is not improbably related to a further, but relative, fall in the degree of œstrogenic stimulation occasioned by a rise in the œstrone-threshold of the kind described above.

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[1] van Dyke, H. B., and Chen, G., *Amer. J. Anat.*, 58, 473 (1936).

[2] Krohn, P. L., and Zuckerman, S., *J. Physiol*, 88, 369 (1937).

Nicotinic Acid and the Growth of *Staph. aureus*

Further chemical work towards the isolation of the so-called 'staphylococcus growth-factor', previously described[1], suggested that at least part of the biological activity of the high-vacuum distillate derived from yeast extract might be due to nicotinic acid and/or the corresponding amide.

The gelatin-hydrolysate basal medium already described[1] was used. *Staph. aureus* will not grow (ærobically) on this medium alone. It has now been found that addition of nicotinic acid, or its amide, will permit growth when added to this basal medium, as a substitute for the concentrated preparation from yeast (high-vacuum distillate) ordinarily used as source of the growth-factor. This distillate and nicotinic acid have the same order of activity.

The same potency is shown by different samples of nicotinic acid, namely: (*a*) nicotinic acid prepared by nitric acid oxidation of nicotine; (*b*) nicotinic acid prepared by acid hydrolysis of pyridine-3-nitrile (prepared from pyridine); (*c*) a three-times recrystallized specimen from a fractional crystallization of technical nicotinic acid (the least- and most-soluble fractions were somewhat less active).

The fact that the pyridine-3-nitrile was inactive before hydrolysis is the best evidence that it is nicotinic acid itself and not an associated impurity which is biologically active.

Nicotinic amide is more active than nicotinic acid; 0·05 γ of amide per 10 ml. of medium will permit a just visible growth.

Using the amino-acid basal medium recently described[2], nicotinic acid and the amide are inactive, whereas the high-vacuum distillate is active. This indicated therefore that the 'staphylococcus growth-factor' is complex, and that only one component of it can be replaced by nicotinic acid or its more active amide. The other component (or components) is present in limited amount in the gelatin-hydrolysate, and in the high-vacuum distillate.

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March 10.

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[1] Knight, B C. J. G., *Brit. J. Exp. Path.*, 16, 315 (1935).

[2] Fildes, P , Richardson, G. M., Knight, B. C. J. G., and Gladstone G. P., *Brit. J. Exp. Path.*, 17, 481 (1936).

Visible Mesomorphic Fibres of Tobacco Mosaic Virus in Juice from Diseased Plants

In Nature of December 19 last there appeared an interesting letter by Bawden, Pirie, Bernal and Fankuchen under the heading "Liquid Crystalline Substances from Virus-infected Plants". I have arrived at conclusions similar to some of those recorded in the above letter, and the following, to some extent complementary, observations may be of interest.

Fig. 1 (*a*) is a photomicrograph of what I consider to be fibres of tobacco mosaic virus. This conclusion is based on the following facts. The fibres developed in a sample of the expressed juice of mosaic-diseased tobacco plants which had been clarified by centrifuging and afterwards stored at about 1° C. for several months. The bulk of the juice was then found to be clear, and a dense, creamy-white, fibrous sediment of protein, which took up less than one-fifth of the total volume but which contained 97 per cent of the infective principle, had formed at the bottom of the flask. A drop of this sediment with accompanying mother liquor was taken to prepare the slide used for the photographs reproduced here.

The fibres, when undisturbed, appeared to be several centimetres long and fairly flexible, but when mounted under a cover-slip they usually broke into fragments 2–5 mm. in length. The width of individual fibres was of the order of 0·001 mm. Viewed under crossed nicols, the fibres were seen to be doubly refractive with straight extinction, as shown in Fig. 1 (*b* and *c*).

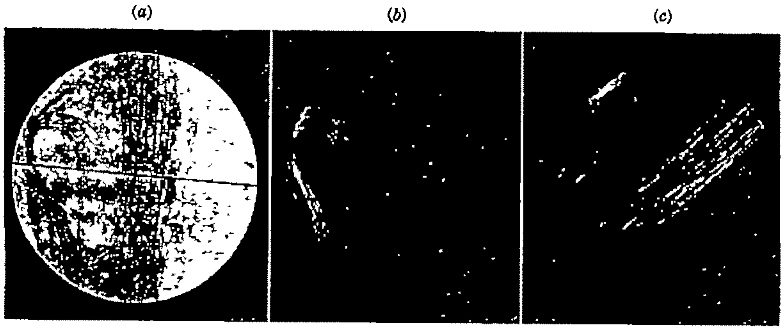

Fig. 1

a. PHOTOMICROGRAPH OF PORTION OF FIBRES FORMED IN THE CLARIFIED JUICE OF MOSAIC-DISEASED TOBACCO PLANTS AFTER THE JUICE HAD STOOD AT 1° C. FOR SEVERAL MONTHS. *b.* THE SAME FIELD AS IN *a*, PHOTOGRAPHED BETWEEN CROSSED NICOLS. *c.* THE SAME FIELD AS IN *a* AND *b* PHOTOGRAPHED BETWEEN CROSSED NICOLS AFTER ROTATING THE STAGE THROUGH 45°. ALL × APPROX. 60.

An entirely different property was observed when the fibres were viewed by reflected light. They showed up as bright white streaks when the incident light was at right-angles to their length, but were scarcely visible when the light was parallel to the fibres, suggesting a terraced structure in one direction.

By gently agitating the suspension, the fibres broke up into shorter lengths and had the appearance of short, straight needles or rods (0·1 mm. or shorter). Violent shaking reduced the greater part of them to a state where they were no longer visible (×600), and at this stage the suspension was translucent. On standing undisturbed, the process was reversed, and finally the long, satin-like fibres reconstituted and settled at the bottom of the tube, leaving a clear, supernatant liquid. This process was repeated many times without causing any apparent change in properties. The fibres were reduced to a state below microscopic visibility by quite moderate dilution.

The probability of the identity of the fibres with the infective principle was further strengthened by their behaviour when heated. The fibrous material underwent no visible change until a temperature just below 92° C. was reached, when the whole mass cleared abruptly and the fibrous, satin-like substance changed to a clumped, coagulated mass which floated to the top. The fibres were then no longer visible under the microscope and the change appeared to be irreversible. The temperature at which the fibres collapsed is also the temperature of the thermal inactivation point of this virus.

If the reaction to heat of a dense, tangled mass of the fibres is watched under the microscope, the fibres are seen to maintain their form and appearance unchanged until near the transition point, when there occurs a quivering of the whole mass, frequently followed by a general flow. The fibres then straighten and appear to become taut. This is followed by a back-and-forth movement, and suddenly the fibres break and each segment shrinks or telescopes in opposite directions. The disrupted fragments go on shrinking and collect in aggregates, leaving the formerly crowded field practically empty.

The ease with which the fibres break up on agitation, and re-form on standing to give exactly similar forms, and other properties, indicate a homogeneity of the constituent units. These fibres are not formed in the expressed juice of healthy plants which has been stored under the same conditions. Although this in itself by no means proves the virus nature of the fibres, when we consider the evidence as a whole, particularly the association of infectivity with the fibres and the identity of the temperature at which the fibres undergo a sudden, deep-seated and apparently irreversible change with the temperature at which the virus rapidly and irreversibly loses its infectivity, there can be little doubt that the fibres are composed of virus, or at least that the virus forms an essential constituent of the fibres. It seems to be a fair conclusion that these mesomorphic, flexible fibres consist of long chains of virus particles linked together by relatively feeble bonds.

The circumstance that under certain conditions the fibres have the appearance of short needles or rods raises the question as to whether the needles obtained by crystallization from ammonium sulphate solution, as first worked out by Stanley[1], may not in fact be short mesomorphic rods rather than true crystals.

The deduction by Bawden, Pirie, Bernal and Fankuchen of the presence of long fibres in their systems, is thus confirmed by my direct observation of the existence of such fibres.

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[1] Stanley, W. M., *Phytopath.*, 26, 305 (1936).

Adsorption on Foam

SINCE surface active substances are among the most active pharmacologically (Michaelis and Rona[1]) we may expect that surface active substances in the organism may be likewise of great importance. It occurred to me that the adsorptive capacity of the great surfaces of foams might be employed in the concentration of such substances, and I have developed a simple technique for this purpose.

The apparatus[2] is outlined in Fig. 1. The liquid to be examined is placed in *C*. Air or an inert gas is bubbled through the liquid by means of the capillary tube *A* which ends in a fine jet *B*. The tube *A* is sealed into the ground glass junction *E*, and may be interchanged with other tubes having various bores. The gas pressure is adjusted so that the foam produced by the bubbles passes slowly over into the a receiver *D*. *C* and *D* are connected by a ground glass junction *G* which allows the interchange of receivers, so that *different fractions of the foam* may be removed. The liquid formed in *D* (denoted by *F*) by the settling of the foam, may now be compared with the original solution (denoted by *O*), and the remainder of the solution in *C* (denoted by *R*). In an experiment with saponin, 1 ml. of the solution *F* was calculated to have had a total superficial area of about 32 m.[2] when in the foam state, which area corresponds to the thickness indicated by the appearance of interference colours.

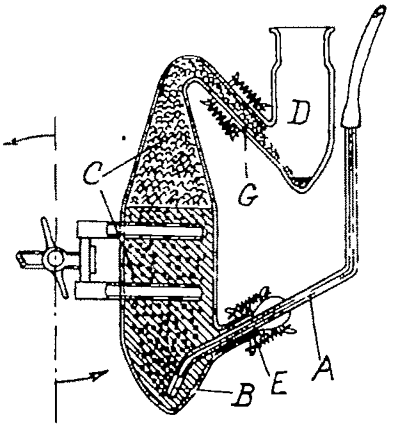

Fig. 1.

The surface tension of the solutions always shows the following relationship: $R>O>F$. By experiments on sodium cholate, carried out in collaboration with R. Bader, it has been shown that there is a concentration of the cholic acid (furfurol-test, Pulfrich photometry[3]) in the liquid formed from the foam (*F*), which contains up to 65 per cent more of the acid than *O*. Further, it proved possible to separate cholic acid from Na-cholate by this method. A precipitate always formed in the earlier *F*-fractions, which proved to be pure cholic acid. No precipitate ever formed in *O* or in *R*.

In most cases the *p*H of *F* and *R* was different from the *p*H of *O*. For example, when *O* is rabbit serum or Na-cholate, *F* tends to become acid, *R* to become alkaline. When *O* is saponin the change in *p*H is in the opposite direction. This apparently means that all the ions are not equally adsorbed on the foam surface. In the case 0·5 per cent Na-cholate solution, the difference in surface tension (σ) between the *F* and the *R* is about 6–8 dynes/cm., the difference in *p*H is about one unit. In the case of 0·02 per cent saponin solution $\Delta\sigma$ is up to 20 dyne/cm., ΔpH about 0·6 unit. Measurements of *p*H were made with a glass electrode, surface tension by the ring method (Lecomte du Noüy's automatic tensiometer[4]).

In collaboration with H. Mann it was further found that the foam has a higher temperature than the liquid from which it is produced (when the gas has the same temperature as the liquid). This effect seems to be a necessary condition for the formation of any foam. The effect would appear to agree with the principle of Braun and Le Chatelier, since in the case of all the substances examined, the production of foam becomes more difficult as temperature increases. The temperature difference (ΔT) between foam and liquid is greater for low concentrations of capillary active substances than for high concentrations. In the case of 0·01 per cent saponin solution, $\Delta T = 3{\cdot}3°$ C.

In collaboration with G. Kolmer it was found that hæmoglobin is less concentrated in the first fractions of *F* than in *O*, but more concentrated in later fractions of *F*, when *O* is a mixture of hæmoglobin and serum. It would seem that substances differing from each other as regards capillary activity pass over one after the other in the various fractions. In collaboration with H. Lassner it was found that the complement and antibodies (hæmolysines) of rabbit serum are not destroyed in the foam.

Detailed reports will appear shortly.

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Feb. 23.

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[1] Michaelis und Rona, "Prakt d physikal. Chemie" (Berlin, 1930)

[2] Pat. pending. The apparatus is obtainable of K Ewald, Vienna IX

[3] Josephson, B., *Biochem. J.*, **29**, 1519 (1935).

[4] Lecomte du Noüy, "Equilibres superficiels des solutions colloidales" (Paris, 1929)

Absorption Spectrum of the Carboxyl Group in the Vacuum Ultra-Violet

WE have recently been investigating the far ultra-violet absorption spectra of a number of organic compounds of the type R_1COOR_2; R being an alkyl group or a hydrogen atom. It has been found that only the simplest of these, namely formic acid, shows discrete absorption bands in the region 2000–1000 A. The interpretation of the electronic structure of the carboxyl group will therefore depend to a considerable extent upon the analysis of these discrete bands.

The first strong absorption of formic acid starts around 1550 A., at which wave-length a set of somewhat diffuse bands appear. Between 1400 A. and 1100 A. the bands are sharp. The analysis shows that they consist of a number of electronic transitions each of which is represented by a short vibrational progression of two or three members. These pr[illegible]gressions are strong and well separated at long wave-lengths, but become weaker and overlap towards shorter wave-lengths, eventually merging into a continuum around 1100 A. A plausible Rydberg series formed from the ν_0's of the progressions has its limit just about where the continuous absorption begins, namely, 11·2 volts. This value may be compared with the value 10·83 volts obtained for the ionization potential of formaldehyde by a similar method[1].

Mulliken[2] has shown that the latter ionization potential is to be associated with the removal of a non-bonding 2*p* electron from the oxygen atom of the C=O group. He also states that the absorption spectra of the organic acids and esters should resemble the aldehydes and ketones in this respect. The closeness of the two ionization potentials seems to confirm his view. In fact, below 1600 A. a definite correspondence has been found between the electronic transitions of formaldehyde and formic acid; the related bands of both molecules occurring in the same wave-length regions. While there are no analogues in the spectrum of formic acid to the formaldehyde bands at 3000 A. and 1750 A., it must be pointed out that these latter bands are not included among the Rydberg bands of that molecule. Actually their upper states have been assigned to certain anti-bonding orbitals which are apparently suppressed by the presence of the O–H group.

Further evidence that the ionization potential reported here is to be attributed to an electron from the carbonyl group comes from the fact that the strongest vibration frequencies accompanying the excitation were found to have values lying between 1400 and 1500 cm.$^{-1}$. A consideration of the intensity distribution in the progressions shows that they correspond to the vibration 1647 cm.$^{-1}$, of the unexcited state[3]. This is the valence frequency of the C=O bond. Thus we have both the vibration and the excitation occurring in the carbonyl group.

In addition to the bands reported above, some very diffuse (pre-ionized) bands were found in the region below 1100 A. superimposed on the ionization continuum. These may well be due to the excitation of non-bonding electrons from the O–H group. However, it was not possible to make sufficiently accurate measurements on them to justify an analysis.

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[1] Price, W. C., *J. Chem Phys.*, 3, 256 (1935).

[2] Mulliken, R. S., *J. Chem. Phys.*, 3, 564 (1935).

[3] Hibben, J. H., *Chem. Rev.*, 18, 1 (1936).

A Sensitive Adaptation of the Spoon Gauge

THE spoon gauge is probably the most satisfactory and easily constructed instrument available for the accurate measurement of pressure differences when the use of a manometric liquid is not permissible. Its sensitivity, however, is limited to a pointer movement of about one millimetre for each millimetre of mercury pressure, or perhaps a little more with very fragile gauges. We describe below an effective design which shifts the sensitivity several decimal places into the high vacuum range.

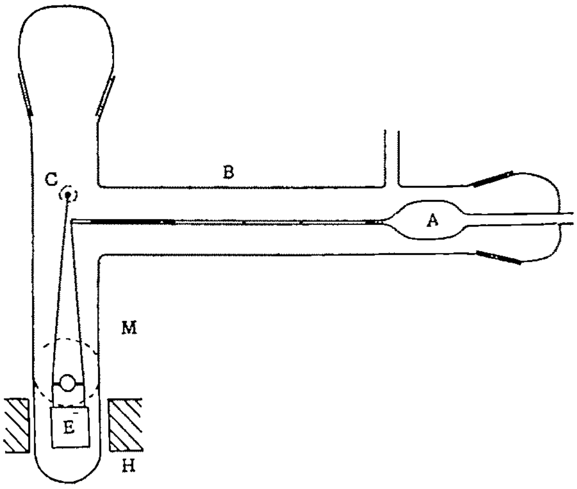

Fig. 1.

The essential feature of the device is a special form of bifilar suspension, which permits amplification of the movement of the pointer end. This suspension consists of unequal and non-parallel threads, the supports of which, placed one above the other, can be brought as closely as desired to the same vertical line. One support is the pointer end, and the other is a movable arm controlling the sensitivity. The threads, spreading out downwards, so as to clear the lower obstructing arm, carry on their ends a horizontal beam to which is attached a mirror and damping device.

The sensitivity depends on the effective horizontal separation of these supports, and this distance can be reduced to less than the thread diameter. Using comparatively rough methods and the usual mirror and scale distances, a magnified movement of about ten thousand-fold is obtainable. With refined methods this figure could be considerably improved.

The particular gauge described below, although simple and convenient in construction, had a sensitivity exceeding one ten thousandth of a millimetre of mercury, and was almost entirely free from vibrational disturbances. A large vertical tube *M* in Fig. 1, housing the suspension, carries two horizontal tubes at right angles, the lower one *B* containing the 20 cm. spoon gauge *A*, and the upper one *C* ending in a ground joint. In this joint could be rotated a slightly eccentric glass arm ending above the tip of the gauge pointer. Long fibres of silk are first attached to the suspension unit, which is lowered into the tube *M*. With each thread touching a support, the beam is adjusted to oscillate axially in the tube about a line parallel with the gauge pointer. The fibres are then sealed to the respective supports with apeison wax and the upper superfluous portions cut short with a hot wire. The sensitivity is raised by rotating sufficiently the cranked rod, and finally all joints are sealed with apeison wax.

The suspension unit consists of a light glass beam, carrying a galvanometer mirror facing a window, and below is fixed a light cylinder of aluminium foil *E*. This rotates in the field of the electromagnet *H*. With critical damping a pressure change is registered with the required accuracy in about two seconds—the natural period of the suspension. The spot light remains stationary within half a millimetre even with the thermostat stirrer running vigorously.

It was found that the zero reading varied somewhat with the magnetic field, due presumably to the magnetic properties of the aluminium vane. For critical damping this amounted to sixty millimetres, and care was taken to maintain a constant field.

This spoon gauge had normally a sensitivity of 8 mm. movement of pointer tip for a pressure change of 10 mm. of mercury. When erected with the scale at two metres from the mirror, the gauge had a sensitivity of 1 mm. deflection for 4×10^{-5} mm. of mercury pressure. This indicated a horizontal separation of the points of suspension of 0·13 mm., which distance is about the minimum that can be easily obtained with the simple arrangement described.

This principle may be used to magnify any horizontal movement.

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Molecular, Nematic and Crystal States of 1 : 1′-Diethyl-ψ-Cyanine Chloride

ATTENTION has been directed in NATURE[1] to a recent publication by Scheibe, Kandler and Ecker[2] concerning the narrow absorption and fluorescence band exhibited by certain solutions of the dye 1 : 1′-diethyl-ψ-cyanine* chloride, in which these authors, on the basis of viscosity measurements, express the view that the effect is due to a reversible polymerization of ions of the dye. Since the publication of a previous note[3], in which I have suggested that the narrow absorption band is characteristic of the molecular state, the ageing of aqueous solutions of 1 : 1′-diethyl-ψ-cyanine chloride containing various concentrations of sodium chloride has been studied by the concurrent application of spectrographic, ultra-microscopic and streaming birefringence methods.

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* This dye is termed 1 : 1′diethyl-ψ-isocyanine in the German publication.

Four distinct phases have now been recognized.

1st Phase. Dye in true solution.

2nd Phase. Absorption spectrum changes from that of cationic dye to give a very sharp 'molecular' band at 573–574 mμ; very strong fluorescence; uniform luminescence without structure seen with ultra-microscope; no streaming birefringence. This phase is rapidly succeeded by the

3rd Phase. The 'molecular' absorption band at 574 mμ shifts towards the red, and becomes less sharp as the preparation ages; fluorescence progressively weakens, and, when excited by plane-polarized light shows partial polarization, whereas the fluorescence similarly excited during the second phase is not polarized; the ultra-microscope shows a fine thread-like structure of a brilliant greenish yellow colour. The threads grow in thickness from about 5 mμ to 500 mμ, while streaming birefringence rapidly increases. This phase also shows powerful streaming dichroism.

4th Phase. After some weeks, normal prismatic crystals of the dye are formed.

Crystals of the dye, less than 1μ thick, exhibit the following trichroism:

Vibrations ∥ to	Colour	Absorption	Surface Colour
$X = n_\alpha$ for red	Pale yellow	General in blue	Pale violet
$Y = n_\beta$	Bluish pink	Sharp maximum at 579 mμ	Intense yellow
$Z = n_\gamma$ for red	Dark brownish red	General from yellow to blue	Bluish violet

The crystals occasionally form slender needles by elongation along *Y*, and consequently appear bluish pink for vibrations along their length, and any shade from very pale yellow to dark brownish red for vibrations at right angles, according to their orientation. The crystals are not fluorescent.

The optical properties of the threads of the third phase differ in four respects from those of the needle crystals.

(1) The threads are strongly fluorescent, the fluorescence being plane-polarized with vibrations in the length of the thread.

(2) The absorption of light vibrating parallel to the length of the thread at first shows a very sharp maximum at 573 mμ, which flattens and moves towards the red as the preparation ages, ultimately becoming identical with that of the *Y* direction of crystals. The threads appear bluish pink for this vibration direction.

(3) The absorption of light vibrating perpendicular to the length is independent of the orientation of the threads, which appear pale orange for such vibrations.

(4) The birefringence is of the same sign for all orientations of the threads, so that the birefringence of threads crossing at a very acute angle is always additive, whereas with random orientations of needle crystals crossing at an acute angle, partial or complete neutralization often occurs.

The threads appear to be true crystals in one dimension (*Y*) only, for the abnormalities 3 and 4 above are accounted for if we assume that the molecules have either free rotation, or else a random orientation, about the *Y* axis. It is therefore highly probable that the threads of Phase 3 are strictly analogous to the nematic form of 'liquid crystal'. The viscosity abnormalities noted by Scheibe, Kandler and Ecker are therefore explained, not by "polymerization of dye ions" but by the existence of nematic aggregates of dye molecules. The sharp absorption band and associated fluorescence is a characteristic of electronic transitions of individual molecules and their nematic aggregates.

Edwin E. Jelley.

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March 11.

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[1] "Research Items", Nature, **139**, 378 (1937).

[2] Scheibe, Kandler and Ecker, *Naturwiss.*, **25**, 75 (1937).

[3] Jelley, E. E., Nature, **138**, 1009 (1936).

Precise Distribution of *Mercurialis perennis* according to Soil Hydrogen Ion Concentration

In a wood covering several acres on the Lower Greensand of Surrey, *Mercurialis perennis* (dog's mercury) appeared to be distributed in an irregular way, in patches which clearly were not determined by the light intensity alone. In one case it was abundant along the lower side and absent along the upper side of a track that ran across a gentle slope. The pathway had been made up with chalk, and it was clear that the sandy soil below the path had become a possible habitat for *Mercurialis* because of the washing down of solid calcium carbonate and probably of dissolved bicarbonate as well. The whole region covered by the wood bears scattered patches of chalky soil, owing to transport of chalk for agricultural use and in making up trackways.

Determinations of hydrogen ion concentration were made on soil samples from eight pairs of sites scattered in various parts of the wood. The two sites of each pair were not more than three metres apart (generally within one metre) one being in a patch of *Mercurialis* and one on ground where it was absent; and each sample was taken from a spot where it was obvious that light was quite adequate but not too strong for the growth of *Mercurialis*.

The *p*H of the eight samples bearing mercury had a mean of 6·3, the values varying between 7·3 and 5·5; (free carbonate was present in the only two samples with a *p*H above 7·0). The *p*H of the eight samples from sites with no mercury had a mean of 4·8, the values varying between 5·5 and 4·4.

The absence of *Mercurialis perennis* from soils with a low quantity of exchangeable calcium has been shown by De Silva[1] and by Mukerji[2], and it needs no substantiation. Likewise De Silva has reported the local occurrence of *Mercurialis* on a spot which had recently been given a higher base status by the dumping of rubbish. What is interesting about the records given here is not so much that the spots bearing *Mercurialis* have a high *p*H, as that the similar spots tested where there was no *Mercurialis* all showed a distinctly lower *p*H, that is, that *Mercurialis* has become distributed to all (generalizing from the data collected) the adequately lit spots where the edaphic factors make its growth possible. This is, of course, a state of affairs which one would expect, particularly in a species readily dispersed and not hampered by an already closed community, and its truth is generally assumed; but as one rarely sees data which prove the point, it seems of interest to recount the facts given above, which serve as a proof for this particular case and within the limits of the rough method adopted.

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Feb. 24.

[1] De Silva, B. L. T., *J. Ecol.*, **22**, 532 (1934).
[2] Mukerji, S. K., *J. Ecol.*, **24**, 317 (1936).

Absorption of Strain Energy in Metals

WHEN a metal is strained, the work done is partly stored up as strain energy and partly used up by internal absorption. The ratio (φ) of the energy absorbed to the energy stored is a constant, characteristic of the material, but sensitive to changes in structure and temperature. It is often assumed that the absorption can be represented by a damping force proportional to the velocity of deformation, but such an assumption is not in agreement with the experimental facts.[1]

There appears, however, to be a linear relation between the Debye temperature θ of a metal and the logarithm of φ. This is shown by the graph below in which the values for Debye temperatures (calculated from specific heats) have been taken from the "Handbuch der Metall-Physik", vol. 1, p. 252 (Leipzig, 1935), and the values of φ from a paper by A. L. Kimball and D. E. Lovell[2]. It should be noted that apparently Kimball and Lovell took no special precautions to ensure constancy of temperature.

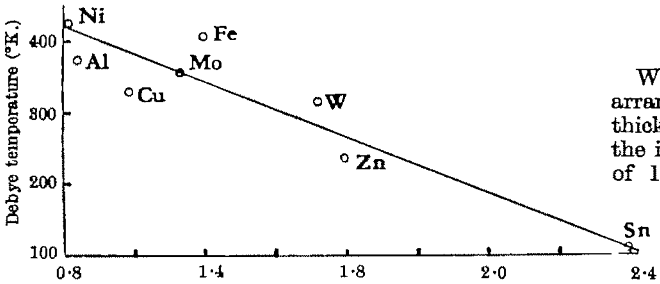

Fig. 1.

This relation suggests that the process of absorption may be one of scattering of phonons of elastic strain energy by those atoms or molecules which are vibrating at the Debye frequency. Such a process would be analogous to the scattering of photons in the Raman effect.

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[1] de Bruyne N. A., and Maas, J. N., *Aircraft Engineering*, 1936, p. 289.
[2] *Mechanical Engineering*, 1927, p. 440.

Electrical Stimulation of the Cochlea

IF the external auditory meatus is filled with saline solution and an alternating current is passed through the ear by means of an electrode immersed in it, a tone is heard. The pitch is determined by the frequency of the alternating current and may correspond to its fundamental or first harmonic[1,2,3,4,5,6]. If at the same time the stem of a vibrating tuning-fork is placed on the head, it is easy to obtain regular beats by adjustment of the A.C. frequency. This shows that the 'electric' stimulus and the bone-conducted stimulus travel along a common pathway before they enter any all-or-none-mechanism. As v. Békésy[7] has shown the same regarding air conduction and bone-conduction, it is clear that in electrical stimulation of the cochlea the same peripheral mechanism is involved as in stimulation by air-borne sounds.

This seems to give further support for the 'movement' theory advocated by Stevens[5] and by Hallpike and Hartridge[6]—but only if one assumes that pitch-discrimination in normal hearing is effected by mechanical resonance (which, incidentally, is my belief). It may, however, be pointed out that even if pitch-discrimination were effected by electrical resonance *ad modum* Zotterman[3], one should expect the transient effects described by Hallpike, Hartridge and Rawdon-Smith[8]. As is well known, the behaviour to transients of a resonator of given pitch and selectivity is the same, whether it is constructed from electrical or mechanical components.

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Feb. 15.

[1] Jellinek and Scheiber, *Wien. klin. Woch.*, **43**, 417 (1930).
[2] Perwitzschky, *Z. Hals usw. Heilk.*, **26**, 477 (1930).
[3] Fromm, Nylén and Zotterman, *Acta Otolaryngol.*, **22**, 477 (1935)
[4] Gersuni and Volokhov, *J. Exper Psychol.*, **19**, 370 (1936).
[5] Stevens, *J. Acous. Soc. Amer.*, **8**, 191 (1937).
[6] Hallpike and Hartridge, NATURE, **139**, 192 (1937).
[7] v. Békésy, *Ann. der Phys*, (5), **13**, 111 (1932).
[8] Hallpike, Hartridge and Rawdon-Smith, NATURE, **138**, 839 (1936).

Diurnal Variation of Cosmic Ray Shower

WITH a three-fold coincidence apparatus, counters arranged in a triangle and with a lead plate 1·5 cm. thick placed above the upper counter, I have registered the intensity of a cosmic ray shower during a period of 110 days. The result of these measurements, performed at sea-level, does not show any connexion between the variation of the shower-intensity and the diurnal periodicity of the horizontal intensity of the earth's magnetic field, as is the case with vertical coincidences[1].

Assuming that a primary shower produces radiation composed of electrically charged particles, we should expect under the influence of the earth's magnetic field a much larger diurnal variation, for the greater barometer effect of the shower seems to suggest that the shower-producing primary radiation is softer than the radiation producing the vertical coincidences. The non-existence of any correlation between shower intensity and the earth's magnetic field can likewise be interpreted in the sense that the primary shower-producing radiation is not composed of electrically charged particles. On the other hand, the experiments indicate a very good agreement between the variation of the shower intensity and that of the temperature of the outer air; both having a maximum in the late afternoon. (Priebsch found at 2,300 m. altitude the maximum of the daily period to be at noon[2].) The positive correlation coefficient between shower intensity and temperature was found to be $r = 0{\cdot}72 \pm 0{\cdot}10$, and the temperature effect $TE = 0{\cdot}074 \pm 0{\cdot}010$ per cent per degree C.

The measurements were performed through the kind assistance of the Hungarian Council for Natural Science.

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Budapest.
March 13.

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[1] Barnóthy, J., and Forro, M., *Z. Phys.*, **104**, 534 (1937).

[2] Priebsch, J., *Wiener Ber.*, **145**, 101 (1936).

Potential Constants of Tetrachlorethylene

IN my recent letter to NATURE on this subject[1], the values of f and γ which I have deduced from Delfosse's theory are erroneous. They should be replaced by the following: $f = 4{\cdot}48 \times 10^5$ dynes/cm.; $\gamma = 0{\cdot}65 \times 10^5$ dynes/cm.

It should be noted that f is greater than γ, which is in accord with ordinary chemical conceptions.

Finally, the values of ν_4 and ν_8 and of ν_4^* and ν_8^* should be interchanged.

These values will then read as follows:

$$\nu_4 = 236 \text{ cm.}^{-1}; \quad \nu_8 = 1569 \text{ cm.}^{-1}.$$
$$\nu_4^* = 230 \text{ cm.}^{-1}; \quad \nu_8^* = 1569 \text{ cm.}^{-1}.$$

The conclusions reached in the letter are, however, unchanged.

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[1] NATURE, **139**, 288 (1937).

Points from Foregoing Letters

Commenting on the effects, observed by Harkins and Myers, of minute traces of metallic ions upon monomolecular films, Dr. J. S. Mitchell, Prof. E. K. Rideal and Dr. J. H. Schulman point out that minor traces of metallic ions 'sensitize' chemical processes in monolayers and affect the electrical protential at phase boundaries. This fact may be related to the biological action of the metals. Dr. C. Robinson describes the lowering of the interfacial tension between oil and water, in presence of salts of long-chain acids, due to calcium ions present as impurities in distilled water.

H. Christensen, M. Krogh and M. Nielsen suggest that symptoms of mercury poisoning may result from the presence of mercury spilled on the floor in poorly ventilated rooms.

The formation of ammonia in a series of stages, in shed blood, is described by Prof. E. J. Conway and R. Cooke. The authors also find that the blood (both plasma and red corpuscles) contains a powerful enzyme capable of splitting off ammonia from adenosine.

A phenol derived from the essential oil of anethole (*p*-hydroxy propenyl benzene) is found by Prof. E. C. Dodds and W. Lawson to possess an œstrogenic activity approaching that of the sex hormone œstrone. The authors give a table showing the activity of several other compounds, proving that the phenanthrene nucleus is not an essential part in the molecule of an œstrogenic substance.

B. C. J. G. Knight reports that one of the 'growth factors' present in the high-vacuum distillate of yeast, which enables *Staphylococcus aureus* to be grown on a special 'basal medium', can be replaced by nicotinic acid or its amide.

The formation of visible mesomorphic fibres in clarified, expressed juice of mosaic-diseased tobacco plants is reported by R. J. Best. The fact that infectivity is associated with the fibres, together with the fact that the fibres collapse at the temperature of the thermal inactivation point of the virus, and other properties, lead to the conclusion that the fibres are the virus, or at least that the virus forms an essential constituent of the fibres. It is considered that the fibres consist of long chains of virus particles linked together by relatively feeble bonds.

A technique for the concentration of capillary active substances from composite liquids by the use of foam is described by Dr. Franz Schütz. A difference in the degree of adsorption of certain ions on foam is shown to take place and with it a change of pH and surface tension in the liquid formed by the settling of the foam and in the original solution. Other phenomena, including a new physical temperature effect in connexion with foam, are discussed.

A device for increasing the sensitivity of the 'spoon gauge' for measuring pressure differences, the essential feature of which is a special form of bifilar suspension, is described by A. Lewis and Dr. D. W. G. Style. This enables a pressure difference 4×10^{-5} mm. of Hg. to be read on the scale.

By the application of spectrographic, ultramicroscopic and streaming birefringence methods to the study of dispersions of 1 : 1′-diethyl-ψ-cyanine chloride, in sodium chloride solutions, Dr. E. E. Jelley has found that the dye passes from the dissociated state through a molecular phase of very brief duration to form very thin threads. From a study of the optical properties of these threads, and of very thin needle crystals of the dye, he has deduced that the threads are crystalline in the direction of their length only, and correspond to the nematic type of liquid crystal.

The apparently haphazard distribution of certain plant species over a small area may really reflect very exactly the variations in the conditions of the habitat. This was observed by J. F. Hope Simpson to be the case with *Mercurialis perennis* (dog's mercury) in a wood the soil of which showed marked variations in hydrogen ion concentration.

An experiment showing that the stimulus produced by an alternating current in a saline-filled ear can be combined with that produced by a vibrating tuning fork to give 'beats', is described by E. Bárány. This, the author states, shows that the electric stimulus and the bone-conducted stimulus travel along a common pathway before they enter any all-or-none-mechanism.

Unlike the intensity of cosmic rays themselves, the number and intensity of showers produced by the cosmic rays at different times of the day is not related to the intensity of the horizontal component of the earth's magnetic field. This, Dr. M. Forró states, may indicate that the primary shower producing radiation is not composed of electrically charged particles.

Research Items

Racial Crosses in Cape Verde Islands

PROF. A. A. MENDES-CORREA, director of the Institute of Anthropology, Oporto, took advantage of the presence of some three hundred natives of the Portuguese Colonies at the Colonial Exhibition at Oporto in 1934 to make a series of observations of their anthropological characters. Among them were nineteen cross-breeds from the Cape Verde Islands, of whom all with the exception of two were more than twenty years of age. Thirteen were male and six female. As the people of these islands have been little studied, the results (*Z. Rassenkunde*, 5, 1) are of no little interest. The population of the islands is 150,553, of whom 5,794 are white, 40,154 black, and 104,605 mixed. The subjects observed had dark brown skin, dark eyes and dark brown ulotrichous hair. One woman and two men showed wavy hair. The prominence of the cheek bones was marked in the majority of men and most women. The face was very variable. Three men and one woman showed a certain obliquity of the eyes. The nose was straight in profile, and was not long. The nostrils were elliptical, almost round, with the longer axis transversal. Only four men had a stature over 1·650 m. The number is too small for the mean of 1·702 m. to have significance. The female stature varied from 1·520 to 1·680 m. There appeared to be a tendency to exceed the Portuguese mean. The skelic index also appeared to approach the negro, rather than the Portuguese. A number of measurements taken on the upper and lower extremities pointed in the same direction, the measurements being on the whole intermediate between Portuguese and negro (Guinea), but on the whole inclining towards the latter. The cephalic index of the men varied between 74·4 and 84·1, while among the women it varied from 71·4 to 84·2. As compared with Portuguese and negro, the figures show a tendency to an increase, which it is not easy to explain. Is it a result of admixture, as certain investigations on other peoples seem to show ?

Beavers in Michigan

DURING the open season of 1936 (March 16–31 in Lower Peninsula and April 1–15 in Upper Peninsula) 137 bodies of beavers (*Castor canadensis michiganensis*) trapped in Michigan were examined by Seth B. Benson (*Occas.* Papers Mus. Zoo. Univ. Michigan. No. 335, June 1936). Contrary to the opinion of trappers that males largely predominate among beavers trapped in spring, it was found that the sex ratios were practically equal, 51·8 per cent females, 48·2 per cent males. Measurements and weights showed that the animals fell into two groups, a yearling class, and two-year-olds with adults. The yearlings formed 59·1 per cent of the catch, 25 per cent were two-year-olds, and the remaining 15 per cent were three-year-olds or older. None of the yearling females was pregnant, and the appearance of the uteri suggested that they do not breed. There was some indication also that some two-year-olds do not breed, or, if they do, that it is later in the season than March and April. Of the 34 adult females, 21 or 61·7 per cent contained embryos, some being almost full term. Although the author does not allude to the fact, it seems unfortunate that the open season should coincide with a period when so many females are about to produce young.

Biology of Arctic Marine Invertebrates

IT has long been known that reproduction by direct development is a characteristic feature of bottom invertebrates in arctic seas. A recent publication by Gunnar Thorson has shown how prevalent this is ("The Larval Development, Growth, and Metabolism of Arctic Marine Bottom Invertebrates", *Meddelelser om Gronland*, 100, No. 6; 1936). A study of the bottom fauna and the plankton was made throughout the complete year in fiords in north-east Greenland. In all, about two hundred species of polychætes, echinoderms, molluscs and crustaceans were studied. Of these, it was found that ninety-five per cent reproduced without true pelagic larval stages, the majority having very large yolky eggs. These were all purely arctic species, and the remaining five per cent, which had pelagic larval stages, were species not confined to the Arctic; these occurred in the plankton during the short period when food was most available. It is noteworthy that in north-east Greenland it was these latter species which were quantitatively commonest in the area. Examination of oxygen consumption was made, mostly on lamellibranchs, and it was found that they had a fairly high oxygen consumption compared with more southerly species at the same temperature. But at the temperatures at which they live respectively, the arctic species had a somewhat lower consumption than the southern. A comparison is made between the biology of the arctic fauna and those from other regions, and the origin of the arctic shore fauna is discussed. The paper is an important contribution to our knowledge of the biology of arctic marine animals.

Cirripedia of the Arabian Sea

A LARGE number of cirripedes are described by Mr. H. G. Stubbings (Cirripedia. The John Murray Expedition 1933–34. Scientific Reports. Vol. 4, No. 1. British Museum (Natural History), 1936). Two areas, the Zanzibar area and the Gulf of Aden, stand out as being specially favourable, twenty species out of forty-three collected by the expedition coming from the first, and thirteen from the second, only two species being common to both. Farther north along the South Arabian coast cirripedes were much scarcer. As is to be expected in such a deep sea collection, the genus *Scalpellum* and its subgenera predominate, fourteen species being represented. The geographical and bathymetrical distribution of *Scalpellum* is discussed, and it is shown that *S. velutinum*, which has a very wide distribution, ranges from 50 metres to 2,900 metres, but lives mainly between 600 metres and 2,000 metres. Several dwarf males were found on this species and a series of growth forms from newly metamorphosed cypris stages together with the cypris stages themselves. Dwarf males and growth stages were also found in various other forms. Among the specially interesting species are *Oxynaspis* *aurivillii* overgrown with polyps of an antipatharian, and several species growing on Crustacea. Amongst the latter are three species of *Pœcilasma* all growing on the crab *Echinoplax pungens* which is a favourite host, and one of these also growing on the palinurid *Puerulus angulatus* from the Gulf of Aden. Five new species are described, three *Verruca* and two *Balanus*.

Use of the Developing Egg in Virus Research

VIRUSES are unable to multiply apart from living cells, and the maintenance of a virus in the laboratory after isolation has, therefore, depended upon inoculation for the most part, though tissue-culture methods, particularly those devised by H. B. and M. C. Maitland, have proved useful, but have replaced the living animal only to a limited extent. During the last four or five years, it has been shown that the chorio-allantoic membrane of the developing hen's egg is suitable for the cultivation of most, if not all, viruses, and solves many of the difficulties connected with their study. This work has been especially pursued by Dr. F. M. Burnet, who has now written a monograph on the subject (Medical Research Council, Special Rep. Series, No. 220. London: H.M. Stationery Office, 1936. 1*s*. net). This gives the full technique of the method, which is comparatively simple, surveys the published work on the subject, and contains many new observations and suggestions. It is surprising how many viruses can be cultivated by the method; by serial passage, it has even been possible to adapt the virus of epidemic influenza to the egg-membrane, which seems to constitute an ideal medium for virus study, as well as being cheap and requiring a minimum of attention. The chorio-allantoic membrane also provides a tissue of simple structure in which to study the histological changes that may be caused by a virus infection.

Fire Blight of Apples and Pears

THE bacterial disease caused by *Erwinia amylovora*, and known as fire blight, has been a serious menace to apple and pear trees in America for more than half a century. Many studies of the disease and the pathogen have been made, and a recent publication by Dr. K. G. Parker (Cornell Univ Agr. Exp. Sta. Mem. 193, August 1936, Ithaca, N.Y.) describes further investigations upon the overwintering, dissemination and control of the malady. Large cankers appear upon the branches of infected trees, or are brought to the orchard upon grafting material. The activity of the bacteria within such cankers causes an ooze of infectious material, which may be disseminated to healthy shoots by rain or by insects. Several species of flies, and ants, stand incriminated in this respect. A few bacterial organisms which are antagonistic to *E. amylovora* have been found, and some of them can inhibit the infection of blossoms when inoculated along with the pathogen. Disinfection of the overwintering cankers seems to be the obvious method of control, and solutions of cadmium sulphate have been found most suitable for this purpose.

Refrigerated Gas-Storage of Fruit

SINCE 1929, the capacity of gas stores in England has risen from negligible proportions to more than two million cubic feet in 1936—a capacity not far short of a million bushels of apples. The time is thus opportune for the survey of the development of refrigerated gas-storage methods presented by Drs. F. Kidd and C. West (*J. Pom. and Hort. Sci.*, 14 (4), 299; 1937). The principles underlying the method are given, the considerations governing the construction of gas-tight chambers and the methods of controlling the composition of the storage atmosphere. The following advantages of gas-storage of apples over cold storage in air have been established. (1) Ripening of the fruit at a given temperature proceeds at half the rate in air, that is, the life of the fruit in store is twice as long; (2) low-temperature breakdown is avoided because temperatures are used above the limit at which this develops; (3) firmness of the fruit is preserved almost unchanged over long periods of storage; (4) change in ground colour from green to yellow is markedly retarded; (5) *Tortrix* moth larvæ are quickly killed in gas storage; (6) life of the apples after removal from gas storage is remarkably long. An account is given of the normal behaviour of apples after gathering and the influence on this behaviour of temperature, oxygen and carbon dioxide concentration and volatile substances. The information so far available refers particularly to apples and pears, but there seems every possibility that similar methods may be applicable with equal success to plums, peaches, grapes and citrus fruits.

First Crossing of Antarctica

A NOTEWORTHY event in the history of Antarctic exploration was Mr. Lincoln Ellsworth's flight across Antarctica in 1935, a distance of 1,842 nautical miles, from Snow Hill Island, Graham Land, to Little America on the Ross Sea. Mr. Ellsworth's own account, accompanied by a provisional map, appears in the *Geographical Journal* of March. His aeroplane, the *Polar Star*, was large enough to carry fuel for a range of 5,000 miles if only fuel and oil were required and had a 600 h.p. engine and a possible speed of 215 miles per hour. Much of the load, however, had to consist of two months' equipment and supplies for two men. Thus when he took off, the loaded *Polar Star* weighed 7,987 lb., of which 3,614 lb. was the load of the aeroplane and 2,796 lb. (466 gallons) the load of petrol. This was just enough fuel to carry the *Polar Star* across, with four landings on the way. At the final landing, sixteen miles from Little America on the Bay of Whales, the fuel was completely exhausted. Several features of importance were noticed on the way. Stefansson Strait of Wilkins appears to be not more than three miles wide and might even be a fjord and not a strait. This seems to be in accordance with Mr. Rymill's recent discoveries farther west. Eternity Range, south of the strait, showed bold rugged peaks rising to 12,000 ft., in contrast with the lower, flatter summits of Graham Land. Farther on, this range gave way to scattered nunataks and then, in about lat. 78° S., long. 85° W., was sighted the lofty Sentinel Range. Thereafter stretched an apparently unbroken ice-covered plateau at an elevation of about 6,000 ft. to Marie Byrd and Edward Lands.

Sea Breezes

AT a meeting of the Royal Meteorological Society held on February 17, Dr. R. C. Sutcliffe gave the results of an analysis of ten years observations of the wind up to a height of 5,500 feet, made with the aid of pilot balloons at Felixstowe, with the object of studying the behaviour of the sea breeze at various levels. In order to eliminate days unfavourable for a full development of the sea breeze, those days on which the duration of sunshine shown by a Campbell-Stokes sunshine recorder was less than 70 per cent of the possible duration for the time of year were omitted. The mean direction of the coast at Felixstowe, it may be noted, is from south-west to north-east, a south-east wind being, therefore, an on-shore wind. It was found that when a sea breeze replaces a land breeze as the day advances towards the hottest time, the vector change of speed at right angles to the coast is about 15 m.p.h. on an average up to a height of 500 ft., but is less higher up, becoming very small above about 1,500 ft. Although the average depth of appreciable sea breeze is therefore only about 1,500 ft. at Felixstowe, no definite evidence of a compensating return current was found higher up. The component along the coast behaved so that there was a tendency towards a geostrophic wind in the afternoon, the land being on the left, as though it were a region of low pressure; this coastal component averaged about 5 m.p.h. near the surface, except in the case of northerly winds. With a general inshore wind not due to sea breeze, there was very little increase in the landward component towards the hottest time of the day, but there was a backing of the direction.

Air Temperature during Total Solar Eclipses

IN *Mon. Not. Roy. Astro. Soc.*, 97, 2 (Dec. 1936), Dr. John L. Haughton has a paper in which he describes the apparatus used by him for determining the fall in temperature during the total solar eclipse of June 19, 1936. The instrument responded very rapidly to change of temperature, and it was possible to read to about 0·1° C. by means of the millivoltmeter (1 mv. = 2·1° C.). The maximum fall from a curve indicating what the temperature might have been if there had been no eclipse was only 1·5° C., and Dr. Haughton thinks that this small fall can be accounted for by the low altitude of the sun and the thermostating effect of the large mass of water. (The observation was taken on board the S.S. *Strathaird.*) When we hear of 'the great fall in temperature' in the case of some eclipses, this is, Dr. Haughton thinks, a fall in radiation temperature, not in air temperature. Comparisons are made between the fall in temperature during this eclipse and the fall in the case of the eclipse of 1927 and also of 1932; but owing to the different conditions, accurate comparisons are impossible, so that the table showing the results has little value.

Composition of the Atmosphere

THE constancy of the percentages of carbon dioxide and oxygen in uncontaminated atmospheric air was established by Benedict in 1912. T. M. Carpenter has now described (*J. Amer. Chem. Soc.*, 59, 358; 1937) several hundred analyses of air made in the period 1930–36 in New Hampshire, Baltimore and Boston. The apparatus was capable of giving burette readings to 0·001 per cent. The grand average of all three series gave 0·031 per cent for carbon dioxide and 20·939 per cent for oxygen. In spite of widely different local conditions of the three laboratories, there was no evidence that variations in season or proximity of large consumers of fuel caused any measurable differences in the carbon dioxide and oxygen content in the atmospheric air. The Boston laboratory is situated near a large power station and that in New Hampshire near a heavily wooded locality. The deviations from constant values found were very small, the percentage of oxygen having a constancy beyond the accuracy of many atomic weight determinations.

Oxidation of Coal

B. JUETTNER, R. C. Smith and H. C. Howard (*J. Amer. Chem. Soc.*, 59, 236; 1937) have examined the oxidation with alkaline permanganate of a Pittsburg bituminous coal and of a 500° coke made from it. It is shown that 90–95 per cent of the carbon can be recovered in the form of water-soluble, non-colloidal acids, of which aromatic acids correspond with 30 and 35 per cent, respectively, of the carbon in the coal and coke. Good recoveries of oxalic and aromatic acids can be obtained by direct electrolytic decomposition, in a three-compartment cell, of the potassium salts resulting from the oxidation. Oxalic acid and aromatic acids recovered in this way were 88 and 98 gm. per 100 gm. of coal and coke, respectively. It is pointed out that the failure to recover hydrocarbons more complex than diphenyl by decarboxylation does not necessarily preclude the possibility of the presence of acids with condensed aromatic nuclei containing carboxyl oxygen, since drastic alkaline decomposition is known to split the nuclei of such aromatic acids. R. C. Smith and H. C. Howard (*ibid.*, 234) have also shown that the products of pyrolyzing cellulose at temperatures up to 400° contain benzene and diphenyl.

Refraction and Diffraction of Ultra-Short Waves

IT is probable that in the near future, ultra-short waves (those below ten metres in length) will be extensively used for television, for short-distance point-to-point communications and for communicating from or between aircraft. Any information, therefore, concerning the physical properties of these waves is of great practical importance. In the *Journal of the Institution of Electrical Engineers* of March, T. L. Eckersley, taking up the theory which has been developed by several eminent mathematicians, shows how it can be explained graphically in a method helpful to radio engineers. Hitherto it has been assumed that the earth has infinite resistivity, and formulæ for the propagation of spherical waves round it have been found. Eckersley has extended the solution to the case of a spherical earth of finite resistivity and has deduced results which, at least partially, are borne out by experiment. The problem is not one that can be solved by geometrical optics but requires the full wave theory for its solution. The author considers that diffraction plays the leading part in controlling short wave propagation, but he has found evidence of variation of signal intensity at extreme distances, which he considers can only be caused by the gradient of the refractive index of the air near the surface of the ground. He considers that the hypothesis that the variations are due to reflections from the ionosphere is a very doubtful one. Water vapour has a high refractive index and the effect of a small percentage present is very pronounced. He shows that there is a gain in the signal strength with height in the regions beyond the visible range. Several observers in America using either aeroplanes or autogyros have observed this increase in the signal strength with height, and their measurements are in fair agreement with theory.

The Indian Science Congress Association

HYDERABAD MEETING

THE twenty-fourth annual meeting of the Indian Science Congress Association was held at Hyderabad on January 2–8, under the presidency of Rao Bahadur T. S. Venkatraman, of the Indian Agricultural Service, who was made C.I.E. in the New Year honour list. Summaries of the presidential address and of the addresses of presidents of the ten sections follow.

THE INDIAN VILLAGE

In his general presidential address, Rao Bahadur T. S. Venkatraman discussed "The Indian Village—its Past, Present and Future". The Indian village, which has remained in a quiescent and more or less petrified state for two thousand years, began as a result of Aryan group settlement in the north. This had produced two types of village, the *ryotwari* village, in which a group or family took up as much land as they thought they could cultivate; and the joint village, in which the founders were powerful families, or clans, who were not agriculturists, the cultivators of the soil owing obligation to these families, and being something in the nature of tenants. These villages were self-supporting. and governed by a council of elders, with a system of village industries, of which the practitioners received a portion of the agricultural produce for their service.

The old self-sufficing village system has now broken down by contact with the West, which has brought in competition and the commercialization of crops, now grown not merely for home consumption, but also for export. In the present-day village, notwithstanding the extension of irrigation, seven-eighths of the population are dependent on the monsoon, rendering agricultural income unsteady and uncertain. The village is out of touch with markets, hence a great part of the profit goes to the city which markets the commodities. The increase of population has grown beyond the capacity of the land, especially as the use of manure, animal and human, is banned by sentiment. Sub-division and fragmentation of land militate against efficiency in production and debar the introduction of capital. The attachment to the cow is now working detrimentally, as an enormous head of cattle is carried, which contributes nothing to profits, the only advantage being an abundance of milk. Labour is uneconomical and inefficient, as well as intermittently employed. The villagers are overwhelmed with debt owing to the fluctuation and uncertainty of their incomes, so that many are reduced to the position of serfs. The standard of village life is low, and compares unfavourably in interest with the life of the city. As a result, all the more intelligent are drawn to the towns.

How can the downward tendency be checked? Some provision has already been made by Government organizations for improvement in agriculture and for technical advance. Fragmentation and subdivision need restrictive legislation, education should be extended in village schools with a rural outlook, while intellectual alertness, business habits and a broader outlook on life should be cultivated in the villagers. The co-operative spirit of the villages of old should be fostered anew. Village industries should be encouraged and commercialized, while if products were partly manufactured in the area of production, much of the present cost of transport could be saved. Town and village are complementary, each contributing something to the life of the other. The duty of India is clear, the president said in conclusion, namely "to improve the *Village*, the nucleus of our country life, and infect its Chief Agent the *Villager* with a chosen culture of the virus of modern age through *Education* and *Industrialization*."

ABSORPTION OF LIGHT BY ATOMS AND MOLECULES

Prof. S. Datta chose as the subject of his presidential address to the Section of Mathematics and Physics the "Absorption of Light by Atoms and Molecules", and in the course of it summarized the advances made during recent years, giving references to nearly eighty researches. Under atoms he explained the rule according to which the lines absorbed form only one group of those radiated, and showed that it is not rigidly obeyed. The energy levels of the theory of line spectra must be considered of finite thickness in keeping with the 'uncertainty principle'. The width of the absorption lines is due partly to this and partly to the thermal motion of the atoms of the gas. The intensity is best explained by Dirac's theories, but the thermal broadening and the Raman effect may require a sub-division of the quantum for their explanation. The complex motions which may take place in a molecule, even when only diatomic, account for their more complex spectra; but many of the phenomena of absorption are explained on the theory of both attractive and repulsive forces between the constituent atoms, while the continuous absorption bands may be ascribed to the absence of quantization for the normal vibrations.

CHEMISTRY OF ANTIMALARIALS

In his presidential address to the Section of Chemistry, Prof. J. N. Ray discoursed upon the chemistry of antimalarials, a subject of prime importance to India, since the prevalence of malaria is a most formidable obstacle to progress in that country. It is interesting to note that the cinchona bark, which was first used as a febrifuge in the fifteenth century, still furnishes the best specifics against malaria.

Although quinine has not yet been synthesized, its chemical structure is known, and the physiological action of its various groupings has been closely examined. Thus the superiority of quinine to cinchonine as an antimalarial has been traced to its greater solubility in the red blood cells, on account of the presence of the methoxyl group, which alone differentiates it from cinchonine. Again, while stereoisomerism around the secondary alcohol group, which links the quinoline to the quinuclidine ring, has no marked influence on its pharmacological properties, the latter are destroyed by substitution of hydroxyl by hydrogen, chlorine or acetoxyl. Oxidation of quinine and cinchonine to the corresponding ketones (quininone and cinchonone) is, however, not sufficient to affect their value, since reduction of the keto-group occurs in the body. The chief factor in antimalarial action is probably the quinoline nucleus, but the alcohol group plays an auxiliary part. The vinyl group in the side-chain of the quinuclidine ring does not appear to be directly responsible for prophylactic properties, although hydrogenation increases and oxidation destroys the effect.

Among the numerous synthetic antimalarial drugs are *plasmoquine* and *atebrine*, which are derivatives of 6·methoxyquinoline and 2-chloracridine respectively, each containing the same complex alkylamino-side-chain. Neither plasmoquine nor atebrine, however, has true prophylactic action, for there is no specific action on the sporozites. Plasmoquine is most effective in conjunction with quinine. The combination has been tried on the large scale by the Bengal Government with encouraging results. Robinson and his colleagues have prepared several derivatives, the most promising being 8· (δ·aminobutylamino) 6·methoxyquinoline.

A synthetic drug has still to be found which will have curative value in recurrent infection. The alkaloids of opium appear to be of very little value, but the work of Gunn and Marshall on harmaline, which is effective in acute cases, shows that the search need not be confined to the quinoline series.

Prof. Ray appealed for further financial aid for research in pure chemistry.

INDIAN EARTHQUAKES

Mr. W. D. West discussed "Earthquakes in India" in his presidential address before the Section of Geology and Geography. He traced the beginning of their study to Dr. Thomas Oldham, the first director of the Geological Survey of India, who compiled a valuable catalogue of Indian earthquakes, and investigated the Cachar earthquake of 1869, and the advance to its present state mainly to his son, the late Mr. R. D. Oldham, who wrote the report on the Assam earthquake of 1897, a memoir that has been described as being "worthy of a great subject".

Mr. West divided the country into three great zones, one the belt of Tertiary folding to the south of the Himalayas, the second consisting of the frontal trough of alluvium, and the third the whole of peninsular India. The first zone is that in which all the great earthquakes originate, beginning with the peninsula of Cutch (marked by the earthquake of 1819), and bending round through Baluchistan (the Quetta earthquake of 1935 and others), Northern India (the Kangra earthquake of 1905 and the North Bihar earthquake of 1934), Assam (one of the greatest of all earthquakes, in 1897), and Burma (numerous earthquakes from 1839 onwards). Fault-displacements at the surface occurred with only three of these earthquakes, those of Cutch in 1819, Chaman in 1892, and Assam in 1897.

Mr. West also directed attention to two subjects of great importance, the provision of earthquake-proof buildings in the two northern zones, which coincide with the most populous districts of India, and the foundation of an earthquake research institute for the detailed study of Indian earthquakes.

INDIA'S CLIMAX VEGETATION

Mr. H. G. Champion's address before the Section of Botany directed attention to the neglect of the forest and the tree by the Indian botanical investigator, a neglect that is the more surprising in view of land is under forest, and that the natural climax vegetation for the greater part of the land surface is probably forest.

Mr. Champion pointed out that the direct application of transpiration data from European observations to Indian conditions without verification "is positively dangerous" ; yet the comparison of forests with other types of soil cover and their study in relation to the water economy of the land surface represent problems of great importance to India.

Similarly the lac industry, the supplies of valuable gums, dammars, resins, etc., could benefit by studies of tree physiology, while Mr. Champion's own studies upon the 'spiral grain' of the Chir pine have given an indication of the significance that genetic studies may yet have for Indian forestry.

INDIAN CONTRIBUTIONS TO HELMINTHOLOGY

The presidential address to the Section of Zoology was delivered by Dr. Gobind Singh Thapar. The subject chosen was that of helminthological research in India. Beyond doubt, the subject offers great possibilities in that country, where, apart from valuable work on its medical and to a less extent on its veterinary aspects, comparatively little has been done until recently, when new lines have been opened up and schemes of co-operation set in being. Certain references to helminths in ancient writings, among which possibly *Enterobius vermicularis*, microfilariæ and tapeworms can be recognized, were cited, and the present position of the science outlined. It was pointed out that difficulties arise from the fact that an obsolete terminology is still employed in many general text-books of zoology and there are even errors, sometimes serious ones, in the accounts of the life-histories of common forms.

The helminth fauna of India other than those members of it responsible for human helminthiases is largely unexplored. Details of the morphology of some helminths, *Ascaris*, *Enterobius* and *Labidurus* were given to illustrate how they may play their part in solving problems of classification and relationship. Attention was directed to the discovery of an *Echinococcus* cyst that simulates a *Cœnurus* cyst in that it lacks the typical brood capsules. Brief notice was taken of plant nematodes, host specificity, anthelminthics, pearl formation, etc.

The address concluded with an appeal for a wider appreciation of the importance of helminthological study in India, and for further co-operation among the various workers. Some aspects of this address have been more fully elaborated by the author elsewhere (Lucknow University Studies, 3).

ETHNOLOGY OF THE COORGS

In his presidential address to the Section of Anthropology, Dr. Dewan Bahadur L. K. Ananthakrishna Iyer presented "An Ethnographical Study of the Coorgs". Inscriptions throw little light on the early history of the Coorgs, but from historical evidence it is conjectured that they were not without racial admixture from a remote period. There has been also a great deal of culture contact between the Coorgs and the people of Malabar, Canara and the Tamil districts. Their language is a mixture of Dravidian languages. In physical traits their mountain habitat has differentiated them from the people of the plains. In their economic life they are first

Agriculture, which is of the rudest kind, is similar to that carried on in other parts of India. It has been transmitted unchanged for ages. The industry of the people of the highlands is confined exclusively to the cultivation of rice. Though agricultural implements are few and rude, enough has been produced from ancient times to meet home consumption and to export to Malabar. Where possible the valleys have been formed into flat terraces for cultivation.

The agricultural year opens about the middle of April, when ploughing begins with the first shower. This is a ceremonial observance, in the course of which the ancestors, the river deity and the presiding deity of the division of the district are invoked, and prayers are offered to Siva. Before the completion of the transplanting of the largest field, an open space ten feet wide is left the whole length to provide the race ground for the Coorg sport.

Food supply is plentiful. The Coorgs rear sheep and goats, and the chief article of their diet is rice. Hospitality is proverbial. The houses are situated close to the paddy fields, and resembles the Nayar house. The approaches to the old Coorg house mark the design of fortification, pointing back to the old days of general feuds. Their dress and ornaments are peculiar. Their marriage customs are a medley of old and new. Formerly marriage festivities had a communal character. The Coorg family is joint and patriarchal, and no family affair of any importance may be undertaken without the knowledge of the senior member. The senior female member is the queen of the household. Public morality is controlled by a council of elders. The Coorgs are animists, having ancestor and demon worship ; but they show evidence of the influence of outside beliefs. Of late they have begun to worship the Hindu deities.

AGRICULTURE IN INDIA

For the presidential address to the Section of Agriculture, Rao Bahadur B. Viswa Nath took as his subject, "Science and Practice of Agriculture". Indian soils and agricultural practices, he said, were several centuries old and research should, and was, concerning itself more with details of existing practices than with the evolution of wholly new methods, the aim being to build up on the existing system a state of agriculture suited to the conditions of the soil and the resources of the cultivator.

Work on soil had originally been confined to a study of fertility, but other aspects were now known to be important, and it had been found that characteristics and reactions of different soils were determined by climatic factors rather than by their geological origin. As regards manuring, the importance of organic manures for Indian soils was stressed. Intensive cultivation and continued use of artificial fertilizers were liable to lead to evil consequences if they were not accompanied by the addition of adequate organic matter ; in fact, the utilization of the increased knowledge of the soil obtained by research would be in proportion to the building up of the reserves of organic matter in the soil. Further, the nutritive value of a crop was enhanced by the use of organic manure. With the view of meeting this need, much attention had been paid to the utilization of animal and vegetable waste products. Composting had achieved considerable success, but a simpler and cheaper method was still required if it was to be more generally adopted by Indian agriculturists.

In conclusion, the president showed that there was considerable scope for increased production, as the present yield of food crops was sufficient for the proper feeding of only two-thirds of the Indian population.

ANIMAL NUTRITION AND PUBLIC HEALTH

"The Relation of Animal Nutrition to Public Health in India" was the title of the presidential address to the Section of Medical and Veterinary Research, delivered by Colonel A. Olver. He pointed out the causative role of faulty nutrition in relation to many diseases from which livestock suffer in various countries. Thus, 'bush-sickness' in New Zealand and elsewhere is due to iron deficiency, and calves in India develop a form of blindness caused by vitamin A deficiency in the fodder; well-fed meat and milk of good quality are of higher biological value than similar material of lower quality. In India every year there is a period when natural growth of succulent fodder is almost at a standstill, and when the foodstuffs available for stock are mostly dry, over-ripe crop residues lacking in mineral, vitamin, and other essential constituents. This reacts upon the population, who cannot thrive when the meat is poor and the milk is deficient in quantity and quality.

Colonel Olver therefore urged that more attention and research should be bestowed upon the production of fodder crops of good quality. The production of suitable fodder crops economically in a system of agriculture that is largely governed by the limited capital resources of Indian cultivators is, however, one of the most difficult of the problems with which the better nourishment of the people of India is unfortunately confronted.

INDIAN PHYSIOLOGY

Lieut.-Colonel S. L. Bhatia commented, in his presidential address before the Section of Physiology, on the melancholy fact that in spite of the great importance of a knowledge of physiology among those who are responsible for the well-being of the people, this subject has been little studied in India, in comparison with physics and chemistry. The Section of Physiology of the Association, which celebrates this year its first anniversary, looks forward to a period of vigorous growth, in which professors of physiology now established all over India in full-time chairs with well-equipped laboratories, will direct their energies particularly towards problems of special importance to India—problems of nutrition, of adaptation to tropical climates, and of the application in India of methods which have already been applied in the West.

Colonel Bhatia emphasized the practical importance of physiology by reviewing the growth in Europe of this offspring of medicine, which has had so much influence on its parent, and which has never been so abstract and impractical as some of its critics believe. The decision of the Royal College of Surgeons of England to hold a primary F.R.C.S. examination each year in India will give a great impetus to the study of physiology in all the medical colleges.

The president read quotations from some of the letters of greeting and encouragement which the

Section had received from leading British physiologists. Prof. A. V. Hill spoke of the international character of physiology and of its status as an independent science. If physiology had been content to be merely the handmaid of medicine and to give important positions only to medical men, it would have missed many of its ablest exponents—Pasteur, Langley, Barcroft, Cannon, Bayliss, Lucas, Krogh, Lapicque, and many others, including, we may add, A. V. Hill himself.

SOCIAL MIND OF THE INDIVIDUAL

K. C. Mukherji took, for the subject of his presidential address to the Section of Psychology, the "Social Mind of the Individual". He regretted that there should be any controversy about the importance of social compared with individual psychology, since it is a matter of observation that individual psychology depends as much upon the psychology of society as the psychology of society upon it.

While admitting the importance of the institution of the family life for the welfare of the State in its material aspects, he emphasized that the mental effects of the family life in relation to the foundations of national sentiment are equally important. Although the effects of family life on one hand may be a barrier to the development of wider social interests, it is, however, the necessary preparation for the foundation of the social sentiments. The views of various writers on the ultimate elements of social interests were critically considered.

Mr. Mukherji thinks that life in the first instance is a social life which grows unconsciously, but, when with advancing individual development the critical spirit arises, the unconscious acceptance of the social group becomes modified by conscious effort; thus the social life may be said to be individualized.

The relation of the individual to the group led him to consider the relationship between minor groups under the political, economic, or cultural dominance of a major group. If the minor group accepts the dominance of the major group, there is no trouble; if the minor group assumes an attitude of equality or superiority in some field, it threatens the prestige of the major group, and fear of that loss tempts to aggression. He thinks that this represents the problem of the Jews in Germany, and the Hindu-Muslim tension. The address raised some very interesting problems in a clear form.

X-Ray Studies of Proteins

AT the thirty-seventh lecture of the Bedson Club at Armstrong College, Newcastle-on-Tyne, on March 5, Dr. W. T. Astbury gave an account of his work on the "X-Ray Interpretation of Protein Structure".

Proteins can be divided into two classes, fibrous and globular, and they all contain α-amino acids condensed, primarily, as polypeptide chains. This classical theory of Emil Fischer does not fully characterize the proteins, and research has shown that these long polypeptide chains are folded and further cross-linked by the reactive centres of the side chains. In dealing with the proteins, it is necessary to ask three questions: What are the side chains? How are they distributed? And what is their stereochemical aspect? Dr. Astbury dealt with the last topic.

The fibrous proteins are mainly stable, the simplest being fibroin (silk protein) which consists largely of glycine and alanine residues. Its X-ray photograph agrees with the view of a fully extended polypeptide chain, and this is confirmed by the fact that silk fibres cannot be reversibly stretched. Any stretching that does occur is permanent and due to the crystallites sliding over one another. The stretching of wool, hair, etc., is about a hundred per cent and reversible, and the usual X-ray photograph is not the same as that of fibroin; but on stretching, a similar photograph has been obtained, indicating that keratin (the protein of hair) is a fully extended polypeptide chain system only in the stretched state (β-keratin); the unstretched condition is known as α-keratin. It seems, therefore, that in the β-keratin form the proteins consist of parallel polypeptide chains linked by cross-linkings, while in the normal or α-form these chains are folded. If keratin is stretched and steam applied, the cross-links are hydrolysed and the extension then becomes permanent by the formation of new cross-links. Keratin fibres can also be contracted by nearly fifty per cent (supercontraction) due to further folding of the main-chain. This supercontraction of hair has been found to be very similar to the contraction of muscle. The extension and contraction of many fibrous proteins can take place by free rotation around the single valency links, and therefore unreasonable straining of the valency bonds does not occur.

The globular proteins are only stable within narrow limits. Some of them have been obtained in a crystalline state, and in this condition X-ray investigation has been possible. Svedberg, by means of the ultracentrifuge, has indicated that the molecular weight is a simple multiple of 35,000 (approx.). The characteristics of this class are rapidly lost on denaturation, and the stretched state of the denatured protein gives X-ray photographs very like those of β-keratin and the stretched fibres in general, thus showing that all proteins, whatever they are in the natural state, can be brought to a condition approximating to long polypeptide chains with cross-links.

The folding of these chains must be specific, and Dr. Astbury discussed possible methods by which this could take place, and indicated how supercontraction was brought about. The specificity argues some controlling factor, and it was suggested that this is a property of the side chains.

In conclusion, Dr. Astbury dealt with the feather protein and the virus which causes 'mosaic' disease in tobacco plants. The former falls between the fibrous and globular, while the latter, analogous in several ways to feather protein, appears to be no other than a crystallizable protein bridging the supposed gap between living and non-living matter.

Observations of the Aurora and the Zodiacal Light

IT is one of the attractions of astronomy that useful spheres of work are open to all ranges of instrumental equipment from the largest to the smallest, whilst a few phenomena are best observed initially without a telescope at all. In the category of phenomena for naked-eye study are included the aurora and the zodiacal light, though for critical research these also require the camera, photometer and spectroscope. A memoir issued by the British Astronomical Association (32, Part 3) summarizes the work carried out since 1931 by the section under the directorship of Mr. W. B. Housman, dealing with the aurora and zodiacal light.

The observations were made in Great Britain, in which artificially illuminated skies often present serious difficulty in recording these delicate phenomena, and also in Australia, where for several reasons the conditions tend to perfection for the observation of the zodiacal light. The fascination of watching auroral displays is conveyed by the frontispiece, which reproduces a drawing, made by the late Dr. W. J. S. Lockyer from a ship off the coast of Labrador, of the aurora borealis of August 5, 1932. Owing to their increasing frequency with the rise in solar activity, records of the aurora are of interest to radio research workers and other geophysicists interested in upper air phenomena, as well as to astronomers who look to the sun for clues of their origin.

Observations of the zodiacal light (including the zodiacal band and *Gegenschein*) are being vigorously pursued in a systematic manner. The reality of both short- and long-period variations in the apparent brightness of the zodiacal band is being investigated by a longitudinal chain of workers from Australia to Japan. The observations made by the Section since 1931 (and especially those made by the Rev. R. B. Bousfield, of Queensland) strongly suggest a general variation with that of the 11-year solar cycle. A chart of the zodiacal band, drawn by Mr. H. Jarvis from Bousfield's observations and his own, and first published in *Mon. Not. Roy. Astro. Soc.*, 1934, is reproduced in the memoir; it fills a gap in existing star maps and handbooks.

The Automatic Radio Compass

IN the October number of the quarterly journal entitled *Electrical Communication* published by the International Standard Electric Corporation, there is a paper by H. Busignies describing the automatic radio compass and its applications to aerial navigation.

Ten years ago, attempts were made to develop a compass system, called the 'Hertzian compass', in which the angles indicating the position of a radio transmitter appeared automatically on a graduated scale, similar to the scale of an ordinary magnetic compass. Rough models were made and the essential principles established. Exhaustive trials were made with the collaboration of the French Air Ministry, and commercial production was commenced. It gives an automatic and unbroken visual indication of the direction of a radio station by showing the angle between the direction of this station and the aeroplane's axis. Le Matériel Téléphonique, Paris, constructs a radio compass (R.C. 5 Radio Compass), which indicates the direction of a transmitter on a dial graduated in degrees completely round the circle.

The radio compass may be described as an automatic radio goniometer. It indicates the direction of chosen transmitters which may be situated at any points round the aeroplane. The apparatus is based on the following principle. When a receiving loop aerial turns regularly round a vertical axis, maximum reception occurs every time that the plane of the loop passes in the direction of the transmitter. If the loop turns at a constant speed, a certain number of maxima and minima receptions per second can be observed in a receiver turned on to a transmitter. A rotating speed of five revolutions per second has been chosen as the standard, maxima and minima of receptions taking place at ten per second. The phase of these maxima and minima, that is, the moment at which they occur in connexion with a given origin, depends on the direction of the transmitter in relation to the axis taken as origin. If the location of the transmitter changes in relation to the radio compass, the minima and maxima phases also change, and it is the changing of the phases which is utilized in the apparatus to obtain the automatic indication

A two-phase current generator the phase of which is constant in relation to the revolutions of the rotating loop is placed on its rotating axis. The two-phase current creates a rotating field in a magnetic stator which may be compared to the stator of a synchronous motor. This field rotates at a speed double that of the loop. The variable current from the receiver actuates an armature carrying a pointer associated with a dial. In this armature, therefore, an alternating current is produced by the rotation of the receiving loop, and in the stator a fixed phase rotating field by the two-phase machine. Thus the magnetic reactions of one flux on the other give a definite position to the armature, which sets itself perpendicularly to the flux. The radio compass does not itself indicate the 'sense' of direction, but this 180° ambiguity can be eliminated in several ways. Little if any trouble arises from interference of transmitting stations. The total weight of the apparatus is about 50 lb., depending on the size and type of the aeroplane. The guaranteed accuracy of the apparatus is ±2° for a distance of 300 miles from a 300-watt transmitter.

Guided by the radio compass, the aeroplane always flies in the direction of the station and, if there is no wind, it flies in this direction along a great circle. When there is wind, the pilot determines the drift angle when starting by noticing the course which gives a constant reading of the magnetic compass with a constant indication of the radio compass. Thus, when the correct drift angle has been determined the compass readings can be corrected. In France, both civil and military aviation authorities have submitted the compass to exhaustive trials, and many aeroplanes are already equipped with them.

University Events

ABERDEEN.—At the spring graduation held on March 31, the honorary degree of LL.D. was conferred upon the following, among others: Olaf Bloch, head of the Research Department, Ilford Laboratories; Naughton Dunn, surgeon and lecturer in orthopædic surgery in the University of Birmingham; Prof. A. W. Gibb, emeritus professor of geology in the University; Dr. J. F. Tocher, lecturer in statistics in the University.

CAMBRIDGE.—Dr. F. P. Bowden, fellow of Gonville and Caius College, has been appointed Humphrey Owen Jones lecturer in physical chemistry in succession to Dr. R. G. W. Norrish.

S. D. Elliott has been appointed University demonstrator in the Department of Pathology.

Dr. R. van der R. Woolley has been appointed to the John Couch Adams astronomership and as first assistant observer at the Observatory.

The Amy Mary Preston Read scholarship, value £150, awarded this year for research in scientific subjects, has been gained by J. W. S. Pringle, of King's College, who graduated with a double first in natural sciences in zoology and comparative anatomy in 1934.

GLASGOW.—Dr. George L. Montgomery has been appointed Gardiner lecturer in the pathology of diseases of infancy and childhood.

Sir William Waters Butler has contributed £100 towards the cost of erecting the new Chemistry Institute.

At the Commemoration Ceremony on June 16, the honorary degree of LL.D. will be conferred on: Prof. Jan Boeke, professor of histology and embryology in the University of Utrecht; Sir Robert Muir, emeritus professor of pathology in the University of Glasgow; Prof. Max Planck, emeritus professor of theoretical physics in the University of Berlin; Sir Albert Seward, emeritus professor of botany in the University of Cambridge, recently master of Downing College, Cambridge.

OXFORD.—Sir William Beveridge, director of the London School of Economics and Political Science since 1919, has accepted the invitation to become master of University College in succession to Dr. A. B. Poynton, and will take office on October 1 (see also p. 619).

M. H. Hey, Magdalen College, has been granted the degree of D.Sc. for his work in mineralogy.

The Halley lecture for 1937 will be given on May 28 at 5 p.m. in the University Museum by Dr. B. F. J. Schonland of the University of the Witwatersrand. His subject will be "The Lightning Discharge".

Science News a Century Ago

Brunel on the Thames Tunnel

AT a meeting of the Institution of Civil Engineers on April 11, 1837, Brunel gave an account of the progress being made with the construction of the Thames tunnel, then the greatest work of its kind under construction. The tunnel previously begun by Vazil and Trevithick, he said, had been only about 5 ft. high and 3 ft. wide, whereas the tunnel now being made was 38 ft. wide and 22 ft. high, and it was being excavated by the aid of a shield. This shield consisted of twelve parallel frames ranged side by side, each divided into three cells. Each frame was made so that it either derived support from its neighbour or assisted in supporting those adjacent. The advantage of the system which had been adopted of building by rings had been demonstrated by the fact that the brickwork had sustained two eruptions of the river, but had exhibited no sign of rupture. The great inconvenience suffered was through the want of a drain; an attempt to make one had been made, but after getting into a stratum of quicksand 50 ft. thick, it had to be abandoned. The land springs were a source of annoyance; many of them were extremely offensive, and produced cutaneous eruptions and were an annoyance to the workmen. The difficulties were great, but they would in time be surmounted.

The University of Cambridge and Gresham College

IN 1836 William Palmer (1802–58) was appointed professor of law at Gresham College, London. In his inaugural address he dealt in an interesting manner with the history of the foundation of the College. His address occupied two closely printed columns in *The Times* of April 13, 1837. After referring to the career of Sir Thomas Gresham, Queen Elizabeth's visit to his house in Bishopsgate Street on January 23, 1570, and Gresham's determination to found a college for the several sciences in the City, Palmer quoted from a letter dated March 25, 1575, from the vice-chancellor and senate of the University of Cambridge addressed "To the most accomplished Sir Thomas Gresham, the best maecenas of good learning", urging that the college should be founded at Cambridge and not in London. The letter was in Latin, but the translation ran: "In urging this alone, we would not so strongly or so long contend, unless for the convenient fitness of the place, and for the wholesome state of the air, and usefully for the dignity of the State, and piously for the defence of religion, and fruitfully for the progress of virtue, and happily and fortunately for the advancement of learning and splendidly as well as gloriously for thine own everlasting fame thou mayest erect thy college here rather than in any other place." The college should be at Cambridge or Oxford, but not in London, "to the detriment or almost ruin of either university."

But the compliments of the University could not divert Gresham from his purpose, as seen by his will of July 5, 1575. After his death and that of Lady Gresham, the City and the Mercers Company came into his estates, and the latter applied to Cambridge and Oxford for advice as to the appointments to be made, with the result that of the first seven lecturers three came from Cambridge, three from Oxford and one was appointed on the recommendation of the Queen.

Henderson's Star Observations at the Cape

On April 14, 1837, Thomas Henderson (1798–1844) read a paper to the Royal Astronomical Society entitled "On the Declination of the principal Fixed Stars, deduced from observations made at the Observatory, Cape of Good Hope, in the years 1832 and 1833". Henderson had been appointed to succeed Fallows at the Royal Observatory at the Cape of Good Hope in 1831. He arrived there in April 1832, but had to resign in the following year on account of ill health; and in 1834 was made the first Astronomer Royal for Scotland. In the short time he was at the Cape he did much valuable work under considerable difficulties. In the last of the tables given in his paper in 1837, Henderson included a list of 31 stars, with their direct and reflected zenith distances with the differences he found.

Samuel Hall's Marine Surface Condenser

In the *Nautical Magazine* of 1837, p. 330, it is recorded: "On Saturday, April 15, Mr. Hall's patent improvements on steam-engines, as applied to a pair of 180 horse-power on board the *Hercules* steam-vessel, were investigated by Sir William Symonds and Mr. Ewart, on the part of the Lords Commissioners of the Admiralty. Several scientific gentlemen and others interested in steam navigation were also present. The party proceeded down the river in the *Hercules*, as far as Gravesend, and were well satisfied with the superior working of the engines and the successful competition of the *Hercules* (though laden so as to draw 12 ft. 4 in. water) with other vessels of the finest build, and the best engines, working by injection. The *Hercules* has been running regularly for a year and a quarter between London and Cork; and these improvements besides having stood nearly a three years and a half trial, in a steam packet plying in salt water, the great and important advantages of Mr. Hall's improvements may be considered as established, leaving no doubt that injection engines will hereafter be entirely superseded."

Giovanni Rasori (1766–1837)

Prof. Giovanni Rasori, the founder of the once popular but long extinct doctrine of contra-stimulation, whose death took place on April 15, 1837, was born at Parma on August 20, 1766, the son of a hospital dispenser. After qualifying at Pisa at the early age of nineteen years with a thesis on the more recent ideas in medicine, he spent three years at Florence as assistant to the celebrated surgeon Fontana, and the next two years at Pisa, where he studied under Spallanzani and Peter Franck. In 1795 he travelled to England and visited London, Oxford, Cambridge and Edinburgh, where he made the acquaintance of John Brown, the founder of the Brunonian system.

Rasori's doctrine of contra-stimulation was a modification of the Brunonian system, according to which all remedies except bleeding have a stimulating action and only differ from one another in their degree of stimulation. Unlike Brown, however, he held that in the great majority of cases diseases are caused by excess of stimuli and only a few are due to lack of stimuli. He maintained, therefore, that two kinds of drugs were needed, namely, contra-stimulants, of which tartar emetic was the best example and stimulants, such as ammonia, alcohol and ether.

Societies and Academies

Paris

Academy of Sciences, March 1 (*C.R.*, 204, 625–732).

Alfred Lacroix: A fall of stony meteorite in New Caledonia, on July 16, 1936.

Emile Borel: The approximation of real numbers by rational numbers.

Georges Giraud: Equations and systems of equations in which figure principal values of integrals.

Emile Mathias, Claude Auguste Crommelin and J. J. Meihuizen: The curve of densities and rectilinear diameter of krypton. For temperatures below 190° C. absolute, krypton follows the law of the rectilinear diameter.

Edouard Chatton: A new element of the structure of the Sporozoa: the argyrome.

Antonio Caliohiopulo: The method of selection of the errors of observation.

Ilie Popa: Periodic Laplace series.

Louis Pasqualini: The convexity of a disk of the surface $z=f(x,y)$ projected on the plane $x0y$ along a convex figure K and the second paratingent of which is void, except on a point shaped ensemble.

Jean Delsarte: A generalization of the Euler-MacLaurin formula.

Joseph Fayet: The reduction of homogeneous, linear differential equations to equations with constant coefficients.

Pierre Lelong: The Lindelof principle and the asymptotic values of a meromorph function of finite order.

F. J. Bourrières: The self-maintained oscillations of the extremities of elastic tubes emitting a continuous current of fluid and those of free reeds fitted in at the top.

Jean Capelle: The matching of helicoidal gears.

Pierre Clerget: A machine for classifying combustible liquids according to their advance in inflammation under the conditions of use in compression ignition motors. The results obtained with the machine described show that the relation between the ketene number (Boerlage) and the delay in ignition is not linear, but has a hyperbolic tendency.

Pierre Dive: The variations of the angular velocity in a fluid star.

Jean Dufay, Mlle. Marie Bloch and John Ellsworth: The emission of CO^+ bands in the head of Peltier's comet (1936, *a*). The CO^+ bands were well marked in the spectrum of the head of Peltier's comet, but the spectrum of the tail was too weak to be photographed under the same conditions.

Jules Géhéniau: The moments of impulse in the photon theory of L. de Broglie.

Robert Guillien: The utilization of relaxation oscillations for the measurement of capacities. The method described allows rapid and exact measurements and is specially suitable for the study of the dielectric constants of liquid gases.

Pierre Jacquet: The structure of electrolytic deposits. The experimental results confirm the hypothesis of N. Thon relating to the inhibition of the active centres of a polycrystalline metallic cathode, and show that the discharge of the hydrogen ions plays an essential part in the structure of the metals of the iron group and of all metals obtained in complex baths.

St. Procopiu and G. Vasiliu : Magnetization discontinuities in an alternating field. Explanation of the multiple frequencies appearing in ferro-resonance.

Nicolas Kurti, Paul Lainé, and Franz Simon : Researches on the ferromagnetism of ferric ammonium alum.

Pierre Barchewitz : The position of the CH bands of the halogen derivatives of the saturated hydrocarbons and the electric moment of these molecules.

Jean Terrien : The stimulation by resonance of the fundamental doublet of copper in the vapour of cuprous chloride.

Jean Paul Mathieu : Researches on the Werner complex compounds. The Raman spectra of 4- or 6-co-ordinated compounds.

Maurice Lemoigne, Pierre Monguillon and Robert Desveaux : The characterization and micro-estimation of nitrates.

S. Lj. Yovanovitch : A new electro-analytical method for the determination of antimony.

Henri George and Roger Lambert : The dissociation of zircon. Zircon, fused in an electric furnace and rapidly cooled, is completely dissociated into silica and zirconia (ZrO_2).

Armand Marie de Ficquelmont : The constitution of mineral rubber. Studies on the phosphonitrile chlorides, $(PNCl_2)x$.

Mlle. Yvonne Garreau : The preparation and constitution of cyclohexylammonium 2,5-dicyclohexylamino-1,4-quinone-3,6-disulphonate, of 2,5-dicyclohexylamino-1,4-quinone and of hydroquinone-2,5-disulphonic acid.

André Cornillot : A mode of representation of organic compounds.

Marcel Tuot : The formation of nitrosochlorides starting with C_6 to C_{11} ethylenic hydrocarbons.

Charles Prévost and Joseph Wiemann : The iodizing properties of the iodo-argento-benzoic complex compound.

Stanislas Goldsztaub : The crystalline structure of laurionite.

André Rivière : The granulometric constitution of the sandy sediments and the broad lines of their evolution in different geological media.

L. Clariond and Mlle. Yvonne Gubler : The presence of Acadian and post-Acadian eruptive rocks to the south of Djebel Ougnat (South Morocco).

Lévi Herman and Mlle. Fanny Bernstein : The relations between the variations of the intensity of the ultra-violet solar radiation, measured at the level of the soil, and the pollution of the lower atmosphere.

Josef Szuleta : The tannin cells in the pith of the elder (*Sambucus nigra*).

André Sarazin : The evolution of the chondriome and of the vacuolar system in the carpophores and especially in the basidia of *Agaricus campestris*.

Mme. Jeanne Werner and Roger Guy Werner : The study of some lichen gonidia isolated in a pure culture.

Pierre Lepesme : The external action of arsenical preparations on insects.

Gabriel Guignon : The post-nymphal development of the wings of the Lepidoptera.

René Salgues : The preventive fungicidal properties of methylene blue in animal pathology.

Antoine Magnan and Henry Girerd : Attempts at the cinematography of the wings of birds in motion in three mutually perpendicular directions.

Wladislas Kopaczewski and René Paille : Gel formation of whole blood.

Mme. Raymonde Duval : The action of the electric current on hæmoglobin in the presence of different electrolytes.

Alexandre Besredka and Ludwik Gross : Intracutaneous immunization against epithelioma and its mechanism.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 1–39, January 15).

S. Atwood : The last premeiotic mitosis and its relation to meiosis in *Gaillardia*.

A. C. Kinsey : An evolutionary analysis of insular and continental species. Nearly 400 species of the family Cynipidæ (gall wasps) have been studied in the United States, Mexico and Guatemala. These wasps provided good material for the study of insular species because each is restricted to a single kind of oak or group of related oaks, and further, the oak hosts in the western area are limited to high mountain elevations. Some 76 per cent of the wasps are classified as insular species. They are usually homogeneous in constitution, and show few local populations and few inter-specific hybrids ; mutation and early isolation of new types are the important factors in increasing the number of such insular species.

G. Birkhoff : Integration of operators.

G. A. Miller : Groups which contain an Abelian subgroup of prime index.

J. v. Neumann : Algebraic theory of continuous geometrics.

W. J. Crozier and A. H. Holway : On the law for minimal discrimination of intensities (1). As a result of a discussion of visual, auditory and other data, it is concluded that the properties of a marginal discriminable interval of intensity are determined by probability considerations, and are completely independent of specific structural and other properties of the receptor field. It is important to use homogeneous data.

Morgan Upton and A. H. Holway : The psychophysics of hearing. (1) Monaural differential sensitivity and exposure-time. A relationship has been determined between the just noticeable increment in intensity and the exposure time, utilizing one ear and continuous increase of intensity, at three levels of intensity. (2) Binaural differential sensitivity and exposure-time. The same relationship found for one ear applies when two are used, but the just noticeable increments of intensity are lower at each level for binaural hearing.

E. Witschi : Stimulative and inhibitive induction in the development of primary and secondary sex characters. Work with salamanders united experimentally with a strand of tissue containing blood vessels, gives evidence of the production by the medulla of the gonad of two inductive substances. One stimulates testicular differentiation, but within the gonad only ; the other inhibits ovarian differentiation of the cortex and is carried in the blood like a typical hormone. These substances are not the same as the testicular hormone, which stimulates merely the last functional development of the male secondary sex characters.

Forthcoming Events

Monday, April 12

Royal Geographical Society, at 5.—Prof. E. G. R. Taylor: "The Geographical Ideas of Robert Hooke".

Tuesday, April 13

Illuminating Engineering Society, at 7.30.—G. T. Winch and L. Jesty: "Television Images: an Analysis of their Essential Qualities".

Thursday, April 15

Institution of Civil Engineers, at 6.—J. L. Savage: "The Boulder Dam".

Chemical Society and Society of Chemical Industry, at 8.—Joint Discussion on "Physico-Chemical Problems involved in Distillation" to be opened by Prof. J. Reilly.

Friday, April 16

Institution of Electrical Engineers (Meter and Instrument Section), at 7.—J. B. Kramer: "The Photocell and its Applications in Industry".

Royal Institution, at 9.—T. Macara: "Science and the Conservation of Food. Some Special Problems".

British Psychological Society, April 16–20.—Extended General Meeting to be held at the University of Manchester.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Junior Assistant Mycologist in the Midland Agricultural College, Sutton Bonington, Loughborough—The Principal (April 12).

Assistant Engineer in the Mechanical and Vehicle Engineering Section of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, London, S.W.1 (April 12).

Chemical Engineer at the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk (April 14).

Junior Scientific Officer at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (April 20).

Serologist in the Ministry of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (April 24)

Lecturer in Chemistry in the Natal University College, Pietermaritzburg—The Registrar (May 31)

Inspector of Aviation Fuels and Lubricants in the Aeronautical Inspection Directorate—Secretary, Air Ministry (S.2.d.), Adastral House, Kingsway, W.C.2

Secretary of the Institution of Gas Engineers, 1 Grosvenor Place, S.W.1—The Secretary.

Official Publications Received

Great Britain and Ireland

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1935–1936. (Cmd. 5378.) Pp. 172. (London: H.M. Stationery Office.) 3s. net. [173

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 6. The Uses of Rubber in Commercial Horticulture. By Alexander Hay and D. F. C. Vosper. Pp. 16. (London: Rubber Growers' Association.) Free. [173

University of Leeds in association with the Royal Bath Hospital, Harrogate. Annual Report of the Advisory Committee on Research into Rheumatism, 1936. Pp. 4. (Leeds: The University.) [183

University of Sheffield. Report on Research Work carried out in the Departments of Mining and Fuel Technology during the Session 1935–1936. Pp. 20. (Sheffield: The University.) [183

The Thoroton Society of Nottinghamshire: Excavation Section. First Annual Report for the Year 1936. Pp. 35. (Nottingham: Thoroton Society of Nottinghamshire.) [183

The British Broadcasting Corporation. Tenth Annual Report, 1936 (Cmd. 5406.) Pp. 32. (London: H.M. Stationery Office.) 6d. net. [223

Falmouth Observatory. Report of the Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council. By H. Dent Gardner; Meteorological Notes and Tables for the Year 1936, with Mean Values for 65 Years (1871–1935), by W. Tregoning Hooper. Pp. 13. (Falmouth: Falmouth Observatory.) [223

Other Countries

Canada: Department of Mines: National Museum of Canada: Bulletin No. 81 (Anthropological Series No. 18): Anthropometry of the Beaver, Sekani and Carrier Indians. By J. C. Boileau Grant. Pp. ii+37+6 plates. 25 cents. Bulletin No. 82: Annual Report of the National Museum for the Fiscal Year 1935–36. Pp. 24. 10 cents (Ottawa: King's Printer.) [153

Canada: Department of Mines, Bureau of Economic Geology: Geological Survey. Memoir 191: Lode Gold Deposits of Ymir-Nelson Area, British Columbia. By W. E. Cockfield. (No. 2415.) Pp. ii+78. 25 cents. Memoir 196: Geology of Lake Athabaska Region, Saskatchewan. By F. J. Alcock. (No. 2420.) Pp. ii+41+8 plates. 25 cents. Memoir 203: Geology of Teslin-Quiet Lake Area, Yukon. By E. J. Lees. (No. 2429.) Pp. ii+30+2 plates. 25 cents. (Ottawa: King's Printer.) [153

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1929–1930. Part 2. Pp. xiii+382+29 plates. (Cairo: Government Press.) P.T. 100. [153

Punjab Irrigation Research Institute. Report for the Year ending April 1936. Pp. iv+73+62 plates. (Lahore: Punjab Irrigation Research Institute.) [153

Indian Forest Records (New Series). Vol. 2, No. 11: Entomological Investigations on the Spike Disease of Sandal (30) *Reduviidæ* (Hemipt.). By N. C. Chatterjee. Pp. ii+207–221. (Delhi: Manager of Publications.) 10 annas; 1*s*. [153

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 16, No. 2: The Collection of Pteridophyta made in Hispaniola by E. L. Ekman 1917 and 1924–1930. By Carl Christensen. Pp. 93+20 plates. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [153

India Meteorological Department. Scientific Notes, Vol. 7, No. 71: A Note on the Statistical Study of Rainfall in the Mysore State. By A. Ananthapadmanabha Rao. Pp. 21–33+2 plates. (Delhi: Manager of Publications.) 7 annas; 9*d*. [153

Transactions of the Mining and Geological Institute of India. Vol. 32: Drilling Mud; its Manufacture and Testing. By P. Evans and A. Reid. Pp. 263+xxx+15 plates. (Calcutta: Mining and Geological Institute of India.) 12 rupees. [153

Report of the Crohamhurst Observatory for the Year ending 31st December 1936. Pp. 10. (Beerwah, Qd.: Crohamhurst Observatory.) [163

Department of Agriculture, Mauritius: Sugarcane Research Station Bulletin No. 12: Further Investigations on the Root-System of Sugarcane. By Dr. H. Evans. Pp. 34. (Port Louis: Government Printer.) [163

U.S. Department of the Interior: Geological Survey. Bulletin 873: Geology and Mineral Resources of the Butler and Zelienople Quadrangles, Pennsylvania. By G. B. Richardson. Pp. v+93+8 plates. 45 cents. Bulletin 881: Spirit Leveling in Connecticut, 1922–35. By J. G. Staack. Pp. ii+65. 10 cents. Bulletin 886-A: Possibility of New Oil Pools in the Siliceous Lime and Bartlesville Sand in T.23 N., R.10 E., Osage County, Oklahoma. By N. Wood Bass, W. Reese Dillard and Jess H. Hengst. (Contributions to Economic Geology, 1937). Pp. ii+4. Water-Supply Paper 785: Surface Water Supply of the United States, 1935. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. 283. 35 cents. (Washington, D.C.: Government Printing Office.) [163

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 175: Powdery Mildew of Cucurbitaceae. By Dr. Amin Fikry. Pp. iii+25+24 plates. (Cairo: Government Press.) P.T. 7. [223

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 12: List of Publications on the Botany of Indian Crops, Part 2, for the Period 1928–1932. Compiled by R. D. Bose. Pp. iv+198. (Delhi: Manager of Publications.) 3·6 rupees; 5*s* 9*d*. [223

Annual Report of the Agricultural Meteorology Branch, India Meteorological Department, for the Third Year ending 21st August 1935. Pp. 37. Supplements to the Report of the Agricultural Meteorology Branch, India Meteorological Department, for the Year ending 21st August 1935. Pp. iv+77. (Simla and New Delhi: Government of India Press.) [223

Report of the Danish Biological Station to the Ministry of Agriculture and Fisheries. 41, 1936. Edited by Dr. H. Blegvad. Pp. 52. (Copenhagen: C. A. Reitzel.) [223

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Fuel Briquetting. By R. A. Strong, E. Swartzman and E. J. Burrough. (No. 775.) Pp. iv+100+5 plates. (Ottawa: King's Printer.) 25 cents. [223

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 145: Theoretical and Experimental Studies of Convectional Circulation and its Relation to Land and Sea-Breezes. By Tatuo Kobayasi and Tatudirô Sasaki, with the assistance of Tadao Osanai. Pp. 67. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 70 sen [223

Department of Agriculture: Straits Settlements and Federated Malay States. Scientific Series, No. 19: Lac in Malaya. Part 2. An Account of Attempts to Propagate *Laccifer lacca* (Kerr) in Malaya. By N. C. E. Miller. Pp. ii+22+2 plates. (Kuala Lumpur: Department of Agriculture.) 50 cents [223

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 8: Graduate Work in Engineering in Universities and Colleges in the United States. By Walton C. John and H. P. Hammond. Pp. xiii+113. 15 cents. Bulletin, 1936, No. 18—VI: Youth . . . Community Surveys. By Carl A. Jessen and H. Clifton Hutchins. Pp. x+97. 15 cents. Vocational Education Bulletin No. 188 (Agriculture Series No. 49): Young Men in Farming; a Study of Young Men to determine the Qualifications, Opportunities and Needs for Training in Farming, together with derived Guidance, Placement and Training Objectives. Pp. v+117. 15 cents. (Washington, D.C.: Government Printing Office.) [243

U.S. Department of Agriculture. Leaflet No. 121: The Sweet Potato Weevil and how to Control It. By K. L. Cockerham. Pp. 6. (Washington, D.C.: Government Printing Office.) 5 cents [243

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Physical Training and National Well-being

THERE are undoubtedly some who will see a connexion between the Government's campaign for improving the health of the people of Great Britain by physical education and the difficulty experienced by the War Office in obtaining recruits of a sufficient standard of physique for the army. Although, perhaps, the Government proposals have been a little over-advertised, a balanced and scientific attempt to improve the physique and health of the nation is so long overdue that we need not mind from what quarter the final stimulus is supplied.

It should not be overlooked that recent reports of the Commissioners for the Special Areas have insisted upon the need for physical training and recreation, while at the same time they have stressed the need for simultaneous attention to nutrition. In the memorandum which has been issued explaining the Government's proposals for the development and extension of the facilities available for physical training and recreation, it is admitted that bodily fitness depends on two essential elements, nutrition and physical training. Action has already been taken in many ways with regard to the former, and the present proposals are accordingly limited to the latter problem.

The proposals outlined in the memorandum include the establishment of two National Advisory Councils, one for England and Wales, and one for Scotland, to survey the field and to advise as to the best methods of meeting the needs and the lines of general advance. The personnel of these Councils has already been announced and includes representatives of many associations of physical culture of one sort or another, such as Scouts and Guides, the Young Men's and Young Women's Christian Associations, boys' clubs, girls' clubs, the League of Health and Beauty, the English Folk Dance and Song Society, the Margaret Morris movement, etc. Two grants committees are to be established through which, subject to the approval of the responsible Minister, grants will be payable. The National Advisory Councils will organize local committees to develop and co-ordinate the work in various localities and to advise the grants committee on the distribution of local grants. A National College of Physical Training is to be established, and in addition to a grant to the National Playing Fields Association, an interim grant to the Central Council of Recreative Physical Training is proposed. Legislation will be introduced to enable the grants committee to make grants to voluntary bodies and to local authorities, and to empower local authorities to provide community centres, to remove limitations on their present powers of providing physical and social facilities, and to empower county councils to contribute towards the cost of county district councils in the exercise of their powers under the Bill and their power of providing swimming baths.

It is beyond question that the existing provision of facilities for physical training and recreation in Great Britain is both insufficient in amount and sporadic in incidence, being sometimes lacking where most required, and, hampered by want of funds for development, is unable to do more than touch the fringe of the problem. Indeed, the main criticism of the scheme so far advanced is that certain classes of the community are too inadequately nourished to participate in physical training or recreation without risk of further physical deterioration.

To this objection, it is no complete answer that the problem of nutrition is being handled elsewhere. The question of the physical condition of the people must be studied and handled as a whole on scientific lines, and all the relevant factors must be taken into simultaneous account. In the Special Areas, and probably in certain other districts or sections of the community, the development of physical training facilities can do no more than follow the improvement of nutrition and general health, or at the best proceed with it and the need for a constructive and well thought out policy in national health can scarcely be better illustrated than in passages of the Commissioner's recent report.

It would be a tragedy, however, if criticism of this type, or the attention which has since been given to the White Paper on Rearmament, led the nation to lose sight of the ideals and the political philosophy which inspire the present proposals. They will fail of their purpose unless the fullest use is made of them by the existing agencies, whether voluntary bodies or local authorities. Their essential task is not merely to provide facilities sufficiently attractive to make an effective appeal to the people of the country. It is primarily to create in the public mind a realization of the value of physical fitness for its own sake.

This, even more than the fact that the scheme is an attempt to extend to all classes certain physical advantages that are now enjoyed only by the more favoured classes, is the most significant aspect of the Government scheme. Although the country is comparatively well off for voluntary institutions to improve the physique of the mass of the people, the State has done nothing beyond the school age. The recognition that the duty of the State extends beyond the school in this field is not merely an advance in democracy: it is essentially an attempt to achieve a better adaptation of the citizen to his environment in a society dominated by power production.

The new conception of public health which we encounter here is not that inspired by the totalitarian States, even if they have been responsible for some of the first, though perverted, experiments in this field. Its force derives primarily from the necessity of the State intervening to afford the citizen fuller opportunity of physical and mental development in an era when economic forces inherent in an age of power production have severely circumscribed such opportunities and enhanced their importance.

The need for biological adaptation in industrial civilization has so far largely been overlooked, despite a brilliant chapter on this theme by Lewis Mumford in "Technics and Civilisation". None the less, the attempt must be made if man is to regain the mastery of the machine and reap the advantages in the way of an ampler life which that mastery would offer to all. The retreat to the primitive inherent in certain modern dictatorships makes the problem the more urgent. Civilization cannot be run by barbarians, and the refusal of the totalitarian State to face the basic and difficult problems involved in the transition from the historic forms of capitalism and the limited original forms of the machine to an economy centred on life is the more serious through the threat it offers to human motive power, its discouragement of co-operative and creative thought and the disinterested research on which technical achievement as well as spiritual progress rest.

The life and prosperity of this nation, as of all civilized European nations, depend, as Bavink has wisely reminded us, on the measures which we are willing to take against the processes which are destroying our racial health. Such measures must of necessity depend upon insight into the causes of the processes. The very stress and strain under which we live to-day forces us back to the Greek ideal of life as a unity, if we are to avoid racial decay and degeneration and social measures which are really anti-social, in promoting the well-being of one set or generation of individuals at the expense of the whole nation and of human civilization. That the present proposals in Great Britain should be submitted by the President of the Board of Education rather than by the Minister of Health is indeed a hopeful sign. It indicates that the Government recognizes not merely the value of physical fitness itself but also the intrinsic relations of mind and body.

If we cannot have a healthy mind without a healthy body, apart from the glaring exceptions of genius to every general rule, or a sane and judicious electorate which has the poison of disease or physical feebleness at work within, equally we cannot have a really healthy body without a healthy mind. The Greek ideal of an active healthy body postulated a corresponding activity of the mind.

Accordingly, the Government scheme wisely recognizes the need for taking account of the many varieties of temperament which may make one man's joy in a particular physical exercise another man's boredom, and refrains from any attempt at a uniform or a compulsory system. To introduce the element of compulsion, in fact, would be to endanger just that willing interest of the mind from which any course of physical training derives half its value. The scheme is thus poles asunder from the compulsory schemes introduced in the totalitarian States, which all too plainly are closely related to military training. The recognition that the best defence of a State is not in walls but in the health, vigour and character of its individual citizens, men and women alike, need no more imply the denial of individuality than it did in ancient Greece. On the contrary, as the scheme rightly insists, it is only as individualism has its sway that the ideal of fitness, whether physical or mental, can be fully realized. Physical and mental well-being is primarily a duty the individual owes to himself and not to the State. He or she best serves the State by realizing the best in himself or herself in a happy balance of mind in which duty is also happiness, liberty makes its own discipline and life becomes an active pleasure instead of a passive existence.

The contribution of the State is accordingly essentially one of co-ordination, the removal of obstacles and the provision of facilities where required. It is important to note that the last by itself may be quite inadequate. Many critics of the scheme who stress the importance of dealing with the questions of malnutrition and housing are not detracting from the value of the present proposals, but emphasizing the necessity of dealing with national health in accordance with a definite co-ordinated plan conceived on wide and generous lines. In such a plan, the Factories Bill at present before Parliament, for example, will find a place, both in respect of its bearing on the employment of juveniles and in the elimination of overtime, industrial disease and other conditions which undermine the health of workers in industry.

It is interesting to note in this connexion two recent precedents for this conception of public health. Recommendations for the prevention of disease recently submitted to the National Health Insurance Committee by the National Physical and Mental Welfare Advisory Board of New Zealand include the suggestion for the replacement of the present Health Department and Mental Hospitals Department by a National Health Department, in which not merely the medical profession but also sciences such as applied biology, chemistry, dentistry, economics, education, ethics, eugenics, hygiene, nutritional physiology, psychology, physics, sociology, etc., are represented in accordance with the principle that the prevention of physical, mental and moral disability and the maintenance of national health require the aid of many branches of science. For this purpose the appointment in each local centre of a man or woman with the synthetic mind, which is not a common characteristic of medical men or other scientific specialists, is recommended.

Even more significant, however, is the system by which the former Social Democratic Municipal Government in Vienna succeeded during its fifteen years rule in changing the population of a town badly shaken by the vicissitudes of a lost war and by the effects of blockade, starvation, poverty and disease into probably the fittest town population of Europe. This welfare and youth protection organization of the Vienna municipality was the best thought out and most efficiently organized single system in the world. Its standard was a good deal higher than any yet known in England, and amounted to a refusal to accept poverty as a reason why any of Vienna's citizens should be unhealthy or lack means for enjoyment.

If the scheme unfortunately no longer exists since the new rulers came to power after February 1934, its details and organization should not be forgotten, above all by scientific workers, whose tradition and responsibility alike it is to urge unceasingly upon the Government the idea of a creative and thinking mind, no less upon national health than in the expenditure of enormous sums on armaments. Not merely from the point of view of the co-ordination of different branches of science in the service of national health, nor from the point of view of securing adequate expenditure on scientific research in this field, whether in physical training itself, in problems of nutrition, housing, industrial disease and safety, but above all from the point of view of the stimulus to intelligence and character which is inherent in a well-conducted scheme, this question of physical training and national health commands the attention of scientific workers. The support which the present scheme may be expected to claim from them, however, should not lead them to overlook the wider and more fundamental questions, or to cease their pressure upon the administration to secure on an ever-increasing scale the free and maximum employment of scientific knowledge and research in the service of the health and welfare of the community.

Nerve, from Amphioxus to Man

The Comparative Anatomy of the Nervous System of Vertebrates, including Man
By Prof. C. U. Ariens Kappers, Prof. G. Carl Huber and Prof. Elizabeth Caroline Crosby. Vol. 1. Pp. xviii+864. Vol. 2. Pp. xii+865–1845. (New York: The Macmillan Co., 1936.) 63*s*. net.

THIS comprehensive work, of nearly 1900 quarto pages carrying more than 700 text-figures, has grown out of Prof. Ariens Kappers' "Comparative Anatomy of the Nervous System", of now more than fifteen years back. The present is a new treatise, retaining however the orientation which Prof. Kappers' earlier treatise had in view. The collaboration of the joint authors has been happy in extending the first-hand touch of the book with current research and research material to both sides of the Atlantic. The Amsterdam Institute of Brain-Research and the Laboratory of Comparative Neurology of the University of Michigan have each supplied their special contributions to the making of the work. But the whole compilation is one harmonious exposition directed throughout to the same main objects, and viewed from a single steady point of view. A bibliography, impressively liberal in scale, is appended to each chapter. The several chapters are themselves of almost monographic proportions, but their scope is always kept broad.

The work may be taken to address, for the most part, readers of two classes. Research workers will assuredly find it indispensable. These it will help to check their own findings and views against a well-balanced presentment of the present state of knowledge. It is exemplary in giving chapter and verse from its authorities. There will further be those who, versed in human anatomy, desire a general background of the neurology of vertebrates against which to set it, giving evolutionary perspective. For these the anatomical side of what they want is provided here better than by any other single work we know. Its volumes will long remain a welcome source of authoritative reference.

The authors begin with an account of the morphology of neurones and of the synapses between them, and the opening chapter includes a presentation of the theory of *neurobiotaxis* as that stands to-day. The theory states that a nerve-cell migrates, or strictly that the body of the nerve-cell shifts, toward a nerve-path from which it is receiving predominant excitation. The topography of nerve-cells in the central nervous organs affords examples of this. Thus associated activity tends to draw two nerve-cells together. Dr. Ariens Kappers will always be remembered in neurology as the earliest observer to put forward as an immediate problem how it is that the several kinds of neurone come by their characteristic individual shape. Most of us were content simply to accept the fact and use it gladly for identifying a cell which did this from a cell which did that, and the shape was clue to the direction of nervous transmission through it. But, as geotropism influences the tree and its branch-pattern, Kappers asked what tropism it might be directs the neurone's branches He discusses this here, and leans towards explanation by galvanotropic processes. It is a subject seeming to beg for experimental observation with the micro-needle of Chambers in embryonic tissue-cultures such as those of the Harrison laboratory.

The work then continues to climb the nervous system stage by stage, and devotes its chapters to successive levels reaching finally the forebrain. Facts and assessments rich in neurological interest are met with as this course is followed. In dealing with the spinal cord, attention is directed to its being in birds actually more primitive than it is in many of the reptiles. Short local paths as against long brain-ward paths are more abundant in the former than in the latter. So voluminous is the group of spinal motoneurones for the pectoral muscle in most birds that it goes by the name of the 'flying centre.' The mammalian spinal cord is as characteristically mammalian as is the mammalian brain. Its brain-ward tracts climb to higher levels of the brain than do their submammalian homologues. Its paths for fine tactile discrimination and muscle-sense are larger than in the submammals and largest of all in man. They are on their way to the great receiving station in the brain, the thalamus, reaching it by relay. Still further marked is this character as followed in downward paths from brain to spinal cord. There are the mid-brain tracts, tecto-spinal and rubro-spinal, the former actually on 'relay' to the viscera as well as skeletal muscle, In addition, a wholly new path descends from the motor field of the brain cortex to the spinal cord to synapse there, via a relay, with the motoneurones of the neck and limbs. This path is in the monkey more than twice as ample as in the dog, and in man as compared with monkey is again far larger still. It typifies the greater grip of the brain cortex on the behavioural acts of man and the greater disablement in man following on cortical injury.

The reviewer has to resist temptation to stay too long over the several fields offered by a detailed and interesting book. Under "Co-ordinating Apparatus" the inferior olive and its 'complex', with their bearings on neck-movement and neo-cerebellum, are very clearly and fully traced. Passing upward, the cerebellum itself is given a penetrative analysis. No part of the brain repays comparative review more worthily; that is allowed it here, and with more than competence. But the problem of how cerebellar symptoms in disease come to be what they are remains still the puzzle it so long has been. It is pointed out that as to cerebellar localization, two disharmonious patterns seem to co-exist, one receptive illustrated by the entrant paths, one mapped out in muscular regions and movements, the two seeming disparate.

Coming to the diencephalon and telencephalon, which are for the non-technical reader what we may suppose he would regard as the brain proper, the account goes forward with its wealth of detail to reach a final chapter of two hundred pages on the cortex in the mammalian brain. It is brought home to us, if need were, that it is to the mammals that life owes this supreme nervous product. We see how the birds, a newer outcome of evolution, are in a sense back-sliders from the path of promise to real progress. They, although starting later, did not follow the lead given by the mammalian stock in making a cerebral cortex. They have developed a brain on another line. They have exalted instinct with its triumphs of performance but its fixities, rather than humble 'trial-and-error' with its adaptability and, despite its humility, its orientations toward 'reason'.

A fully detailed account is given of the remarkable development of the cortex in the mammalian stock up to and into man. Stress is laid on the close correspondence found between the neocortex, which in man is the overwhelmingly larger part of the cortex, and the underlying dorsal thalamus. If we might venture an analogy between the concepts of modern cerebral neurology and the old doctrines of Aristotle's "De Anima" as they echo down the Middle Ages and into the earlier Renaissance, for example with Jean Fernel, it would be to find a likeness between *sensorium commune* and the great complex of the thalamus.

The fields of the cortex which ripen late in the human brain are those which appear late in phylogeny. Some of them were wont to be thought purely cortical in the sense of possessing connexions only with the cortex itself. They are, however, now known to follow what seems indeed a universal rule in being connected with the great subjacent 'exchange', the thalamus, the general receiving station.

The treatise is anatomical, and rightly keeps rather strictly to that scope. Such inferences as it allows itself on function come perhaps with the more impressiveness. It stresses that removal of considerable portions of the total mass of the cortex including the motor fields does not seriously interfere with the normal motor activity of lower mammals such as the rat, yet the destruction of merely a small portion of a certain region of the cortex in man produces a paralysis from which only slight improvement is noted over the course of years. Rats almost completely decorticated are able to learn the brightness discrimination habit in approximately the same time as do normal rats. But in man the destruction by disease of a large area of the cortex commonly brings idiocy.

The human cortex forms the climax, as well it may and indeed must. The preface at the beginning of the first volume had been careful to set forth that, in the descriptions which would follow of the inner urge underlying the development of the brain and nervous system generally, no teleological principle was implied. Each stage of development is an end within itself. "The development is here entelechic," meaning by entelechy an inherent organic property, not a property apart from the organism.

That no reference is made to the difficulty of relating to cerebral structure what is commonly regarded as the greatest of all its functions, mind, is natural enough. Admirable and comprehensive the treatise is; it by those very qualities marks the more definitely the gap between the description of nervous structure and of mind. Nerve and thought, the more we learn about each of them the more different each seems from the other. The more we know about the brain the further it seems to get from mind, because chemistry and physics do not lead there. Matter, however carefully anatomized, does not take us thither. An anatomical treatise may, however, well be excused from raising this question.

The authors are to be congratulated on producing a thoroughly authoritative work, in every way a memorable treatise. That Dean Huber of the University of Michigan did not live to see its completion is a matter of deep regret. Prof. Kappers and Dr. Elizabeth Crosby in their preface pay warm tribute to him as a colleague. The volumes are excellently issued, on paper not too heavy, with liberal type and admirable text-figures, for the most part original to the work. The sole misprint we have noticed is on p. 1663. The whole production with its impressive array of marshalled facts and its clear and judicious exposition is a contribution to its subject for which every neurologist will be grateful.

C. S. S.

Organic Chemistry in Theory and Practice

(1) Essential Principles of Organic Chemistry
By Prof. Charles S. Gibson. Pp. viii + 548. (Cambridge: At the University Press, 1936.) 18*s*. net.

(2) Organic Chemistry:
the Chemistry of the Compounds of Carbon. By Prof. L. J. Desha. (International Chemical Series.) Pp. xv + 750. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 21*s*.

(3) Practical Organic Chemistry:
By Dr. F. G. Mann and Dr. B. C. Saunders. Pp. xiii + 403. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 8*s*. 6*d*. net.

(4) An Introduction to the Preparation and Identification of Organic Compounds
By Prof. R. D. Coghill and J. M. Sturtevant (International Chemical Series.) Pp. xiii + 226 (New York and London: McGraw-Hill Book Co., Inc., 1936.) 10*s*. 6*d*.

(1) and (2). The chief problem that faces authors of text-books of organic chemistry is that of selection of what is worth while from the vast mass of original literature. In books of moderate size, choice and arrangement of topics are all-important, and the reviewer's task is to consider whether they have been made with proper regard to the theoretical and practical development of the science. In this respect, the authors of both these books may be considered to have succeeded.

The standard is roughly that of a first-year university course, and the books serve as general surveys, which prepare the student for more specialized work. Only where the method is particularly valuable, as in the tautomerism of acetoacetic ester, has a problem been approached from the historical point of view. References are wisely omitted; for here they would only disturb the continuity, and needlessly increase the size. The authors have realized that a text-book of organic chemistry is something different from a suitably abridged version of Beilstein's "Handbuch"; theirs has been a more philosophic approach in which essential principles are emphasized, and in which descriptions of compounds and reactions are presented only in so far as they illustrate them. Thus the subject is taught as a science, and not merely as a technique. The old subdivision into aliphatic and aromatic has been largely abandoned, the grouping being according to function. Aliphatic and aromatic hydrocarbons are treated together, so that the fundamental similarities and differences may be appreciated. Derivatives then follow in their appropriate groups of ketones, acids, amines, etc., with accounts of modern developments appearing in the proper context.

Prof. C. S. Gibson, as befits a teacher at a great hospital, stresses particularly the biological side of the subject. The properties and reactions of biologically important compounds such as lecithin and adrenaline are described at length, and the special value of the book to medical students is enhanced by the full treatment accorded to amino-acids, carbohydrates and purines. A number of representative preparations, and an appendix on practical methods are given. The too frequent use of footnotes is injudicious; for many are too long, and their subjects might well appear in the main text.

Prof. L. J. Desha in particular makes frequent reference to industrial methods, and is alive to the importance of catalytic and high-pressure processes. His book, which is rather wider in scope, includes under the title of "Special Results of Certain Structures" a convincing treatment of such themes as tautomerism, re-arrangements, colour and dyeing. It concludes with a long section on plant and animal products, so that students may have a better knowledge of the "composition of the food they eat, the clothes they wear, and the bodies thus fed and clothed". But even here, Prof. Desha is more concerned with the industrial significance of the products. Special features of his book are the questions at the end of each chapter, and the charts showing the inter-relationships of compounds.

(3) and (4). In his foreword to the first of the two practical books, Sir William Pope reminds us that the "vast superstructure of organic chemical theory" has been based on careful experimental work. It is significant therefore that the four authors confess that the students do not readily link in their minds the 'paper' chemistry of the lecture room, and their own efforts in the laboratory. With this salutary thought, they set out to effect that essential liaison between theory and practice, and they should achieve a large measure of success. Both books may be recommended for the important reason that the authors write from their own experience of large classes, and have borne in mind the cost of materials, the time available, and the convenience of operations. Both pay special attention to safety precautions not only by

prefatorial injunctions, but also by appropriate warnings in the text. Preparations have been carefully chosen, with the view of illustrating reactions and also giving practice in a wide variety of operations. Each is prefaced by a theoretical discussion, and is concluded by an account of the reactions of the product. The modern method of teaching aliphatic and aromatic chemistry together has aided in their selection and arrangement.

The English work is much longer and more comprehensive; in addition to preparations and identification, it deals very fully indeed with quantitative analysis, and has a useful section on practical enzyme chemistry. It is so composed that its earlier pages can introduce the subject in schools, whilst it should prove useful to honours degree students. The very full accounts of practical operations should be of great value in large classes where personal supervision is limited. Every student of organic chemistry will require this extremely low-priced book.

Special emphasis is laid by the American authors on the section dealing with the identification of compounds. They justly point out that a wide experience in practical chemistry, including incidental preparative work, can be gained by it, especially in the important matter of the manipulation of small quantities. They have exercised great care in the preparation of this section, and they claim that their methods, which have been thoroughly tried out at Yale, prove interesting as well as instructive to students. L. P. W.

Evolution of Kingship

Kings and Councillors: an Essay in the Comparative Anatomy of Human Society. By A. M. Hocart. (Egyptian University Collection of Works published by the Faculty of Arts, No. 12.) Pp. 306. (Cairo: Egyptian University; London: Luzac and Co., 1936.) 4*s.* 6*d.*

MR. HOCART has already written an interesting work on the evolution of kingship; and here he deals further with the subject. Starting from the primitive man's desire to control Nature for his own benefit, as expressed in a ritual that mimics or prefigures the fulfilment of his wishes, he finds the prototype of the king in the leader of the ceremonies—the *choregus*, as we may say. Not very explicitly, since he prefers not to enter into the psychology of symbolism, he supposes the protagonist to become somehow identified with his objective, namely, Nature and all that it yields in support of human life; while, by a like process of identification, he is made equivalent to the cult-object as represented by animal, tree, victim, idol and so on. It is explained that "the essential thing in worship is not reverence but identity"; so that killing the king in solemn sacrifice is all in the day's work.

Such identity, it is added, consists in the fact that all alike are "receptacles of the same spirit, life, or whatever you may choose to call it". As owners of the various receptacles, the worshippers are apparently in a position to enjoy to the full this spirit or life at large in the universe, though but at second hand; since it is the splendour of the king that "provides the hard-driven peasant with escape from his drab drudgery"—so much so that, if he realizes that he is but contributing to its upkeep, he will pay his taxes willingly, just as he should in duty welcome the privilege of paying tithes.

Meanwhile, the evolution of kingship would seem in certain respects to have been a degradation in the light of the early notion that a king is meant to reign rather than govern. In place of the undifferentiated quest for life of primitive times which takes concrete shape in the divine king as in an image, the modern world has by specialization narrowed down the aims of the social life as religious *or* civil, rather than as both together; so that in becoming administrative the higher offices of State lose in representative significance. For the rest, we are assured that "we vastly exaggerate the importance of government in our society", seeing that it is self-help that really governs. As for certain recent developments of the political leader, Mr. Hocart must, if he would follow ancient precedent, allow his claim to infallibility, but might likewise insist that an euthanasia goes suitably with that prerogative.

Taken as a whole, this essay is very suggestive, and it will come as a revelation to many that practical politics not only have had a mystical background, but even to-day may depend on the traditional sanctities of life for their subconscious motive. It is a pity that the author goes out of his way to "abjure the method of Tylor and his successors". He has inspiration enough to fill his chapel without pitting himself against the fathers of the church. R. R. M.

An Introduction to Nematology

By B. G. Chitwood and M. B. Chitwood. Section 1, Part 1. Pp. 53. (Baltimore, Md.: Monumental Printing Co., 1937.) 2.50 dollars.

THE Nematode worms, although forming a large class which includes many economically important species, usually receive little attention in zoological text-books. The appearance of a comprehensive account of them in the English language is therefore to be welcomed, and the work, of which this is the first part, will probably contain many surprises for zoologists unfamiliar with the great mass of recent work on the group.

The first chapter contains a semi-popular account of the occurrence, mode of life and economic importance of the Nematodes, and a brief outline of the history of their study. There follows a short summary of their general structure, which might with advantage have been written rather more simply and with fewer technical terms of very recent origin. The next two chapters are devoted to detailed accounts of the cuticle and hypodermis and of the musculature and body-cavity, and will doubtless be followed by chapters on the other organs and systems.

Two "outline classifications" are included, the first containing short definitions of subclasses, orders, suborders and superfamilies, the second still briefer definitions, but extending to subfamilies. The classification adopted embodies advanced views which have not yet stood the test of criticism, and it may be doubted whether the primary division of the class into "Phasmidia" and "Aphasmidia", based on the presence or absence of a pair of small sense-organs on the tail, will prove generally acceptable. The authors' views on taxonomy need not, however, detract from the usefulness of the work.

The text is printed in double columns of rather small type, which some will find a disadvantage, but is profusely illustrated with good figures. A useful feature is the separate bibliography at the end of each chapter or section. H. A. B.

Logging—Transportation:

the Principles and Methods of Log Transportation in the United States and Canada. By Prof. N. C. Brown. Pp. xv+327. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 20*s.* net.

PROBABLY about two million people in North America are dependent on the timber industry. This is at present carried on entirely in virgin forests, though replanting and conservation are safeguarding them for the future. Obviously Nature alone cannot have developed either roads or navigable streams in such parts, and it hence becomes clear that half the cost of board or beam is absorbed in its transport; hence this text-book specialized solely to this one question. The operations after felling are the assemblage of the tree trunks at convenient spots (skidding) and the long-distance transport to the saw mills. Up to the present, the cheapest and most convenient means of transport have been streams and rivers, but these are unsuitable to the heavier hardwoods; and much of the standing timber now lies at higher elevations and remote locations. The question is one of the value of the timber: whether it will pay for the necessary horse or power tractors or chutes to assemble it for water flotation or for rail. The whole book is the story of the engineers' ingenuity in the adaptation of their needs to local topography, and they are the class who will appreciate this admirable and well-illustrated book.

A Manual of Practical Anatomy:

a Guide to the Dissection of the Human Body. By Prof. T. Walmsley. New edition. In 3 Parts. Part 1: The Head and Neck. Pp. viii+357+3 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 12*s.* 6*d.* net.

THE study of practical anatomy remains, along with instruction in clinical examination, the best of the scientific disciplines to which the medical student is subjected. Each, however, must discard what is redundant, useless or unnecessary, and each must adopt new methods when they are better. In anatomy much useless information has been assembled and taught about the relations of one structure to another. On the other hand, much valuable information about the structure and function of the body has not found its place. For many purposes the X-ray machine is better, more informing and more accurate than the method of dissection.

The present book is shorter than others, and does something to lessen the drudgery of the student. By keeping to illustrations that are simple it remains a dissecting manual, and in furnishing outlines to be filled in by the student it uses a valuable device for learning. The value of the X-ray method of studying anatomy is shown by the reproduction of X-ray films. The skilful use of small print helps the student to evaluate better the information he is acquiring.

This useful and straightforward dissecting manual is a contribution towards a more satisfactory presentation of the anatomy of the human body.

A History of Fishes

By J. R. Norman. Second edition. Pp. xv+463+8 plates. (London: Ernest Benn, Ltd., 1936.) 15*s.* net.

FIRST published in 1931, this book is by now sufficiently well known and appreciated to render a lengthy review unnecessary. A veritable encyclopædia on fish-life, profusely illustrated by Lieut.-Col. W. P. C. Tenison, it is a most interesting and useful volume which most specialists and many laymen would like to have on their bookshelves. Hitherto, the published price of 28*s.* net has prevented this, but the recent issue of a photo-lithographic reproduction of the original work, at the much more favourable price of 15*s.*, will enable many more to purchase a copy. Comparing this second edition with the first, it must be admitted that the print has lost quality in the process of reproduction, although the general result is surprisingly good. The binding, however, would seem to leave something to be desired, since the plates (at least in the reviewer's copy) will soon become detached, including the most attractive photograph of the angel fish which forms the frontispiece.

Meteorites and the Craters on the Moon

By Dr. L. J. Spencer, C.B.E., F.R.S.

SEVERAL views have, from time to time, been put forward to explain the origin of the remarkable series of shallow craters on the surface of the moon. One of these is that they were formed by the impact of meteorites. Two main objections to this view have been frequently stated. It is said that all meteorites would not have fallen in a direction perpendicular to the surface to produce craters of a circular outline : many must have fallen obliquely and formed oval craters. Again, it is often asked : Why is the earth's surface not pock-marked in the same fashion ? A study of meteorite craters and of meteoritic showers[1] on the earth's surface shows that both these objections are without justification.

Since the discovery of the meteorite craters at Henbury in Central Australia[2] in 1931 and at Wabar in Arabia[3] in 1932, it has been clearly demonstrated that these are not craters of impact or percussion, but that they are explosion craters. The kinetic energy of a large mass of iron (nickel-iron) travelling at a high velocity, was suddenly transformed into heat, vaporizing a large part of the meteorite and some of the earth's crust, so producing a violent gaseous explosion, which formed the crater and back-fired the remnants of the meteorite. Such an explosion crater will be circular in outline whatever be the angle of approach of the projectile. The materials collected at the Wabar craters afford the clearest evidence that very high temperatures prevailed. The desert sand was not only melted, yielding a silica-glass, but this boiled (b.p. about 3,500°C.) and was vaporized. The meteoritic iron was also in large part vaporized, afterwards condensing as a fine drizzle. Minute spheres of nickel-iron, of the same composition as the meteorite, are preserved in the bubbly silica-glass. In some portions these are present to the extent of about two million per cubic centimetre of the glass. The fact that these minute spheres show a bright and highly polished surface suggests that the earth's atmosphere was blown aside in the fiery blast.

On the earth's surface, only five really certain examples of meteorite craters are yet known. These are all associated with fragments of meteoritic iron. Stony meteorites have not been found around any crater, despite the fact that, of observed meteoritic falls, 95 per cent are stones. Irons form only 5 per cent of observed falls ; but they account for 82 per cent of 'finds' of which the fall is not recorded. The friable stony meteorites are usually broken up in the earth's atmosphere, and fall as a shower of stones. Only a really large mass of iron can possibly give rise to a crater. Near the largest known iron meteorite, the Hoba in South-West Africa, weighing 60 tons (or 100 tons allowing for the surrounding zone of iron-shale), there is no sign of a crater.

Astronomers, who revel in large numbers, tell us that some twenty million meteors enter the earth's atmosphere every day. The majority of these are assumed to be the size of a pea or a grain of sand. But perhaps they may be much larger, for the ablation of material from the surface of a meteor must be enormous. In any event, those that reach the earth's surface must have been very much reduced in size ; and the number actually collected each year averages only five. We have to be thankful that our atmosphere extends for at least a hundred miles above the earth's surface.

On the moon, with the absence of an atmosphere, conditions are very different. Meteorites there will encounter no check on their velocity. They will not be reduced in size, and stony masses will not be broken up. They will strike the surface at 20 or 40 or more miles per second. An astronomically small body with a radius of 100 feet and consisting of nickel-iron with a density of 7·7 will have a mass of very nearly a million tons and a kinetic energy measured by $\frac{1}{2}mv^2$. When this is arrested, something is going to happen. Part of the energy will be expended in penetrating and compressing the materials on the surface of the moon. This pressure will be released with explosive violence and moonquake waves will result. But a large part of the energy will be transformed into heat, vaporizing the meteorite and adjacent materials, and causing a violent gaseous explosion.

The idea of such a gaseous explosion was anticipated before the discovery of the Henbury and Wabar craters in a remarkable paper which has only now come to my notice and which appears to have been generally overlooked. In 1924, A. C. Gifford[4] compared the craters on the moon with the Arizona crater, and he concluded that they are explosion craters. The energy of a meteorite travelling at 20 miles per second he calculated to be 123,900 calories per gram, and at 40 miles per second to be 494,700 cal./gm.; compared with the energy of dynamite of about 1,100 cal./gm. He assumed that the meteorite would penetrate to a depth of two miles in the moon's crust (but this is surely too deep), and calculations for various velocities (0·01–0·32 miles per second) of the ejected materials gave for the resulting craters diameters of 0·197–202 miles across the rim. He further showed that a central peak will be formed inside the crater, and that the amount of material ejected may be fifty or sixty thousand times the mass of the meteorite.

S. Mohorovičić[5] in 1928 also concluded that the lunar craters are explosion craters, but he attributed them to explosive volcanic action. By exploding charges buried in cement powder, he produced craters with a striking resemblance to those on the moon, some of which show the central peak and the outer radial streaks. Similar craters were also produced by Alfred Wegener[6] by throwing spoonfuls of cement powder on to a level surface of the same material; and he concluded that the lunar craters were formed merely by the impact of meteorites. Robert Hooke in his "Micrographia" (London, 1665, p. 243) compared the craters on the moon with those formed by the "eruption of vapours" on the surface of "a pot of boyling Alabaster", and with those formed by dropping bullets on to wet "Tobacco-pipe clay". He rejected the analogy of impact, for, as he naively remarks, "it would be difficult to imagine whence those bodies should come." In his day, reports of the fall of stones from the sky were discredited by scientific men. These experimental craters are shallow saucer-shaped depressions with a steep inner slope at the rim and a gentle slope outside, just as is seen in meteorite craters. Larger artificial craters of the same kind are formed by high-explosive shells and military mines.

The bright streaks radiating for hundreds of miles from some moon craters, for example, Tycho and Copernicus, but casting no shadows and conspicuous only at full moon, present a difficult problem. These craters may perhaps be due to the fall of large meteoritic irons, the density of which is 7·7, as compared with 3·5 of stones. The vaporized metal probably condensed as millions of tiny spheres, as at Wabar. (An astronomical calculation will give the number of such spheres, 0·01 mm. in diameter, that could be produced from, say, a million tons of metal!) The force of gravity on the moon being only one sixth of that on earth and there being no air resistance, such particles might be projected for great distances by the explosion. Experimental explosion craters show rays of material beyond the crater rim; Mohorovičić obtained rays a metre in length outside a crater 3·6 cm. in diameter. It may be suggested that these bright streaks on the moon are areas covered by tiny spheres of shining metal. Some support to this view is given by the fact that the ratio of the number of craters showing bright rays and spots to those without these features is of the same order as the ratio of the numbers of irons and stones that reach the earth. Craters that show no bright rays and spots can then be supposed to have been formed by the fall of stony meteorites.

The darker areas or 'seas' of the moon show fewer craters, and some of those around the borders are broken. These areas perhaps represent lava-fields of more basic lava from fissure eruptions, comparable with the plateau basalts of the Brito-Arctic region, the Columbia River in the western United States, and the Deccan in India. (The density of basalt, 2·8—3·1, is less than that of the moon as a whole, 3·3.) Such areas must be of later date than the broken craters and the surrounding mountains; but earlier than the fewer perfect craters within the areas, and also earlier than the bright streaks running across them from craters outside. The mountains are no doubt the result of crustal movements following shrinkage; and are earlier than the lava-fields. The several craters evidently belong to different periods. Some were no doubt formed when the moon first had a solid crust. Except when engulfed by lava-fields, these features will persist, for, in the absence of water and an atmosphere, there can be no denudation, as takes place on the earth. The effects of insolation and desert weathering must, however, be particularly severe—a point that does not seem to have been realized. With the sudden changes in temperature from the very hot day to the very cold night, each with a duration of half a lunar month, rocks will be exfoliated and crystals cracked along their cleavages, and all materials on the surface will be reduced to a fine powder.

On the earth, the few known meteorite craters are of recent formation, though none within the historic period. The same is true of the fall of the eleven known larger masses of meteoritic iron, ranging from the Hoba of 60 tons to the Cranbourne of 3½ tons in the British Museum collection. These will be destroyed by weathering and all traces of them obliterated by denudation long before the next geological period. Fossil meteorites are not known; nor is there any probability of any ever being found. The argument based on the absence of pitting on the earth's surface could never have come from a geologist.

Considered as volcanoes, the lunar craters can be compared only with explosion craters.

None of them shows a cone reaching as high as the outer rim. Further, these cones are usually craterless, and more of the nature of a central peak. In nearly all the craters the rim is complete. In the few good examples of terrestrial volcanic explosion craters, formed by the blowing away of the cone of a typical volcano, the rim is always broken. The Monte Somma rim extends only half-way round the new Vesuvius, and the rim of Krakatoa is very irregular. The quiescent type of the Hawaiian volcanoes have craters of irregular outline. Photographs of a model of Vesuvius and the volcanoes of the Phlegrean Fields have been given to show an apparent similarity to the lunar craters; but the photographs, being taken in plan, are misleading, for these volcanoes are actually cones rather than depressed craters. Terrestrial volcanoes are distributed along lines of weakness in the earth's crust; whereas the craters on the moon are scattered about promiscuously, as if from a pepper-pot.

A point that perhaps invalidates the meteorite theory is that there is no evidence of the formation of craters on the moon at the present time. An apparent variation in the size and brightness of the small crater mapped as Linné affords the only doubtful evidence of any change. Nevertheless, meteorites are still falling on the earth, in spite of the protecting atmosphere; and presumably they must also be falling on the moon. In earlier periods it is evident that the meteoritic bombardment must have been much more intense. Maybe the larger stray masses of the solar system have already been gathered up. On the earth during historic times there has been no catastrophic fall, except perhaps that on June 30, 1908, at a spot in central Siberia, almost as inaccessible to us as the moon itself, and of which precise information is still lacking.

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[1] Details are given in recent papers in the *Mineralogical Magazine*, and abstracts of recent literature in *Mineralogical Abstracts*.

[2] NATURE, 129, 781 (1932).

[3] NATURE, 129, 932 (1932).

[4] Gifford, A. C., "The Mountains of the Moon." *New Zealand J. Sci. Tech.*, 7, 129–142 (1924); and recapitulation in 11, 319–327 (1930) See NATURE, 126, 379 (1930).

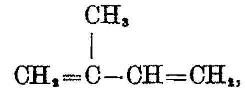
[5] Mohorovičić, S., "Experimentelle Untersuchungen uber die Entstehung der Mondkrater: ein neuer Beitrag zur Explosionshypothese." (Croatian with German summary.) *Archiv za Hemiju i Farmaciju, Zagreb*, 2, 66–76+4 plates (1928).

[6] Wegener, A., "Die Entstehung der Mondkrater." (Sammlung Vieweg, Heft 55, Braunschweig, 1921).

Pigments Associated with the Fatty Tissues of Plants and Animals*

By Prof. I. M. Heilbron, F.R.S., and A. E. Gillam

TURNING now to a brief consideration of the question of the biogenesis of the carotenoids, their structure reveals an obvious connexion with isoprene



$$CH_2{=}\overset{\overset{\displaystyle CH_3}{|}}{C}{-}CH{=}CH_2,$$

a hydrocarbon that may be regarded as the fundamental unit from which numerous important plant products are elaborated, as a result of the regular combination of individual units. The fact that the carotenoids are symmetrical necessitates, however, the assumption that they are built up in the plant, not on this simple plan alone, but by the union of two molecules of an intermediate compound containing twenty carbon atoms. According to Karrer, this may be the alcohol phytol, $C_{20}H_{39}OH$, which constitutes approximately one third of the chlorophyll molecule. Condensation of two phytyl residues could thus theoretically give rise to lycopene from which, by simple ring closure, the carotenes would be produced.

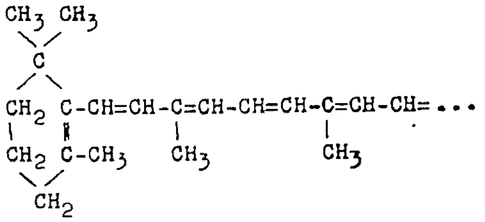
In conclusion, the physiological importance of these pigments in the economy of life must be considered. So early as 1919, Steenbock advanced evidence of a possible connexion between carotene and vitamin A, the physiologically important substance found in all liver oils, notably those of the cod and halibut. This is essential for growth, for in its absence young animals cease to grow, and ultimately die. More specific effects due to vitamin A deficiency are the eye disease, xerophthalmia, decreased resistance to respiratory infections and night-blindness. This latter affection is completely curable in a few days by the absorption of food rich in vitamin A; its cause appears to be related to the fact observed by Wald that the vitamin plays an essential role in the visual perception which occurs on the retina of the eye. The vitamin itself forms an almost colourless highly viscous oil which is notable for its intense absorption band at 328 mμ, and the characteristic blue colour which it gives with antimony trichloride. It is thus clear that the pigment carotene cannot itself be vitamin A, but, as established by von Euler in 1929, it can nevertheless replace the typical vitamin in the animal organism. Complete clarification of this apparent anomaly was reached when Moore conclusively

* *Continued from p.* 615.

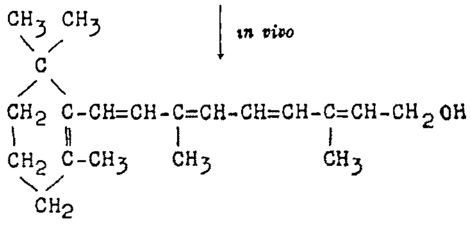
demonstrated that if carotene is fed to rats suffering from vitamin A deficiency, it is converted into the colourless vitamin, which appears in the liver.

The structure of vitamin A has been established, and its formation from carotene may be represented by the following equation, although the exact mechanism of conversion is still obscure:

$$C_{40}H_{56} + 2H_2O = 2C_{20}H_{30}O$$



½ β-Carotene



Vitamin A

Arising from the foregoing, it follows that animals are primarily dependent upon the carotene of grass for their supply of vitamin A. The full appreciation of this fact opens up interesting problems for mankind, and much experimental work is being carried out in order to make use of this new knowledge.

Of the many studies which have been made of the variations in the carotene and vitamin A content of milk as affected by the diet, breed, age, etc., of the cows, I need only mention a few carried out notably by Steenbock in America, by Messrs. Imperial Chemical Industries, Ltd., at their experimental farm in Berkshire, as well as in our own laboratory.

Palmer and Eccles were the first to prove that the yellow colour of butter is mainly due to carotene. The further discovery that butter also contains vitamin A and that the two pigments can be quantitatively evaluated by spectroscopic methods opened the way to the investigation of the factors controlling the quantities of these substances in milk and butter. The actual amounts normally present in milk fat are extremely small, namely, carotene 1–20 parts and vitamin A 2–20 parts per million. In collaboration with Prof. J. C. Drummond of University College, London, Dr. R. A. Morton of Liverpool University, and Dr. S. J. Watson of I.C.I. Agricultural Research Station, we have, during the past few years, been examining the possibility of maintaining the high vitamin content of summer milk throughout the winter. We have ascertained that by employing grass, artificially dried in specially designed driers, in place of part of the concentrates usually given to stall-fed cattle in the winter, both the vitamin A and carotene content of milk (and hence of butter) can be maintained at nearly the level usually regarded as peculiar to summer samples. In a particular experiment, one group of Shorthorn cows was stall-fed on a normal diet throughout a whole winter, whilst another group had a dried grass supplement replacing part of the concentrates. Vitamin A and carotene were determined in the milk fats once a month and the results, expressed graphically in Figs. 1 and 2, leave no doubt as to the efficacy of the dried grass supplement.

Similar experiments have been carried out with A.I.V. silage instead of dried grass. This particular silage is made by storing the fresh grass in a silo and conserving it by sprinkling with dilute acid, the process being due to A. I. Virtanen of Finland.

The following results are typical of those obtained with this fodder. A group of thirteen pure-bred South Devon cows were stall-fed for five weeks on an ordinary winter ration of hay and concentrates. They were then placed on a diet containing 40 lb. of A.I.V. silage per cow per day for five weeks, and afterwards transferred back to the control ration for another five weeks. The colour, carotene, and vitamin A values of the resulting butters are shown in Table 4 and clearly demonstrate—from the vitamin A angle—the value of A.I.V. silage.

TABLE 4

EFFECT OF A.I.V. SILAGE IN THE RATION, ON COLOUR, CAROTENE AND VITAMIN A CONTENT OF MILK FAT (SOUTH DEVON COWS)

	Ration	Date of sample	Yellow Colour (Lovibond units)	Carotene (mgm. % fat)	Vitamin A (mgm. % fat)
1st Period	Control 5 weeks	Jan. 25, 1933	4·0	0·10	0·18
2nd ”	A.I.V. silage 5 weeks	March 1, 1933	8·4	0·27	0·41
3rd ”	Control 5 weeks	April 7, 1933	2·8	0·11	0·24

Although the vitamin A activity of a butter can in general be roughly correlated with its yellow colour, we have found that this is only strictly true when comparing butters from the same breed of cow. Thus when Shorthorn or Ayrshire cows were fed on a ration rich in carotene, the yellow colour rose to a maximum above which the further addition of carotene in the diet would not increase it. The Shorthorn butter was, however, always somewhat more yellow than that obtained from the Ayrshire cows. The traditionally high yellow colour of the milk in Jersey and Guernsey cattle is due to their having a higher 'ceiling value' for carotene in their milk-fat than any of the other breeds Experimental results indicate, however, that although Shorthorn milk-fat is normally paler than that from the Guernsey cow, the gross vitamin A activity is about the same; this is due to the fact that the milk of the Shorthorn has a slightly higher proportion of the true vitamin A.

The figures in Table 5 were obtained by spectrophotometric examination of the milk fats of pure-bred Shorthorn and Guernsey cows kept on the same diet at the National Institute for Research in Dairying. Parallel biological tests for gross vitamin A potency carried out by Dr. S. K. Kon showed that the butters of the two breeds were indistinguishable at each of the three seasons.

The differences in carotene and vitamin A content of the milk of different species of animals are exemplified by the Guernsey cow and the goat; for the latter, in striking contrast to the former, gives a butter which is almost dead-white in colour. Despite the almost total absence of carotenoids in goat's butter, it nevertheless contains vitamin A in amount only slightly lower than that of an average cow's butter.

Although the seasonal variations in the colour and vitamin A content of milk and butter are actually directly due to the presence or absence of carotene in the diet, that is, fresh green grass is necessary to produce good yellow butter, there is one exception to this generalization. Whatever the breed of cow or the season of the year, the colostrum is usually 10–20 times richer in both vitamin A and carotene than is the normal milk. The quality falls rapidly from the first day after calving and reaches normality again in about a week. This richness in vitamin A is therefore quite consistent with the traditional belief in the high food value of colostrum, and furnishes another remarkable example of the way in which biological processes provide for special circumstances in the life of the organism. These phenomena have been shown to be exactly parallelled in the human subject.

Examples of the relative vitamin A values of ordinary and colostrum milk are given in Table 6, the results having been obtained in the course of the experiments described above.

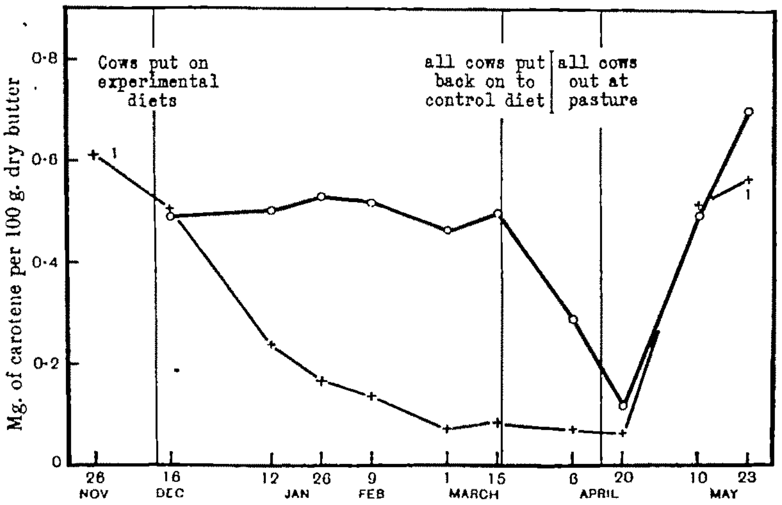


Fig. 1. CAROTENE OF THE BUTTERS
+ — +, control ration. o — o, artificially dried grass ration.

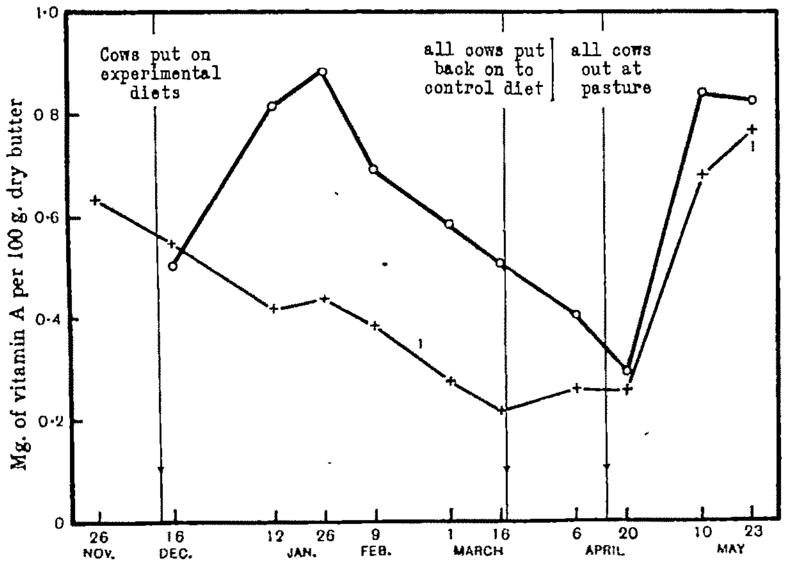


Fig. 2. VITAMIN A* OF THE BUTTERS
+ — +, control ration. o — o, artificially dried grass ration.

Examination of the carotene and vitamin A values of milk-fat leads to a consideration of the vehicle by which the carotene of the food is transported to the udder of the cow, namely, the blood serum. Studies of bovine blood sera have shown that the carotene and vitamin A vary with the amount of carotene in the food, thus being richer in summer than in winter. It is also interesting to note that the serum of cows is distinctly richer than is that of bulls, but whether this is due to a genuine sex difference or to different conditions of management has yet to be ascertained (cf. Table 7 due to Gillam and El Ridi).

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* Results expressed here and throughout this article are based on the assumption that pure vitamin A has an intensity of absorption of $E^{1\%}_{1\text{cm.}}$ 328 mμ = 1600.

TABLE 5

CAROTENE AND VITAMIN A VALUES OF SHORTHORN AND GUERNSEY BUTTER FATS UNDER IDENTICAL CONDITIONS OF FEEDING

	Shorthorn		Guernsey	
	Carotene	Vitamin A	Carotene	Vitamin A
Summer	0·78	1·10	2·24	0·89
Autumn	0·67	0·93	1·80	0·70
Winter	0·19	0·39	0·50	0·34

(Values as mgm. per 100 gm. fat).

TABLE 6

COMPARISON OF THE CAROTENE AND VITAMIN A VALUES OF THE FAT OF ORDINARY AND COLOSTRUM MILK (INDIVIDUAL COWS CHOSEN AT RANDOM)

Breed	Date of sample	Carotene (mgm. % fat)	Vitamin A (mgm. % fat)
Friesian	Oct. 20	3·40	1·24
	Nov 20	0·38	0·52
Ayrshire	Nov. 22	4·60	2·96
	Dec. 22	0·18	0·37
Guernsey	Oct. 28	3·61	1·13
	Nov. 28	0·91	0·67
Shorthorn	Oct. 13	2·90	3·51
	Nov. 13	0·28	0·48

TABLE 7

CAROTENE AND VITAMIN A IN COW'S BLOOD SERA (AVERAGE VALUES)

	Cows		Bulls	
	Carotene	Vitamin A	Carotene	Vitamin A
Winter	0·40	0·13	0·08	0·05
Summer	1·11	0·29	0·42	0·14

(All values as mgm. per 100 ml of serum)

We have attempted in the foregoing to trace the stages in the development of our knowledge of the lipochrome pigments and to show how, by the application of the elegant methods now used by the organic chemist, the constitution of the more important of these natural polyenes has been elucidated. Apart from the intrinsic interest of this work, it has led to the fundamental discovery of the close interrelation between carotene and vitamin A, one of the indispensable key substances of life.

Fire-Walking: Scientific Tests

EIGHTEEN months ago, the University of London Council for Psychical Investigation arranged a demonstration of fire-walking, with the view of obtaining precise information upon its scientific aspects. Descriptions of the condition of the feet of the performer, Kuda Bux, before and after the walk, and results of some physical observations, were given in NATURE of September 21 and 28, 1935 (136, 468, 521). As the observations were not altogether conclusive, two more demonstrations were arranged by the University of London Council for Psychical Investigation through Mr. Harry Price, honorary secretary of the Council, in the grounds of Mr. Alex. Dribbell at Carshalton, Surrey, on April 8 and 10.

The professional fire-walker was Ahmed Hussain, a Moslem from Cawnpore. In the first experiment, the trench containing the charcoal on oak-ash was 12 ft. long. The temperatures were measured by special thermocouples with the co-operation of the Cambridge Scientific Instrument Co., Ltd., and were shown to be 575° C. on the surface and 700° C. inside. After examination and tests for chemical treatment, Hussain walked the trench in 1·3 sec., showing no signs of injury. He then repeated the walk leading three amateur volunteers with the claim that they would be immune from burning. They were, however, all burned to a varying but slight degree. A further two volunteers then performed the walk separately and unaided. They were also slightly burned, and where the number of steps had been uneven, the foot that had been down most often was most affected. This indicated that the injurious effect was cumulative, although Hussain claimed that he could walk any distance. As he refused to retrace his steps, the trench was increased to 20 ft. for the second experiment.

In the second experiment, the surface temperature was 740° C. and the inside 750° C. Hussain took six steps in 2·3 sec., and this produced five blisters on one foot and marked erythema on the other, a condition closely resembling that of the amateurs after four steps. The effect was therefore cumulative in his case also. One of the former volunteers covered the distance in four steps and 1·4 sec., and then later, in rope-soled shoes, took seven steps in 3·6 sec. The frayed portions of the rope were slightly scorched at the edges only. The feet sank into the ash to a depth of between two and three inches, and it seems clear that its poor thermal conductivity prevents damage to normal skin if the contact-time is less than about half a second, although the small flames within it will produce singeing of the hairs. This time corresponds with that of one quick step: two steps with the same foot could only be done without injury by the practised professional, and three steps was beyond his limit.

This small difference between amateur and professional, together with observations made during the experiment, make it very unlikely that any hypothesis of a special induced mental state is required, such as is, of course, maintained by the Indian performers.

Obituary Notices

Prof. A. Pictet

THROUGH the death, on March 12, of Amé Pictet, Swiss chemists have lost their doyen, and organic chemistry one of its foremost investigators. Descended from a family of bankers, Pictet was born at Geneva on July 12, 1857, and in 1876 he entered the local university. In deciding to devote himself to scientific investigation, he followed a Swiss patrician tradition which has given us, to name but a few, De Saussure the physicist and De Candolle the botanist, both citizens of Geneva, the Bernouilli brothers and the two cousins Sarasin, respectively mathematicians and oceanographers of Basle. After some years of study at Geneva under Marignac, Pictet migrated to Dresden, then to Bonn, where he attended Kekulé's lectures and wrote a doctor's dissertation on the esters of tartaric acid, under the direction of Anschütz. After further study in Paris, he returned to Geneva and became in 1882 *Privatdozent*, in 1894 extraordinary professor of organic chemistry, in 1897 ordinary professor of biological and pharmaceutical chemistry, and ultimately professor of inorganic chemistry.

Pictet's early work on heterocyclic compounds, such as phenyl indole, phenanthridine and isoquinoline was connected with his interest in alkaloids, dating from the time of his doctor's dissertation, and showing itself more fully in his book "Constitution chimique des alcaloïdes végétaux", Paris 1888, of which a second edition (1897) and several translations appeared.

The synthesis of nicotine by Pictet (1895–1904) attracted universal attention, like that of tropine, completed by Willstatter a few years earlier. Up to that time, only a few quite simple alkaloids such as coniine, had been synthesized. From nicotine, Pictet passed on to the still more complex isoquinoline alkaloids, and his syntheses of laudanosine and of papaverine, both in 1909, are among his most notable achievements. About 1912, Pictet abandoned the study of the alkaloids; questioned many years later, he gave as the reason that he could not afford to let his students waste expensive material. He found a new field in the extraction of hydro-aromatic substances from coal by benzene, and was the first to study coal tar produced at low temperature in a vacuum. This led him to distil starch and cellulose under reduced pressure, when (in 1918) he obtained a large yield of lævoglucosan, $C_6H_{10}O_5$, an anhydride of glucose prepared previously in small quantity by Tanret from certain glucosides. Then, entering further into the field of carbohydrates, he synthesized maltose and lactose, and published in 1929 a synthesis of cane sugar. The latter work could not be confirmed by others and it would appear that, in his old age, Pictet was duped by his collaborator; some two years later he retired from his professorship.

Pictet was a corresponding member of the Paris Academy of Sciences, an honorary fellow of the Chemical Society of London, and an honorary member of the Dutch Chemical Society. Although until the foundation of the *Helvetica Chimica Acta*, his work was principally published in German, Pictet was more at home in France; he loved Paris, and was a connoisseur of French cookery. The writer well remembers Pictet's disdain when the latter asked a Dutch colleague for his impression of a famous restaurant, at which they had just lunched, and obtained the reply: "Mais c'était bien cher!"

G. B.

Mr. A. M. Sillar

ARTHUR MOLYNEUX SILLAR, one of the early pioneers of electric lighting, died on March 6 at the age of seventy-two years. He was educated at Shrewsbury, and from 1882 until 1886 he was engaged with the Jablochkoff Electric Light and Power Co. He was chief engineer to the Electrical Engineering Corporation until 1890, and in 1895 he with Mr. E. M. Lacey started practice as consulting engineers. His firm carried out the electrification of the Blackburn tramways in 1897, and in 1902 completed the Bournemouth tramways, this being the first example of a side rail slot system in Great Britain.

In conjunction with his partners, Sillar designed and inaugurated electric power systems for many local authorities and companies both in Great Britain and abroad. Amongst them were Belfast, Blackburn, Bournemouth, Colchester, Pekin, Salford, Swindon and Tientsin. He acted for many electric power companies and railways. He was also consulting engineer to the Post Office and to the London Chamber of Commerce. During the Great War, he was director of National Gauge Factories.

In 1922, Sillar was appointed chairman of the Association of Consulting Engineers, and took a leading part in the social functions of many engineering institutions. The long-established success of the Electrical Engineers' Annual Ball was mainly due to him and largely helped the Benevolent Fund of that Institution. He was well known and highly esteemed in engineering circles. He has left a son who is an engineer with the Calcutta Electric Supply Corporation.

WE regret to announce the following deaths:

Sir Henry Hadow, C.B.E., principal of Armstrong College, Newcastle-upon-Tyne in 1909–19, vice-chancellor of the University of Sheffield in 1919–30, on April 9, aged seventy-seven years.

Dr. William T. Hornaday, formerly director of the New York Zoological Park, known for his work in connexion with the protection of wild life, on March 6, aged eighty-two years.

Prof. Sydney Young, F.R.S., formerly professor of chemistry in Trinity College, Dublin, on April 8, aged seventy-nine years.

News and Views

World Congress of Faiths (Continuation Movement)

As a result of the first World Congress of Faiths held in London in July 1936 (see NATURE, 138, 1; 155) a Continuation Movement to promote further the objects of the Congress was inaugurated with the Maharaja Gaekwar of Baroda as international president and Sir Francis Younghusband as chairman. It is now announced that a week-end intensive Congress will be held at Oxford on July 23–27, when the subject for deliberation will be "The World's Need of Religion". Addresses for discussion will be delivered by members from the different religions, and devotional meetings will be led by representatives of the various faiths. A symposium on "Can Politics replace Religion?" will be conducted from three distinctive points of view, and at a public meeting to be held in the Oxford Town Hall on the evening of July 24 addresses will be given on the subject of "The World's Need of Religion". It may be recalled that the Congress was organized to promote a spirit of fellowship among mankind through religion, and "to awaken and develop a world loyalty, while allowing full play for the diversity of men, nations and faiths". It is, therefore, essentially a movement that is both international and inter-denominational in the broadest sense of the term.

AT the successful London meeting, a large number of distinguished and representative members of the great religious faiths of the world were present, and spoke in support of the objects of the Congress, more especially in so far as they were directed to the promotion of world peace through the co-operation of men of the spirit in all countries and of all faiths. Since, however, the spirit of fellowship, which it is believed by promoters of the Congress is latent in man, needs to be intensified if it is to work out its effect to the full, the Continuation Movement seeks support with that end in view. Particulars of the Oxford meeting, at which accommodation for members will be provided at Balliol and Somerville Colleges, forms of application for membership, etc., are to be obtained from the Secretary, World Congress of Faiths, B/M Congress, London, W.C.1.

Cultural Contrast and Government in India

THE debate in the House of Lords on April 8 on the situation in India arising out of the inauguration of the new constitution made apparent, in the gravity of the issues shown to be involved, the need for a common idiom as between races and creeds such as is sought by the World Congress of Faiths. The lucid and well-balanced statement by the Marquess of Zetland in particular brought into high relief the justice of the frequently repeated contention that, in the clash of culture contact, understanding grounded on a knowledge of local culture and history alone can alleviate and remove the inevitable misconceptions and friction, which arise in the fusion of mutually alien civilizations. In India, the freedom of democratic institutions, notwithstanding the misgivings expressed by those who claimed with reason an understanding of Eastern mentality, has been bestowed upon an oriental community, which has behind it a lengthy tradition, extending over centuries and even thousands of years, of submission to autocratic control. The resulting conflict, if the intransigence of the extremists of the Congress Party be ignored, is expressed on one side in Mr. Gandhi's explanation and amplification of the demand for the unqualified and unconstitutional abrogation of the powers of the Provincial Governors, and on the other in Lord Lothian's letter to *The Times* of April 6 and Lord Zetland's speech in the House of Lords. On one hand, the British Government and the British people are willing and anxious now that the die has been cast, to give every freedom to the peoples of India to win their way through responsible government to a position of independence within the Empire, yet they are at a loss before the naive simplicity of the over-subtle Eastern mind; on the other hand, Mr. Gandhi, who, whatever opinion may be held of his policy and political methods in the past, embodies, especially in the eyes of his co-religionists, all that is best and highest in Hindu culture, in common with others of his creed is unable to enter into an understanding of an honestly intentioned generosity which rests upon no legal bond as he understands it.

Hours of Employment of Young Persons

A SERIOUS gap in our social legislation is exposed by the report of the Committee on the Hours of Employment of Young Persons. Since the Factory and Workshop Act of 1901 and the Shops Act of 1934, limits have been set to the number of hours during which a young person may work, as well as to the amount of overtime and night work. A large class, estimated by the Committee at 125,000, still remains which is not covered by this legislation and is liable to be grossly overworked. This class consists mainly of van boys, hotel pages, messengers, cinema ushers, and the like. The chief objections to these forms of employment are that they are often spread out over long hours, that in busy periods there is no limit to the possible overtime that may be demanded and that often the jobs lead nowhere. That such a position should arise in so new an industry as the cinema industry indicates how sadly overdue is a real attempt to deal with recruitment on quantitative as well as qualitative lines, and the whole report strengthens the case for a scientific approach to the question of recruitment. The recommendations of the Committee include fixed hours, intervals for rest, weekly holidays, strictly limited overtime for young persons more than sixteen years of age and its prohibition for those less than sixteen, as well as prohibition of night work for a period of 11 hours, and it is considered essential that immediate steps be taken to give statutory protection to the unregulated young persons covered by the Report. It is recommended that the regulation of the hours of work of those employed in connexion with factories, docks and warehouses should be entrusted to the Factory Department of the Home Office and, for the remainder, to the local authorities responsible for administering the Shops Acts.

Traffic in Women and Children in the East

A CONFERENCE of Central Authorities in Eastern Countries on the Traffic in Women and Children in the East opened at Bandoeng, Java, on February 2, as the outcome of investigations in 1930–31 by the League of Nations' Commission of Enquiry into the Traffic in Women and Children in the East. This Commission established that the international traffic in Oriental women and girls in the Near, Middle and Far East is, in the aggregate, large. The bulk of this traffic is Asiatic women from one country to another, mainly in victims of Chinese race, Japanese, including Korean and Formosan, coming next in numerical importance, and other nationalities being very much less represented. Traffic in Occidental women to the East, with certain exceptions, chiefly in the Mediterranean Near East, has markedly decreased. The agenda of the Conference consisted of six points covering the chief suggestions of the report for closer collaboration between central and other authorities; and between authorities and voluntary organizations; the protection of migrants, especially minors, victims, or potential victims, of the traffic; the employment of women officials; the question of the continued existence of licensed or tolerated houses, which are the chief agents of internal and international traffic in the Indian and Pacific Oceans; and problems involved in the position of women of Russian origin in the Far East. Nine Governments, including the United Kingdom (Governments of the Straits Settlements, Federated Malay States and Hong Kong), China, France, India, Japan, the Netherlands, Portugal, Siam and the United States of America participated, as well as representatives of the International Criminal Police Commission.

Exhibition of Chemical Engineering

AN exhibition, Achema VIII, devoted to chemical technology, in which nearly three hundred firms have already arranged to take part, will be held in Frankfort-on-Main on July 2–11. Concurrent with the exhibition will be held the National Congress of German Chemists, the semi-centenary of the Verein Deutscher Chemiker, thereby providing the organizers of the exhibition with a unique opportunity of establishing the importance of the chemical engineer to the modern industrial community. The Hohenzollernplatz near to the University has been selected as the site of the exhibition, which will be housed in four separate buildings. In the first of these buildings, having a floor area of 125,000 square feet and subdivided into three sections, termed Halls I, II and II*a* in the official foreword, will be shown scientific apparatus including measuring, regulating and laboratory equipment, technical plant constructed from non-metallic materials, as well as machines for the manufacture, machining and shaping of synthetic materials. Two buildings, namely Hall III, having a floor area of 20,000 square feet, and Hall IV, with a floor area of 100,000 square feet, will be used to display technical equipment on a large scale such as machines and complete plants for the chemical and associated industries and similar exhibits. The last building is again subdivided into two parts, namely Hall III*a* with a floor area of 10,000 square feet which will be devoted to that part of the chemical industry engaged on the production of, and spinning of, artificial fibres, and Hall III*b* with a floor space of 5,000 square feet in which will be shown the publications of the various German scientific associations and societies. Arrangements have also been made for special meetings, conducted tours, showing of industrial films, excursions for visitors to the exhibition. Further information can be obtained about the meeting by application to the Deutsche Gesellschaft fur Chemisches Apparatewesen EV, Achema Bureau, Berlin W 35, Potsdamer Strasse 103*a*.

Broadcasting in 1936

A REVIEW of the activities of the British Broadcasting Corporation during 1936 is given in the tenth annual report of the Corporation, which has recently been issued as a white paper (Cmd. 5406. London: H.M. Stationery Office. 6*d*. net). The year 1936 was conspicuous in the first instance because three successive kings were involved in turn in certain of the broadcast programmes. The report contains details of the outstanding items in a wide variety of programmes broadcast throughout the year, during which the home transmitters were in operation for 71,123 hours, of which the proportion of breakdown periods was 0·031 per cent. The corresponding aggregate time for the Empire transmitters was 16,577 hours, an increase of more than forty per cent on the figure for 1935. Apart from the maintenance of the stations and plant required for these services, the activities of the B.B.C. on the engineering side included the putting into service of the high-power transmitter at Lisnagarvey in Northern Ireland, the completion of a similar transmitter at Burghead in the north of Scotland and the construction of a medium power transmitter at Beaumaris in Anglesey, which has been put into service in the current year. Good progress has also been made with large-scale extensions to the Empire Station at Daventry. These include the commencement of a third transmitter of considerably higher power than those now in operation; together with the erection of additional masts for an improved aerial system, which is the outcome of experiments carried out at the Empire Station since it was first put into service in 1932.

Mention must also be made of the considerable experimental and engineering work involved in the equipment of the London Television Station at Alexandra Palace towards the end of the year under review. The report concludes with a summary of the financial position of the Corporation as at December 31, 1936.

The Need for Motor-car Inspection

REVISED regulations for the construction and use of motor vehicles in Great Britain have just been issued by the Ministry of Transport. They provide, among other matters, for the testing of brakes, steering gear, etc., of a vehicle on the road. In about a dozen of the States forming the U.S.A., it is compulsory for motorists to have their cars inspected to see that they comply with safety regulations. According to a recent note issued by Science Service, of Washington, D.C., it is an even chance whether the motorist will find that his car falls below the requirements for safety on the road or not. The most common fault is bad brakes, but it is not unusual to find that lights are out of focus and wheels out of alignment. In some cases, the owner finds that it would cost him more than his car is worth to make the repairs and so it is relegated to the scrap heap, an action which may possibly have saved the lives of other people as well as his own. Last year in Pennsylvania alone, nearly 15,000 of the vehicles were found to be decrepit, and quietly passed out of circulation. Whenever inspection laws are passed in a State, it has been noticed that there is a great decrease in the number of 'collegiate' models which run on the roads on four wheels with no brakes. It is impossible to say what percentage of highway accidents can be attributed to mechanical defects of the cars, as after a wreck there is little left to test. It is reasonable to conclude that when about half the cars in a State have faulty brakes, they are to blame for some of the tragedies which occur. Because cars are fitted with good tyres and good brakes initially, we are apt to forget that the average car on the road is nearly five years old and is generally slightly shaky. Railway trains and air liners, operated by experts, have to pass a rigid inspection to see whether they are safe. Motor-car drivers are usually amateur mechanics; it is rash to assume that their equipment is safe.

Education in Canada

CANADIAN education, as seen in the course of a four-months winter visit, was the theme of a paper read by Dr. F. H. Spencer, late chief inspector, Education Department, London County Council, before the Royal Society of Arts on November 11 last, and recently made available in print. Although the purpose of the visit was to lecture on English, not to investigate Canadian education, and Dr. Spencer disclaims any title to be listened to as an authority on this subject, his comparisons of school buildings, organization, teacher-training and university extension work in Canada and in England are enlightening, even though admittedly superficial. The most satisfactory of his impressions was of the prevalent enthusiasm for popular education, and the most unsatisfactory was of excessive regimentation alike in the primary and in the secondary schools. He was struck by the importance of the service rendered by the universities through their extension departments, and especially their correspondence courses, to remote but interested and ambitious students in the backwoods. The travels of the university extension tutors in the winter into such remote regions provide them with a stimulating adventure—an experience to which a counterpart has sometimes been found in Great Britain, for remoteness is not always to be measured in miles. In the course of the discussion following the reading of the paper, Prof. Krug of Mt. Allison, New Brunswick, observed that there have been few more worthy contributions to Canadian education and to Empire unity than the visit paid to Canada last year by a group of British school administrators and inspectors; a visit which made, he said, a really deep impression.

Physiology and Hygiene in Education

THE place of physiology and hygiene in general education has yet to be effectively established. Intellectual assent has been generally accorded to Herbert Spencer's dictum—that such a course of physiology as is needful for the comprehension of its general truths, and their bearings on daily conduct, is an all-essential part of a rational education—but those responsible for curricula have not so generally given practical effect to such assent. The subject has lately been investigated by Dr. J. P. Rogers for the United States Office of Education. In his report on "Instruction in Hygiene in Institutions of Higher Education" (Washington, D.C.: Government Printing Office. 10 cents), he observes that only a third of the colleges and universities require attendance at a course in hygiene by their students, and it is rare that any instruction concerning the human body is furnished in the last three years of secondary school work. He quotes some interesting criticisms by university authorities of the methods of instruction in use: one president remarks "my observation has been that this course has been too technical and not sufficiently practical. *I have yet to find an instructor who can put the information in a practical way*". It takes an artist, says Dr. Rogers, to fill such a requirement, and the best teacher of hygiene is the master and not the servant of that body of tradition which passes for 'science' in his day.

Extension of Scientific Buildings in Oxford

A FORECAST of extensions of scientific departments in Oxford is contributed by Dr. A. S. Russell, of Christ Church, to the spring number of *Oxford*, the journal of the Oxford Society. Within three or four years, a new physics laboratory for Prof. F. A. Lindemann will, it is hoped, be put up in the Parks, when the Clarendon Laboratory, now occupied by him, could be adapted to the uses of the Department of Geology now inadequately housed in the Museum. These improvements are expected to be closely followed by the erection of a great new physical chemistry institute. "The Oxford school of chemistry will then be without doubt the finest in the Empire". The article ends with a plea for the award of college fellowships to more of the best of the young men holding University posts in science, especially in the less popular sciences—engineering, zoology, botany, geology. The same number of *Oxford* has noteworthy articles on "Politics or Poetry ?", on university camps for the unemployed (which have amply justified the money and effort expended on them), and on women as housing estate managers on the Octavia Hill system.

Medical Research in South Africa

MUCH important research work is summarized in the annual report of the South African Institute for Medical Research for 1935. The use of a 'mixed vaccine' for the prevention of pneumonia among the Rand native miners has been continued with encouraging results. In the Biochemical Department, a strange finding was that the leaf of a plant belonging to the yam family contained forty times as much iron as spinach. Lucerne has been found to be suitable for human consumption as an anti-scorbutic, and several mines are now including this plant as part of their vegetable ration. The influence of South African snake venoms, previously tested on animal tumours, has now been tried on human cancers. Cobra venom often produced a relief of pain in cases of cancer, but not always ; and no permanent beneficial effect resulted. There was no evidence that African snake venoms had any action on the majority of malignant tumours in man. Rodents to the number of 2,026 were examined for presence of plague infection, of which 51 were found to be infected with *B. pestis*.

Standardization of Microscope Fittings

IN order that the microscope objectives of different makers might be interchangeable for use with the microscope stands of other makers, the Royal Microscopical Society of London drew up in 1858 a specification for the screw thread of objective and of nosepiece. This specification was revised in 1896, 1915 and 1924, and in its final form has been generally adopted by microscope makers at home and abroad. In view of the increasing use of apparatus above the eyepiece, a committee of the Society has now drafted specifications of standard sizes for the external diameter of the eyepiece end of the draw-tube and limits for the outside diameter of the eyepiece shoulder ; these have been adopted by the Council of the Society and are detailed in the December issue of its journal (*J. Roy. Micro. Soc.*, 56, 377–380 ; 1936).

The Smithsonian Institution

THE report of the secretary of the Smithsonian Institution for the year ended June 30, 1936, refers to the continuation of the study of the relation of weather to changes in the sun's radiation. Two papers by Dr. C. G. Abbot appear to prove that the short interval changes of solar radiation are of major influence on the weather for at least the following two weeks. To test this promising method of weather forecasting, seven additional observing stations are required, but a bill to provide funds for this purpose passed by the Senate was rejected later. The Division of Radiation and Organisms has continued its work on the dependence of carbon dioxide assimilation in wheat upon the wave-length of radiation as well as its experiments on the effect of ultra-violet rays on algæ and of light of different wave-lengths on the growth of tomatoes. An extremely sensitive and quick-acting spectroscopic method has been developed for measuring the concentration of carbon dioxide, as well as a highly sensitive robust thermocouple. The Institution has also published the latest results of the high-altitude rocket experiments of Dr. R. H. Goddard, whose earlier work it supported for twelve years. In the most recent trial flights, the liquid-propelled rocket attained a height of 7,500 ft., its automatic stabilizer keeping the flight vertical. Sales of the Smithsonian Scientific Series continue to increase, and in addition to a summary of the work of the Institution and the financial report, the present report of the secretary includes appendixes giving more detailed accounts of the work of the National Museum, the Bureau of American Ethnology, the International Exchanges, the National Zoological Park, the Astrophysical Observatory, the Division of Radiation and Organisms, the Smithsonian Library, the National Gallery of Art and the Freer Gallery of Art.

National Museum of Wales

THE twenty-ninth annual report, for the year ending September 30, 1936, of the National Museum of Wales, gives evidence of steady progress. By an increase of £500, the Treasury annual grant for the year was raised to £17,375, and a detailed report, furnished to H.M. Treasury by the Council, and pointing to the increased expenditure necessitated by the opening of the east wing, had the effect of inducing an allocation of £18,500 for the current year and a promise of £20,000 per annum as from April 1, 1938. The increased grant has enabled the Council to found a Specimens Purchase Fund, to be applied to the purchase of collections or specimens of outstanding importance as the need arises, and to create a Department of Folk Culture and Industries, which was responsible for a special temporary exhibition of Welsh furniture. At that exhibition nearly a hundred examples of furniture, made or used in Wales, and ranging from Tudor to Georgian times, were gathered together. The list of free public lectures displays refreshing variety, and the installation of a 16 mm. sound film apparatus should add to the popularity of the Reardon Smith Lecture Theatre.

Dairy Research in Scotland

THE seventh annual report of the Hannah Dairy Research Institute, Kirkhill, Ayr, contains an account of the developments, finance, and research work of the Institute during the year ending March 31, 1935. An important development has been a study of practical problems connected with grass conservation, made possible by a commercial grass-drying plant placed at the disposal of the Institute by the Agricultural Research Council. The condensing and drying of milk and the manufacture of canned milk products have also been investigated. Research work includes experiments on the nutritive value of milk for calves, the biochemistry of milk secretion, and studies on bovine tuberculosis, contagious bovine abortion and bovine mastitis. The pasteurization of milk and the bacteriological grading of milk have also been investigated. An inquiry into the consumption of milk by children of school age is in progress. As regards finance, State contributions and grants provide £8,000 a year, but an additional £2,000 per annum is required if the Institute is to carry through its full programme of work.

Social Services in the Soviet Plan for 1937

According to the Soviet Union Year Book Press Service, the provisions of the 1937 Plan for the national economy of the U.S.S.R. in regard to the cultural and social services include the following: *Science.* 924·2 million roubles (about £93 million) for the maintenance of scientific institutions in 1937, as against 797·5 million roubles (£80 million) in 1936. Out of this sum, 245 million roubles (about £25 million) will be expended on general capital construction for the needs of science, to include an expenditure of 40 million roubles (£4 million) on putting up new buildings to house the institutions of the All-Union Academy of Sciences, and 25 million roubles (about £3 million) for the building of the All-Union Institute of Experimental Medicine. *Health Protection.* A sum of 7,528·1 million roubles (£753 million) for health protection in 1937, as against 5,803·5 million roubles in 1936. This sum includes an expenditure of 1,000 million roubles on buildings. The number of hospital beds in 1937 will be increased to 619,800, as against 564,000 in 1936; maternity beds to 11,078, as against 6,000 in 1936.

Truth and Propaganda

An article by Prof. M. Polanyi in *The Manchester School*, 7, No. 2, entitled "The Struggle between Truth and Propaganda", although a somewhat polemic criticism of S. and B. Webb's "Soviet Communism: a New Civilization", is of wider interest through its plea for a more determined stand by scientific workers and other intellectual workers for free and impartial criticism against propaganda. Unless thinkers make a fresh stand everywhere, regardless of political consequences, for the criticism which is freely admitted in a democracy, truth will remain powerless against propaganda, the power of which has been immensely enhanced by new means which scientific discoveries and their application have put in its hands. The reconciliation of rival social doctrines, which alone can save Europe from destruction, cannot be attained except through tolerance and the acceptance of truth and facts, no matter how unpalatable or disconcerting to particular theories.

Germany and Science: Yesterday and To-day

A correspondent has pointed out that the speech at the Heidelberg jubilee by Reichsminister Rust, which was referred to in Nature of January 16, p. 98, stands in poor contrast to an equally proud speech of Helmholtz delivered in 1869 (*Les Mondes*, 21, 552). Speaking at Innsbruck at a gathering of German scientific workers and medical men, he claimed that Germany held the first place in the development of natural sciences because the German *savants*, unlike their French and English colleagues, could proclaim truth as they found it, without regard to the opinion of the world, to social and religious prejudices. Our correspondent remarks that there was more of Athens than of Sparta in such men.

Prof. H. E. Armstrong

The familiar and welcome figure of Prof. H. E. Armstrong has been missed in scientific circles for several months; and his caustic comments upon contemporary views and events—both scientific and unscientific—have similarly been absent from the pages of Nature and of other periodicals. Though, however, general physical weakness prevents Prof. Armstrong from moving about and attending meetings in the way he has done all his life, yet he still takes active interest in progressive work of every kind and asks his friends not to hesitate to communicate with him. He enters his ninetieth year on May 6, and maintains the indomitable and fearless spirit which has always characterized him. "I should like", he wrote a short time ago to an old friend, "to start over again in the hope that knowledge may be so made use of that some measure of tolerance and common sense will be infused into the nations."

Seventh International Congress of Genetics

The following communication has been received from Prof. Otto L. Mohr, of the Anatomical Institute, University, Oslo, chairman of the International Committee for Genetics Congresses: "The VIIth International Genetics Congress which was going to be held at Moscow, U.S.S.R. this summer has been postponed. According to the information received from the Organization Committee, a number of scientists and institutes have requested this as they wished to be better prepared for the congress. The Academy of Sciences and the Organization Committee have now extended an invitation to hold the congress in Moscow in August, 1938. Conforming with the mandate given to the Permanent International Committee for Genetics Congresses, the entire matter will be put before this committee for decision. At present it is certain that no International Genetics Congress will be held in 1937."

British Empire Cancer Campaign

At the quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on April 12, the following grants, totalling £2,900, were made, in addition to the bulk grants of last November and January: £1,000 to be placed at the disposal of

Dr. F. Dickens, director of research of the North of England Branch of the Campaign, at Newcastle, for the continuation of the special short-wave investigations being carried out under his direction on behalf of the Scientific Advisory Committee at headquarters; £1,200 for the purchase of a plaque of radium in use by Dr. F. G. Spear at the Strangeways Research Laboratory, Cambridge; an additional grant of £300 for the calendar year 1937 to the Westminster Hospital; an additional sum of £300 to Mr. F. C. Pybus for the salaries of his assistants and expenses during the second half of 1937 and a grant of £100 to Dr. L. H. Gray, at Mount Vernon Hospital, in connexion with the neutron investigations.

Rockefeller Travelling Medical Fellowships

THE Medical Research Council has been entrusted by the Rockefeller Foundation of New York with £3,000 annually, for three years in the first instance, for the award of travelling fellowships in medicine to candidates in the United Kingdom. This benefaction renews an arrangement which had been successful during an earlier period, but which had latterly been interrupted during a revision of the Foundation's general policy. These Rockefeller fellowships are intended for graduates who have had some training in research work in clinical medicine or surgery or in some other branch of medical science, and are likely to profit by a period of work at a chosen centre in the United States or elsewhere abroad before taking up positions for higher teaching or research in Great Britain. Five or six fellowships will be available annually, and applications for the academic year 1937–38 will be invited in May. It is of interest to recall an analysis which was made, at the end of the previous ten-year period, of the positions occupied by the seventy men and women who had completed their tenure of Rockefeller Fellowships awarded by the Council. This showed that twelve were professors in universities, that thirty-six others occupied whole-time positions for teaching and research, and that a further sixteen held part-time appointments of the same kind.

Announcements

SIR WILLIAM BRAGG will deliver the forty-third James Forrest Lecture before the Institution of Civil Engineers on April 27, at 6 p.m. The title of Sir William's lecture will be "The Crystal and the Engineer".

PROF. J. CHADWICK will deliver the twenty-eighth Kelvin Lecture before the Institution of Electrical Engineers on April 22 at 6 p.m. The subject of the lecture will be "The Elementary Particles of Matter".

THE triennial Burton Memorial Medal of the Royal Asiatic Society has been awarded to Sir Arnold T. Wilson. The Burton Memorial Lecture will be given by him at the Society's rooms on May 27, when the Medal will be presented by Dr. Bertram S. Thomas.

THE following appointments in the Colonial Service have recently been made: A. W. Hart, veterinary officer, Nigeria; S. H. Shaw, geologist, Palestine; I. E. James (agricultural officer), senior agricultural officer, Nigeria; A. S. Richardson (senior agricultural officer, Tanganyika), deputy director of agriculture, Uganda; R. S. Pelly (assistant conservator of forests, British Honduras), assistant conservator of forests, Sierra Leone; F. G. Taylor (telegraph engineer, Railway Department), wireless engineer and broadcast officer, Sierra Leone.

PROF. A. BESSEMANS, pro-rector of the University of Ghent, has been elected member of the German Academy of Natural Sciences at Halle.

DR. WALTHER HORN, director of the German Entomological Institute, has been nominated corresponding member of the Finnish Entomological Society and honorary academician of the Museum of La Plata.

THE Corbalan Melgarejo prize founded in Chile to honour the memory of Dr. Ramon Corbalan Melgarejo, author of the Sanitary Codex of Chile and first director-general of the Health Service of the Republic, has been awarded by the Medical Society of Chile to Joaquin Luco Valenzuela.

THE French Association for Researches on Hearing and Deafness has recently elected M. Auguste Lumière as president. The Association consists of medical practitioners, acoustic technicians, hygienists and all interested in the campaign against deafness. The life subscription is 500 francs and the annual subscription 50 francs. Further information can be obtained from the general secretary, 143 bis Promenade des Anglais, Nice.

A MUSEUM has recently been founded at Lennep in Rhenish Prussia, the birthplace of Wilhelm Conrad Röntgen, illustrating the significance of X-rays and the development of Röntgen technique.

THE fifth International Hospital Congress, in which more than fifty countries will take part, will be held in Paris on July 6–11. Further information can be obtained from the Secretariat, Administration de l'Assistance Publique, 3 Avenue Victoria, Paris IV^e.

THE seventeenth Congress of Anthropology and Prehistoric Archæology will be held at Bucharest on September 1–8 in the Palace of the Faculty of Law. Further information can be obtained from the general secretary, Prof. Nicolas Minovici, Institut Medico-légal, Bucharest, or from the Secretariat, Institut international d'anthropologie, 15 rue de l'Ecole de médecine, Paris.

ANOTHER volume of "Researches published from the Wards and Laboratories of the London Hospital" for the year 1936, has been issued by the Publications Committee (London: H. K. Lewis and Co., Ltd. 7*s*. 6*d*. net). The papers selected cover a wide field, and are valuable contributions to medical science.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 677.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Effects of Traffic Disturbance and Night Illumination on London Starlings

THAT the breeding period of birds with a relatively brief annual reproductive season could be shifted to any time of the year by manipulating lighting conditions, regardless of temperatures, was first shown in 1924[1]. The subject has since been investigated by numerous other workers, but a specific answer as to how the light induces the effects that can be so readily demonstrated has not yet been found. While it has been shown that the principle applies widely to birds, some forty species of which have now been examined by various investigators, it has also been shown to be effective in certain mammals, reptiles, amphibians and fish. Evidence that light falling on the eye, or other receptor, stimulates the pituitary, which in turn activates the gonads, is gathering weight, but is not yet wholly convincing.

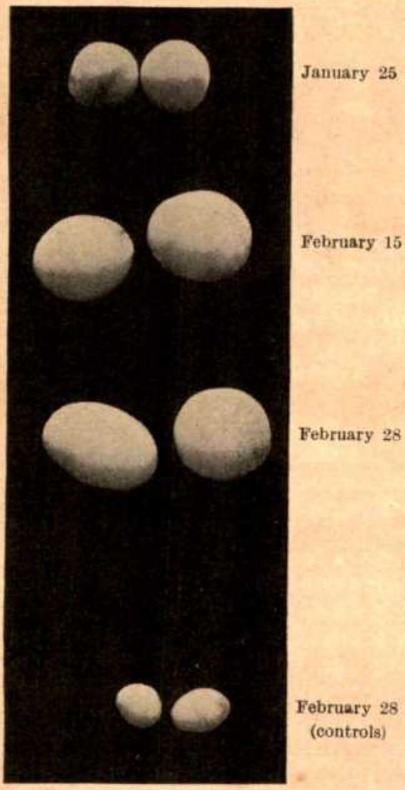

Fig. 1.

TESTES OF JUNCOS. × APPROX. 15.

Nine years ago, an attempt was made to induce winter development of the gonads in the migratory finch, *Junco hyemalis*, by substituting periods of activity without light for periods of artificial illumination. The apparatus and results were fully described in these columns[2]. On account of the lateness of the season (March 17–April 28) it seems possible that the striking results obtained could have been due in part to the fact that recrudescence of the organs, having already begun under the influence of lengthening days, proceeded under the stimulus of forced exercise, and that the results might have been different if undertaken earlier in the winter.

The experiment has now been repeated with the same apparatus and the original species, the Canadian junco (males only), but commencing on January 4, 1937. The only window of the room used was shuttered nightly from 5 p.m. until 9 a.m. A small electric bulb at the level of the ceiling was the sole source of illumination, and its rays could not fall directly either on to the control or experimental birds, their cages standing on the floor under opaque shades. The bulb burned for longer periods nightly, commencing always at 5 (except for the first week when the room was shuttered at 4) and continued the first day for 7½ minutes, 15 the second, 22½ the third, 30 the fourth, and so on until 11 p.m. had been reached on February 28, when the last birds were killed for examination. Synchronously with the burning of the light, a mechanical device gently disturbed the experimentals and prevented them from falling asleep for an additional 7½ minutes daily. The controls slept without interruption from 5 o'clock onwards.

The outcome is illustrated in Fig. 1. The result is not as striking as on the previous occasion even though the total time involved was longer (eight weeks as against six), but recrudescence of the testes was nevertheless induced among the experimentals. Those of the control have remained at the winter minimum and show not the slightest effect of the artificial illumination to which the bird was exposed for two months.

Bissonnette[3] repeated this undertaking on starlings, but found that he could not induce development of the gonads by compulsory exercise in dim light. He did, however, get two specific results. One was excess of the pigmentation that is so characteristic of starlings' testes in the early stage of development: the other was a speeding up of the rate of recrudescence when his birds, after periods of compulsory exercise, were thereafter exposed to increased periods of light of much greater intensity.

It occurred to me during the present winter, on reaching London and noting hundreds of starlings roosting on various public buildings in the West End, that the feeble light falling on them at most of their roosts must be far below the intensity shown by various investigators to be effective in inducing development of the gonads in birds. Practically all of them, however, were roosting over main traffic routes and were being sufficiently disturbed by the din and tumult below them to stay awake intermittently until the small hours of the morning. It was decided to collect samples for examination early in January, but when the time came, difficulties inherent in the general situation came with it. Collecting birds at night in the centre of London was more easily said than done, and it was finally February 10 before a dozen birds from a West End roost had been procured for examination. Some forty country birds have also been obtained for comparison. The results are illustrated in Figs. 2 and 3.

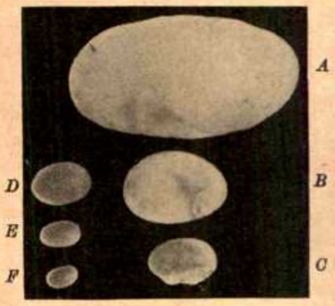

Fig. 2.
TESTES OF STARLINGS. *A*, *B*, *C*: LONDON BIRDS (FEB. 10). *D*, *E*, *F*: COUNTRY BIRDS (FEB. 17–26). × APPROX. 2.

We have since determined that at the spot from which the London birds were obtained, the needle of a Weston lightometer (registering foot candles) fails to record even a vestige of a flicker. I am informed by the makers of the light involved that it is a 1,500-watt tungsten filament lamp and that the red values, considered by Bissonnette as of particular potency in their effect on gonad stimulation, are probably 10 per cent *below* those of a smaller and less-efficient bulb of the same nature. Such bulbs were used in my original experiments and have been adopted by most other investigators.

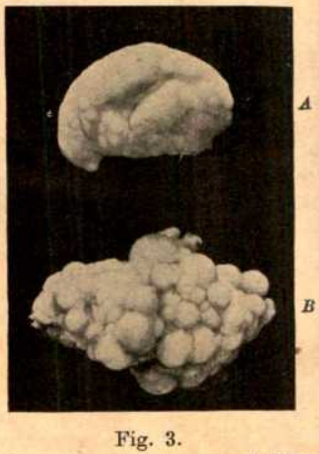

Fig. 3.
OVARIES OF STARLINGS. *A*, BEDFORDSHIRE BIRD (FEB. 17); *B*, LONDON BIRD (FEB. 10). × APPROX. 5.

A review of this topic in its entirety is in preparation. Space required for an adequate discussion precludes the possibility of doing so here, but it seems worth while to put the facts on record for the consideration of others.

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March 5.

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[3] Bissonnette, T. H., "Studies on the Sexual Cycle in Birds. IV. Experimental Modification of the Sexual Cycle in Males of the European Starling (*Sturnus vulgaris*) by Changes in the Daily Period of Illumination and of Muscular Work", *J. Exp. Zool.*, **58**, 281–418 (1931).

Equilibrium and Kinetics in the Gaseous State and in Solution

Diene syntheses are reversible associations of the type $a + b \underset{kd}{\overset{kf}{\rightleftarrows}} c$. The equilibrium constant $K = \frac{k_f}{k_d} = B \exp HR/T$ has been measured for four of these reactions.

(1) *cyclo*pentadiene + α-naphthoquinone ⇄ *cyclo*pentadiene-α-naphthoquinone.

(2) *cyclo*pentadiene + benzoquinone ⇄ *cyclo*pentadiene-benzoquinone.

(3) *cyclo*pentadiene + *cyclo*pentadiene ⇄ di*cyclo*pentadiene.

(4) *cyclo*pentadiene + acrolein ⇄ endomethylenetetrahydrobenzaldehyde.

The results of the measurements are in Table 1.

TABLE 1.

Reaction No.	Measurements in	$B \times 10^7$ l./gm.-mol.	H kgm.-cal.	Temp. range
1	Benzene	1·8	16·9	8–79°
2	Benzene	8·3	17·7	8–79°
3	Paraffin	13	16·8	0–175°
	Gas	1	17·9	25–100°
4	Gas	6·8	18·4	108–242°

Values of B between 10^{-6} and 10^{-7} l./gm. mol. are observed in both states and hence the statistical probability of the formation of c from a and b, whether in the gas phase or in solution, is of the same order of magnitude for all the reactions. Also H, the heat of reaction, is nearly the same for all four diene syntheses, a value of about 17 kgm.-cal. being observed in both states.

The B and H values for Nos. 1[1], 2[1] and 4[2], and for No. 3 in paraffin solution[1] were obtained by determining the temperature dependence of k_f and k_d. In order to obtain B and H for No. 3 in the gas phase the solubilities, L, of gaseous *cyclo*pentadiene and di*cyclo*pentadiene in paraffin were determined over a range of temperatures. L = concentration solution/concentration gas $= C \exp \lambda/RT$ where the non-exponential term C is a measure of the statistical probability of dissolution, and λ is the heat of solution. Van't Hoff's equation connecting the equilibrium constant in two states with solubilities was used in the form $B_g \exp H_g/RT = B_s \frac{(C_a^2)}{(C_c)} \exp (H_s+2\lambda_a-\lambda_c)/RT$ where the subscripts g and s refer to gas and solution and a and c refer to *cyclo*pentadiene and di*cyclo*pentadiene respectively. The following values were obtained: $C_a = 1 \times 10^{-3}$, $\lambda_a = 7{\cdot}13$ kgm. cal., $C_c = 2 \times 10^{-5}$, $\lambda_c = 13{\cdot}1$ kgm.cal. The non-exponential term of the solubility is larger for *cyclo*pentadiene than for di*cyclo*pentadiene, and the heat of solution of *cyclo*pentadiene approximately equals half the heat of solution of di*cyclo*pentadiene.

TABLE 2.

Measurements in	A(l./gm. mol.-sec.)	Activation energy E (kgm.-cal.)	Temp. range
Gas[3]	$1{\cdot}3 \times 10^6$	$16{\cdot}7 \pm 0{\cdot}8$	80–150° C.
Paraffin	$13{\cdot}0 \times 10^6$	$17{\cdot}4 \pm 0{\cdot}5$	0–172° C.

It was found that the reaction, 2 *cyclo*pentadienes → di*cyclo*pentadiene is homogeneous and bimolecular both in the gaseous state and in paraffin solution, and that the Arrhenius equation $k_f = A \exp - E/RT$ is obeyed. The 'constants' of the equation are given in Table 2.

The solubility of the gaseous *cyclo*pentadiene-*cyclo*pentadiene transition state in paraffin is defined by the ratio concentration solution / concentration gas = $C_t \exp \lambda_t/RT$ and can be estimated, using the following relationships which were deduced by Evans and Polanyi[4] and Wynne-Jones and Eyring[5].

$$C_t \sim \frac{A_s}{A_g}(C_a)^2 \text{ and } \lambda_t \sim E_g - E_s + 2\lambda_a.$$

Here C_t is a measure of the statistical probability of dissolution of the transition state, λ_t is the heat of solution, and the subscripts g and s refer, as above, to gas and paraffin solution.

As the solubility of *cyclo*pentadiene, the kinetic A values and the activation energies are known, it follows that

$$C_t \sim 1 \times 10^{-5} \text{ and } \lambda_t \sim 14 \text{ kgm.-cal.}$$

If these values are compared with the non-exponential solubility term and with the heat of solution of di*cyclo*pentadiene, it can be seen that the solubilities of the transition state and of the product are similar.

We are greatly indebted to Prof. C. K. Ingold for his continued interest in this work.

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Cf. Wassermann, *J. Chem. Soc.*, 1928 (1936); NATURE, **138**, 369 (1936).

[2] Kistiakowsky and Lacher, *J. Amer. Chem. Soc.*, **58**, 123 (1936).

[3] Kistiakowsky and Mears give 6·5 × 10^8 and 12·7, *J. Amer. Chem. Soc.*, **58**, 1060 (1936).

[4] *Trans. Farad. Soc.*, **31**, 875 (1935); **32**, 1333 (1936).

[5] *J. Chem. Phys.*, **3**, 492 (1935).

Origin of the Cochlear Effect

IN 1934 Hallpike and Rawdon-Smith advanced a tentative theory to account for the production of synchronous potential waves within the mammalian cochlea, in response to auditory stimuli[1]. According to this, the potential waves were held to be set up by movements of a membrane, thought to be polarized, and bounded on either side by the cochlear fluids. It has now proved possible to show that a membrane, polarized in such a fashion, will in fact yield potential waves of the required type.

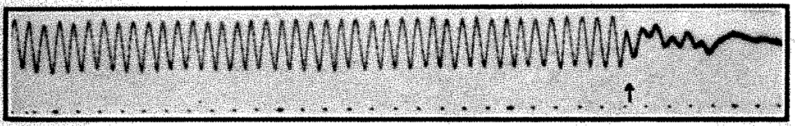

Fig. 1.

CATHODE RAY OSCILLOGRAM SHOWING RESPONSE FROM FROG'S SKIN TO PURE TONE STIMULUS OF FREQUENCY 140 ~ PER SEC. SOUND SWITCHED OFF AT ARROW. TIME MARKER: SMALL DOTS = 0·01 SEC.

The apparatus employed was arranged in the following manner. A piece of the skin of the common frog was stretched over the mouth of a glass tube approximately 1 cm. in diameter. The mouth of a second tube was caused to press lightly over this, in such a way that a fluid-tight seal was produced. The two tubes were then filled with frog's Ringer solution at pH 8. Into each tube a small platinum electrode was sealed so as to dip into the solution. It was then found that a steady potential of some 35 millivolts existed across the electrodes, and therefore across the skin, in the manner first demonstrated by du Bois Reymond[2].

Sounds generated by a heterodyne oscillator and loudspeaker were led by means of pressure tubing to a rubber membrane sealing off the opposite end of one of the glass tubes. The opposite end of the second tube was left open. On attaching the platinum electrodes to the input of a high-gain amplifier, the output of which was connected to a cathode ray oscillograph tube, it was found that potential waves of considerable magnitude (up to 0·5 millivolt) were produced by a stimulus of low frequency. As the stimulus frequency was increased, the efficiency of the mechanism fell off, as would be expected from a consideration of the inertia of the fluid system employed, many times greater than that of the mammalian ear.

The record shown in Fig. 1 was obtained using a stimulating frequency of approximately 140 ~ per sec. Its close resemblance to oscillograms produced in a similar fashion by the mammalian ear may be noted. A further point of similarity is provided by the fact that the application of ether to the skin abolished this effect; abolition of the steady potential previously referred to also ensued.

It is felt that this demonstration that a polarized membrane will yield such an effect lends indirect support to Hallpike and Rawdon-Smith's original theory.

Changes in frog skin potential were first observed by Motokawa[3] to arise from variations in the pressure head across the skin; a similar variation was observed for alteration of tension in the skin. Motokawa's results, and further data obtained here, indicate that such changes in potential are primarily due to changes in the values of the internal 'short-circuiting' (or local action) currents. These changes in turn result from changes in the local, and therefore also in the total, skin resistance. Support is lent to this contention by the fact that the required changes in total resistance can, in fact, be readily demonstrated.

From this evidence it appears that the potential waves recorded in response to acoustic stimuli may perhaps be ascribed primarily to such variations in local resistance, these in turn resulting from variations in pressure head and/or in tension set up by the vibrations communicated to the skin by the fluid with which it is surrounded. It is not impossible therefore that the cochlear effect may also be ascribed to some such mechanism.

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March 12.

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[2] Reymond, du Bois, "Unters. über Thier. Elektr.", (ii), **2**, 9 (1857).

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Phase-Velocity of Electro-Magnetic Waves along the Ground

IN a recent publication, Colwell and his co-workers have recorded the results of experiments to determine the group velocity of electro-magnetic waves along the ground[1]. These experiments indicated that the speed with which a short pulse of radiation passed along the ground between two points situated some kilometres apart was considerably less than the velocity of light in free space. Their measurements were made on frequencies in the neighbourhood of 2,000 kilocycles per second.

In view of these results, it appeared to us that it would be of considerable interest to measure the phase-velocity of waves travelling along the ground. Apparatus was available at the Radio Research Station, Slough, with which such measurements could be made on a certain band of frequencies.

The apparatus consists essentially of a pair of similar aerials placed a known distance apart in the path of the wave and some means of comparing the phases of the signals induced in the two aerials. In the apparatus used, the output from each aerial was applied, after suitable amplification, to a pair of deflecting plates on a cathode ray tube. The fluorescent spot is thus subject to two deflections at right angles, these deflections being proportional to the signals in the two aerials respectively. The amplifiers and aerial circuits are first adjusted so that when equal and cophasal fields exist at the two aerials, the figure traced out on the oscillograph is a line at 45° to the axes of deflection of the spot. This preliminary adjustment is carried out by radiating a signal on the frequency to be used in the measurements, from an oscillator located midway between the aerials, it being assumed that in these circumstances equal and cophasal fields exist at the aerials. When a c.w. signal is received from a distant point on the line joining the aerials the figure traced out on the oscillograph tube is in general an ellipse, from which it is possible to determine the phase difference between the fields at the two aerials, and hence deduce the phase velocity of the wave passing between the two aerials.

If d = distance between aerials (cm.); f = frequency of wave (cycles per sec.); ψ = phase difference between signals in the two aerials (degrees); c = phase velocity of wave (cm. per sec.), it is easily seen that

$$\psi = \frac{360\,d}{c/f} \text{ or } c = \frac{360\,df}{\psi} \text{ cm. per sec.}$$

The aerial system used consisted of a pair of vertical aerials spaced 34·9 metres apart. Measurements were made on signals from a portable transmitter located about a mile from the receiving system, on the line of the aerials. The results are given in Table 1.

TABLE 1.

Frequency	Phase-Velocity
2·50 Mc./sec.	$3\cdot05 \times 10^{10}$ cm./sec.
2·90 ,,	$3\cdot10 \times 10^{10}$,,
3·29 ,,	$3\cdot00 \times 10^{10}$,,
5·95 ,,	$3\cdot00 \times 10^{10}$,,
7·60 ,,	$3\cdot10 \times 10^{10}$,,
10·92 ,,	$2\cdot75 \times 10^{10}$,,
11·70 ,,	$2\cdot80 \times 10^{10}$,,
11·70 ,,	$2\cdot85 \times 10^{10}$,,
15·05 ,,	$2\cdot90 \times 10^{10}$,,
Average	$2\cdot95 \times 10^{10}$,,

Over the range of frequency between 2·5 Mc. per sec. and 15 Mc. per sec. the measured velocity is seen to lie very close to the value $3\cdot0 \times 10^{10}$ cm. per sec. There is no indication of a marked change in velocity with frequency, from which we may deduce that the group velocity of waves along the ground is also within a few per cent of $3\cdot00 \times 10^{10}$ cm. per sec., that is, the velocity of light.

The accuracy of these results depends on the accuracy with which the distance between the aerials and the frequency can be measured and on the accuracy of the process of 'lining-up' the aerials. The measurement of distance was made to an accuracy better than 0·5 per cent and the measurement of frequency was made with a sub-standard wave-meter to an accuracy better than 1 per cent. It is considered that the accuracy with which the 'lining-up' process could be carried out and the accuracy of the measurements made on the ellipse are such that the overall accuracy is about 5 per cent or slightly better.

It remains to note that the observed values show discrepancies from the value $3\cdot00 \times 10^{10}$ cm. per sec. of more than the estimated experimental accuracy. These cannot be due to the effect of waves reflected from the ionosphere since at these ranges such waves would be incident vertically and would not affect the aerial system. The possibility of direct pick-up on the transmission lines coupling the aerials to receiver or on the receiver is ruled out by the negative results of direct experiments to test this. The possibility still remains of re-radiation from disturbing bodies near the receiving aerials.

It should be observed that, while these results are not in agreement with those of Colwell, Hall and Hill, the measurements made by them refer to a pulse which has travelled some kilometres, and which may not have remained quite close to the ground all the way, while our measurements refer to the velocity of the wave actually as it passed between two aerials on the ground.

These experiments were carried out as part of the programme of the Radio Research Board, and this note is published by permission of the Department of Scientific and Industrial Research.

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March 15.

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[1] Colwell, R. C., Hall, N. I., and Hill, L. R., *J. Franklin Inst.*, **222**, 551–562 (1936).

Cosmic Ray Showers

IN the current theories and experiments, the question whether a cosmic ray shower is produced in a single elementary process or rather in a succession of many elementary processes is still open to discussion. For example, the discussions of Geiger and Fünfer[1], and of Bhabha and Heitler[2] are based on the latter idea, while that of Heisenberg[3] represents the former point of view. In the first case, the shower contribution from different layers of producing material would be linear to its thickness, provided the latter is sufficiently small, while in the second case, on the contrary, a quadratic relation between the shower frequency and the thickness is to be expected.

Using the arrangement A of Fig. 1, in which at east three particles are necessary to cause a simultaneous discharge, Morgan and Nielsen[4], later

Watase and Kikuchi[5], have confirmed the quadratic increase in the initial portion of the Rossi curve, as it is shown by Curve *a*. In continuation of the investigations on this problem, Curves *b* and *c* are obtained by using the arrangements *B* and *C*. In case *B*, simultaneous discharges in four counters were recorded, while in case *C* those of five counters were registered. We see that the quadratic character becomes less prominent as the number of counters of which simultaneous discharges are counted increases.

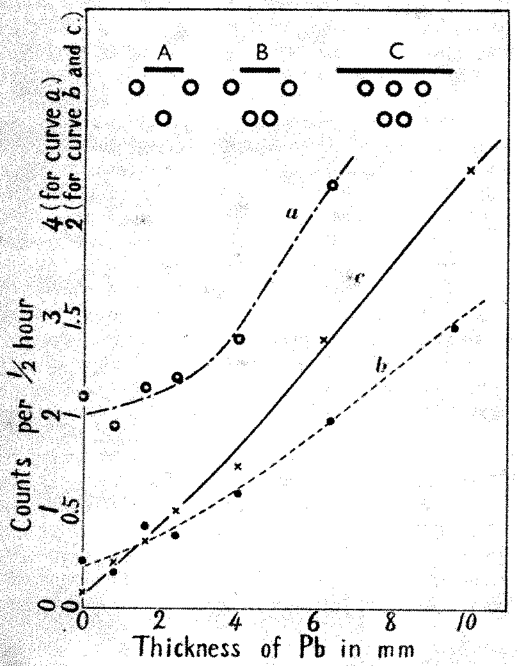

Fig. 1.

These facts show that a shower consisting of a large number of particles can be produced by a single elementary process. The quadratic character in the case of three counters may be explained by the existence of soft radiations of tertiary origin. As the efficiency of the counter for these radiations is much lower than for the direct secondaries, their contribution decreases very rapidly with the increasing number of discharges recorded simultaneously.

The present results do not exclude the existence of showers produced by a succession of elementary processes, but show clearly that the latter is not necessary for the production of a shower containing a large number of particles; or, in other words, there exists an elementary process in which many particles are produced simultaneously, as suggested by Heisenberg.

My thanks are due to Prof. S. Kikuchi for guidance throughout this work.

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Action of Iron Oxide on the Emission Spectrum of Nitrogen-Mercury Systems excited by α-Rays

DURING a research on the synthesis of ammonia at room temperature under α-ray bombardment and in presence of Fe_3O_4, we have found that the gas surrounding the α-particle source emitted a relatively intense green glow. The α-particle source was radon in a small thin glass bulb, through the walls of which the α-particles could pass. The phenomenon is only observable when the iron oxide is reached by the α-rays, and has been bombarded for several hours in a stoichiometric atmosphere ($N_2 + 3H_2$). When a certain amount of iron oxide has been thus in some manner promoted, it remains active in subsequent experiments, even if between two experiments it has been brought into contact with air.

With pure nitrogen the green cold flame increases in intensity, hydrogen seeming to have a simple diluting effect. If radon is mixed with the stoichiometric gas, the glow is only to be seen in the neighbourhood of the magnetic oxide in a layer about one centimetre thick. On shaking, the luminosity spreads throughout the whole tube, and becomes brighter. When after shaking the tube is placed in a horizontal position, the light fades, starting from the end no longer containing the oxide and going towards the other end, until after some twenty minutes it is confined to a zone of one centimetre over the iron oxide. If the glow was emitted by iron oxide dust suspended in the gas, it would start settling in the higher part of the vessel and not on the end opposite to the oxide. The glow is thus to be ascribed to the gas phase.

The light was still visible with α-particle sources as weak as 3 millicuries. Increase of pressure and temperature intensifies the luminosity. Admission of even very small quantities of air by carefully opening the stopcock of the vessel was immediately followed by the extinction of the glow. The glow appears only in the space irradiated by the α-particles, and disappears within a small fraction of a second after irradiation.

Spectroscopic study gave us the nitrogen bands. Some of them (those marked with an asterisk) have already been observed by Sir William and Lady Huggins[1] or Himstead and Meyer[2], in the spectrum of the light emitted by a radium bromide crystal.

Second positive N_2 group	Group (NO)
*3159	2595·7
*3371	2722·2
*3577	2859·5
3805	*2977
4059	

Research was continued in two directions.

(1) The first working hypothesis was that the glow was similar to the green light produced in Strutt's experiments, when a current of active nitrogen met a current of nitric oxide, with formation of the peroxide. In the present case, nitric oxide could be formed by the action of bombarded Fe_3O_4 on excited nitrogen. All attempts to produce the green glow by bringing currents of nitric oxide and nitrogen in contact under α-ray bombardment have failed.

(2) The second hypothesis was that the phenomenon was associated with the presence of mercury vapour. Analogous green glows have been observed when mercury vapour in presence of foreign gases is illuminated by a mercury vapour lamp (Phillips[3], Wood[4], Donat[5]). What seems quite new in our case is the action of iron oxide. This hypothesis is backed

by observation of the increase of intensity (about thirty times) of the Hg line 2536·7 in presence of Fe_3O_4 bombarded by α-rays. Spectra in the visible region show an important increase of the visible triplet 5461, 4358, 4047, in presence of the iron oxide, and especially of the 5461 green line which is not visible at all when Fe_3O_4 is not present.

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Feb. 21.

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[1] *Proc. Roy. Soc.*, A, **72**, 196, 409 (1903) ; **76**, 488, 130 (1905).

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Eddy-Current Resistance in Fluids due to Rotation

THE well-known 'Larmor analogy' between the deflecting force exerted by a magnetic field upon the motion of electrically charged bodies and the 'Coriolis' force which similarly deflects a moving body relative to a rotating system of reference, suggested to me that the resistance to motion due to electrical eddy currents experienced by a conducting body rotating in a magnetic field should be paralleled when a rotating body of fluid is given a second rotation, for example, about a second non-parallel axis. The experiment, which was demonstrated at the recent meeting of the Australasian and New Zealand Association for the Advancement of Science in Auckland, N.Z., does, in fact, rather strikingly exemplify the gyro-magnetic analogy. A spherical vessel of metal or glass, filled with water and provided with an axle that turns in horizontal bearings and rotated (long enough for the water to take up the rotation) comes very rapidly to rest if set up on a rotating table—or even if the frame in which the bearings are set is turned while held in the hand.

With a glass bowl, the actual eddy currents in the water are made conspicuously visible by the movement of bubbles formed from the residual air when the bowl is not completely filled.

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Feb. 24.

Fossil Pollen in Scottish Jurassic Coal

I HAVE recently made an examination of the microspore content of a sample of coal of Jurassic age that occurs at Brora, Sutherlandshire. The seam rests upon strata of the Estuarine Series (g^7), and has as its 'roof-bed' Kellaways Rock ($g^{\underline{10}}$). The seam proves to have a rich content of pollen, principally of genera of conifers belonging to the Abietineæ, but, in addition, it is interesting to record the presence of pollen of the types that characterize the Nymphæaceæ among the dicotyledons.

Water-lily pollen possesses certain characters that make recognition of the type easy. These characters are illustrated diagrammatically in Fig. 1, and may briefly be summarized as follows:

(1) A narrow furrow region (*f*), which in form is ring-shaped or open at one or both ends.

(2) A region, the operculum (*o*), enclosed by the furrow ring, in area always less than a hemisphere. The exine of the operculum may differ from that of the part of the grain outside the furrow ring in being distinctly thinner or differently ornamented (1,*d*).

(3) In the smoother *Castalia* species (1,*d*), the exine tapers in thickness towards the furrow ring, merging with the latter without a marked rim.

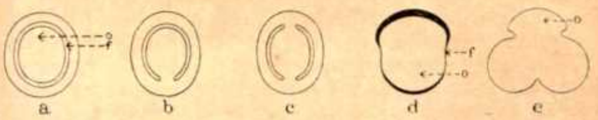

Fig. 1.

(4) In the genus *Nelumbium* (1,*e*) a third furrow is present, differing slightly in shape from those bounding the operculum. A very distinctive feature of *Nelumbium* pollen is that when viewed from the poles, the furrows do not divide the grain into three equal parts, as normally do the three furrows in other dicotyledonous types. In other words, bilateral, not trilateral, symmetry characterizes the *Nelumbium* type. As this distinction is probably a primitive feature, it may be expected to occur more frequently in fossil than in modern pollen types, and it should therefore be looked for in all work in fossil pollen, particularly the more ancient the material under examination.

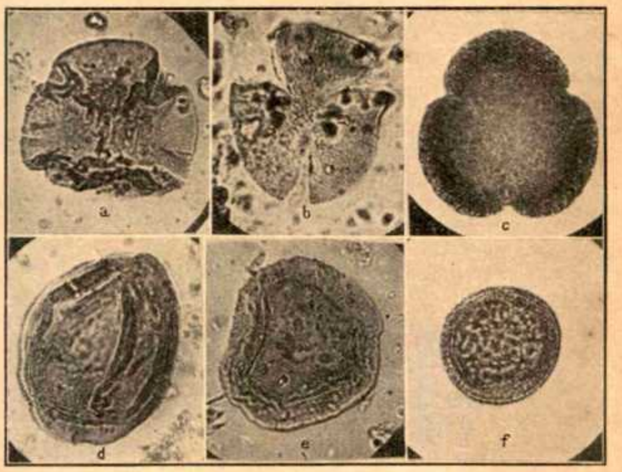

Fig. 2.

(*a*) *Nelumbium* TYPE, JURASSIC COAL, BRORA ; POLAR VIEW SHOWING OPECULAR FURROWS.

(*b*) *Nelumbium* sp., TERTIARY COAL, SCOTLAND, POLAR VIEW.

(*c*) *Nelumbium nuciferum* GAERTN., MODERN SPECIES.

(*d*) *Nelumbium* TYPE, JURASSIC COAL, BRORA ; LONGITUDINAL VIEW, SHOWING THIRD FURROW (CENTRE) AND OPERCULUM.

(*e*) *Castalia* TYPE, JURASSIC COAL, BRORA ; SHOWING OPERCULUM AND BOUNDING FURROWS.

(*f*) *Castalia crassifolia* HAND.-MAZZ., MODERN SPECIES ; OPERCULAR FURROWS ON EITHER SIDE.

ALL FIGURES × APPROX. 325 DIAMETERS.

As I think is evident from the photographs reproduced in Fig. 2, the water-lily pollen in the Brora coal already shows clear differentiation into the types characteristic of the modern genera *Nelumbium* and *Castalia*. Other genera of the Nymphæaceæ may also be present. Except for some forms possibly representing *Magnolia* and its allies, no other dicotyledons appear to be represented.

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March 16.

An *F*-Type Potato Virus in Australia

The *F*-type of potato virus recently described by Clinch, Loughnane and Murphy[1] and Murphy and Loughnane[2] is evidently widely distributed. At Canberra in January 1936 a virus which was carried without symptoms in a number of solanaceous hosts was recovered from potatoes with a slight aucuba mottling of the foliage. The variety of potato was supplied under the name Arran Crest, but its characters were rather those of Arran Pilot. No tuber necrosis was noticed. The virus was recovered a number of times over a period of a year from the tubers of these plants, and from second generation plants grown from the tubers. The presence of the virus did not protect the potato plants from infection with *Y*-type viruses, and various other hosts containing it were infected with *X* virus and $X + B$ without difficulty. It caused severe necrosis on pepper at mean temperatures below about 70° F.; above that, and at temperatures too low for the strong growth of pepper plants, the symptoms were milder. *Solanum nigrum* was found to be an important host on which the virus sometimes produced a very faint and transitory vein-clearing or mottle, but generally no symptoms at all. It could, however, be recovered from apparently unaffected plants in high concentration.

So far as they were studied, the properties of the Australian virus corresponded with those of the *F*-type. Whether this group is important in Australia is not yet known, although viruses causing necrosis of pepper have been recovered from several sources.

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Division of Plant Industry,
Council for Scientific and
Industrial Research,
Canberra.
March 2.

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[1] Clinch, Phyllis, Loughnane, J. B., and Murphy, P. A., *Sci. Proc. Roy. Dublin Soc.*, **21**, 431 (1936).

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Interfertility Phenomena of the American and European Forms of *Panus stypticus* (Bull.) Fries*

Panus stypticus (Bull.) Fries is a small coriaceous agaric which grows usually on the wood of deciduous trees, and is found both in Europe and North America. Although alike morphologically, a striking difference exists between the American and European forms, namely, the former is luminous and the latter is non-luminous[1]. Since they were known to differ in this character, a study of the two forms in relation to their pairing reactions and the method of inheritance of the factor for luminosity was undertaken.

Monosporous mycelia were isolated from single fruit-bodies of *Panus stypticus* collected at Timagami, Ontario; Ottawa, Ontario; and Lake MacDonald, Quebec (in Canada); at Dresden, Darmstadt and Potsdam (in Germany); at Sigless in Austria; and at Wageningen in Holland. Series of pairings in all possible combinations of monosporous mycelia from each of these fruit-bodies have shown that both the American and European forms of this fungus are heterothallic and tetrapolar. These results were published in the Progress Report of the Dominion Botanist for the years 1931–34[2], and have been confirmed by Vandendries' work with the European form[3].

By pairing monosporous mycelia derived from different sources, it has been found that both the American forms and the European forms are fertile among themselves and that the American form is completely interfertile with the European form[3] (Fig. 1).

		6004							
		AB		ab		Ab		aB	
		12	15	22	27	6	9	10	26
5122	AB	1	+	+	+	+	+	+	+	+
		19	+	+	+	+	+	+	+	+
	ab	12	+	+	+	+	+	+	+	+
		25	+	+	+	+	+	+	+	+
	Ab	23	+	+	+	+	+	+	+	+
		26	+	+	+	+	+	+	+	+
	aB	13	+	+	+	+	+	+	+	+
		20	+	+	+	+	+	+	+	+

Fig. 1.

TABLE SHOWING THE RESULTS OF PAIRING EIGHT MONOSPOROUS MYCELIA OF THE LUMINOUS AMERICAN FORM OF *Panus stypticus*, +6004, AND EIGHT MONOSPOROUS MYCELIA OF THE NON-LUMINOUS EUROPEAN FORM, +5122. THE PLUS SIGN INDICATES THE PRESENCE OF CLAMP CONNEXIONS.

In sixty-eight pairings of monosporous mycelia of the luminous American form with the non-luminous European form, the diploid mycelium produced has been isolated and found to be luminous; that is, in the mycelium of the F_1 generation, luminosity is dominant. If sporophores are obtained from these paired cultures, the monosporous mycelia from them will be tested to determine the method of inheritance of the factor for luminosity in the F_2 generation.

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* Contribution No. 491 from the Division of Botany, Experimental Farms Branch, Department of Agriculture, Ottawa, Canada.

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[2] Macrae, R., Rept. Dominion Botanist, 1931–1934, 60 (1935).

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Water and Fat Content of Tsetse Flies

In his recent letter to NATURE on this subject[1] Mr. R. W. Jack emphasizes the importance of excluding the weight of fat in tsetse flies when calculating the percentage of water found in them.

I came to the same conclusion early in 1935, and communicated my opinion to Prof. Buxton in a letter dated April 2 of that year. My complete findings for 1935, when more than 800 flies were examined by me, were published in 1936[2].

In Table 1 my results for 1935 are summarized. It will be observed that with increasing hunger the percentage of water in gross body weight shows a rise. But with fat eliminated from both wet and dry weights the percentage of water shows a slight fall after stage II of hunger, though the variation from stage to stage is now much less than before. The males, other than young males, are divisible into four stages of hunger by external characters—gorged, replete, intermediate and hungry.

Table 1 refers to flies (*Glossina morsitans*) collected in the field.

TABLE 1

Category	Fat, per cent of dry weight	Gross water per cent	Water, per cent of non-fatty weight
Males			
Stage I	25·87	62 19	69 55
Stage II	35 28	60 96	70·83
Stage III	24 53	63·62	69 89
Stage IV	14·56	64·77	68·43
Young	15·93	68 88	72 63
Females			
Mature	16·84	64 44	68 73
Young	15·25	68 92	72·36

Just-fed flies are normally inactive in Nature, but from laboratory experiments it is found that these contain nearly 75 per cent water in non-fatty body weight, the percentage of water in blood. By rapid excretion, water is eliminated immediately after feeding, up to 8 mgm. being removed in the first quarter of an hour.

The results are interpreted in the following way:

Fat is synthesized after feeding, and reaches a maximal proportion in stage II of hunger. Thereafter it diminishes until the next meal (stage III or stage IV). During the inactive period immediately after feeding the water content is depressed below the normal 70 per cent of fatless weight, and as it rises towards the normal, activity is resumed in late stage I. Thereafter the percentage is maintained close to 70 per cent, but falls slightly as hunger increases and loss of water can no longer be made good. It appears that death from 'starvation' occurs when the percentage falls to about 65 per cent.

In wild, young flies, for some unexplained reason, the percentage is higher at about 72½. My colleague, Mr. W. H. Potts, finds that in just-emerged individuals it is even higher.

To summarize the significant differences in the first and third numerical columns of Table 1, stage II is in each case significantly different from all the others. Stages I and III are indistinguishable from each other but, significantly different from the rest, except that in the third column the old females, because of high variance, are not quite distinguished from stage I males. Stage IV and all females and young males are indistinguishable as to fat percentage; in water percentage of fatless weight the young flies are distinct from all the others, but the sexes of young flies and of hungry males and old females are respectively indistinguishable. (Females taken in Nature are nearly always hungry.)

It is of interest that Buxton and Lewis[2] in Northern Nigeria found 63 per cent water in gross weight for wild male *G. submorsitans* and 60 per cent for wild females. These figures become 69 per cent in both cases when fat is eliminated from wet and dry weights. It is likely that some of these females were partly pregnant, as such flies have a higher fat content and therefore a lower percentage of water in the gross body weight.

Mr. Jack's point, that, when the proportion of water is so high, a small change in the ratio may indicate important losses, is well made.

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[1] NATURE, 139, 31 (1937).

[2] *Proc Zool Soc.*, (4), 811 (1936).

[3] *Phil. Trans Roy. Soc*, B, 224, 205.

Effect of Centrifuging on *Amœba proteus* (*Y*)

IN *Amœba proteus*, the cytoplasmic bodies are the nutritive spheres, crystals, neutral red bodies, mitochondria, sudanophil fat and a single contractile vacuole.

Fig. 1 illustrates the stratification of the various cytoplasmic components according to their specific gravity after centrifuging. Fat (*F*) and the contractile vacuole (*CV*) being the lightest, occupy the centripetal position. Next is clear cytoplasm (*C*), then the mitochondria (*M*) followed by a layer of neutral red bodies (*NR*), a layer of crystals (*CRY*) and the nutritive spheres (*NS*) which are the heaviest component of the cell and occupy the extreme centrifugal position. The nucleus (*N*) occupies a position in between the crystals and the nutritive spheres, and the chromatin (*CR*), being the heaviest material in the nucleus, collects towards the heavy side of the cell.

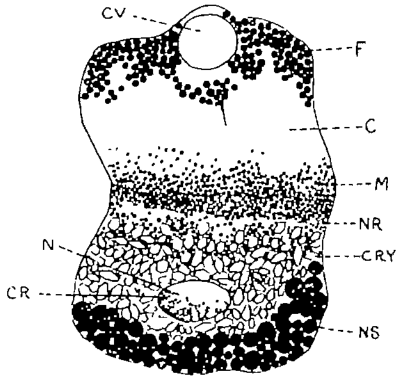

Fig. 1.

The nutritive spheres contain glycogen as a form of reserve food material. It is very interesting to note that no homologue of the Golgi apparatus appears to exist in *Amœba proteus*, and that the wall of the contractile vacuole does not blacken with osmic acid even after prolonged periods.

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March 5.

Excretion from Leguminous Root Nodules

VIRTANEN[1,2], using pea, vetch and clover, has amply confirmed the suspicion of some earlier workers by showing that under certain conditions (for example, in sand culture) there is an excretion of fixed nitrogen in the form of amino-acids from the nodules of these plants into the rooting medium. It does not follow that this finding may be extended to leguminous plants in general. In experiments carried out as an extension of published work[3], and with the assistance of Mr. I. W. Prentice, I have been unable, by analysis of the rooting medium, to find evidence of excretion of fixed nitrogen from the nodules of soya bean plants at any stage in development, although extensive fixation occurred within the nodules. The plants were grown in open sand-cultures, initially sterile.

These negative results may be due, not to the absence of excretion, but to (*a*) excretion being quickly followed by re-absorption by the roots, or to (*b*) the excreted substances in the soya bean differing from those in the types examined by Virtanen in that they are volatile—the sand was dried at 30°–40° C. prior to analysis. These two and other possibilities are being examined.

The earlier work of Stallings[4], who concluded that there is an excretion from soya bean nodules of ammonia, presumably in organic or inorganic combination, will be considered in a later fuller publication, together with other literature.

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March 23.

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[1] Virtanen, A. I., NATURE, 138, 880 (1936).
[2] Virtanen, A. I., *J. Soc. Chem. Ind.*, 54, 1015 (1935).
[3] Bond, G., *Ann. Bot.*, 50, 559 (1936).
[4] Stallings, J. H., *Soil Science*, 21, 253 (1926).

The Crayfordian and Boltonian Industries

THIS note refers to the nomenclature of the prehistoric flint industries found in (*a*) the basal gravel at Crayford and of the Ebbsfleet Channel, Kent, (*b*) the Upper and Lower floors in Bolton and Co.'s brickfield, Ipswich, and (*c*) similar floors in the subaerial loams of the Bean Valley and Ingress Vale, Kent. We propose in future to describe the specimens classified under (*a*) as *Crayfordian*, and those classified under (*b*) and (*c*) as *Boltonian*.

From a prolonged examination of the industries mentioned, we are satisfied that they cannot, without prejudice, be included in any of the ordinary subdivisions of prehistoric flint implements. Thus, the industries in question each includes Clactonian, Levalloisian, and hand-axe features, and it is not possible, therefore, to describe them by the usual nomenclature. The characteristics and geological age of these industries will be described before long, but we think it desirable that their new titles, which we hope will be generally adopted by archæologists, should be made public now.

We would point out that the specific names *Crayfordian* and *Boltonian* are based solely upon the characters of the flaked flints of the two industries, and do not connote any particular geological age for the specimens.

J. REID MOIR.
J. P. T. BURCHELL.

Magnetic and Electrical Dimensions

MY chief reason for desiring to reply to Prof. Howe's letter on this subject in NATURE of March 13 is that the last paragraph of the letter gives the impression, inadvertently I presume, that the implications of the adoption of Ampère's theory of magnetism had been considered fully by the International Committee when they made the recommendation that B and H were to be considered respectively in the roles of effect and cause, and their ratio μ therefore as an entity having physical dimensions. This is not the case.

Prof. Howe and I and all other members of the British Association Committee upon the subject were invited in 1934 to attend the meeting of the International Committee in London by the courtesy of the late Sir Richard Glazebrook, chairman of the International Committee. We were all made parties to the above recommendation, and at the time there seemed to be no alternative to an arbitrary resolution, although had we studied Maxwell's treatise more carefully we might have been more cautious.

It was not until January 19, 1935, that I showed in a letter to NATURE that the adoption of Ampère's theory opened up an alternative mathematical solution which makes μ undimensional, and I followed this by a paper to the British Association meeting at Norwich confirming this result and showing that I got complete support from Maxwell.

I have received a large correspondence about the conclusions of this paper. In September 1935 I received from Sir Richard Glazebrook a letter in which he writes: "To my mind Maxwell's theory, as developed in his book, is based on the two-fluid theory of magnetism. I have not considered how far the adoption of Ampère's theory, which no doubt is nearer the truth, modifies this but will consider the matter when I have a little leisure." It is greatly to be regretted that Sir Richard's untimely death deprived us of his considered opinion upon this important question.

From my correspondence with Prof. Howe, I can see that his main objection from the first to my conclusions has been the mathematical nature of the arguments. To my mind, the whole electrical science is the mathematical machine which he derides in his last letter, that wonderful machine which has produced the electromagnetic theory of light, to which is due the discovery of the quantum theory and all the other developments of modern theoretical physics. All that is fed into this machine consists of the empirical laws and the definitions of the various entities and constants. Now Prof. Howe would have us jettison the machine and the unit pole upon which several of our definitions are founded, and does not propose to provide us with equivalents. Even if equivalents were ready for adoption, is there any possibility of getting them adopted by the scientific world in the month or two before the fate of the dimensions of μ is decided?

Dealing with the purely physical character of μ, consider the coils of a wattmeter. If the current coil is energized, we get a magnetic field surrounding it, which we denote by H at every point. If now we energize the voltage coil, the nature of the magnetic field has not altered but only its magnitude and direction. If, on the other hand, we introduce a little piece of iron instead of energizing the voltage coil, this little piece of iron, according to Ampère's theory, consists of a multitude of atomic electrical circuits, each of which is equivalent to a voltage coil. In what respect does the physical nature of the magnetic field then differ from that which existed when the voltage coil was excited? According to the two-fluid theory of magnetism, they are different *in the iron*, but now that the two-fluid theory is discarded and there is only one medium to be considered, namely, empty space, is there any reason for maintaining the results of a discarded theory? According to Ampère's theory, B and H differ only in magnitude and direction, but are physically identical.

JAMES B. HENDERSON.

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March 22.

IN his letter in NATURE of March 13, Prof. Howe avoids the very plain question put to him by Sir James Henderson. That question is: "What justification has he for writing $\mu \equiv 1/A'$?" The only suggestion put forward by Prof. Howe is that "the forces between magnetic poles and those between electric currents must involve the same property of space". But that condition is equally met by writing $\mu \equiv A'$—which is Henderson's proposal. In view of the strictures in Prof. Howe's review, it is clearly incumbent upon him to face this issue, and make his reasons for his choice as clear as those of Sir James; and I hope that he will do this.

WILLIAM CRAMP.

Points from Foregoing Letters

NEW experiments on the winter development of the gonads in the migratory finch, *Junco hyemalis*, under the influence of artificial illumination are described by Prof. Wm. Rowan. The author also submits photographs showing that starlings in the West End of London have in winter larger testes or ovaries than those in the country. He finds, however, that the light intensity at night, at the spot where the London birds roosted, was below that known to induce development of the sex organs, and he suggests that in this case the effect may be due to the noise which keeps the birds intermittently awake until the early hours of the morning.

The non-exponential and the exponential terms of the equilibrium constant and of the bimolecular rate constant of the reaction 2 *cyclo*pentadienes $\rightleftarrows$ di-*cyclo*pentadiene and of similar associations have been measured in the gas phase and in solution by Dr. G. A. Benford, Miss B. S. Khambata and Dr. A. Wassermann. They compare the solubility of *cyclo*pentadiene and of di*cyclo*pentadiene with the solubility of the *cyclo*pentadiene-*cyclo*pentadiene transition state.

Indirect support for Hallpike and Rawdon-Smith's membrane theory of origin of the cochlear component of the Wever and Bray effect has been btained by O. Gatty and Dr. A. F. Rawdon-Smith, who have shown that potential waves of similar haracteristics can be obtained from isolated strips f frog's skin, immersed in Ringer's solution. A type f artificial cochlea was constructed, and from this ynchronous potential changes were recorded, in esponse to sound.

W. Ross and E. C. Slow have measured the *phase elocity* of radio waves (of frequency 2·5–15 Mc. per econd) travelling along the ground, by observing the hape of the ellipse traced by an oscillograph to which vas applied the suitably amplified output from two imilar aerials placed a known distance apart. Though he observed values, for the phase velocity of the adio waves investigated, differ slightly from the elocity of light (possibly due to re-radiation from isturbing bodies near the receiving aerials), these ariations are small and without marked dependence pon frequency. The authors conclude that the *group elocity* of radio waves along the ground is also within few per cent of 3×10^{10} cm. per sec., which is not agreement with the findings of Colwell and his o-workers.

Curves showing 'coincidence' discharges in ounters' arranged in groups of three, four and five, ndicating the number of cosmic ray showers as fected by the thickness of the material (lead) in hich they are produced are submitted by Y. Watase. he curves obtained by means of the groups of four nd five counters are nearly straight lines, and show at some, at any rate, of the showers are produced y a single elementary process, as suggested by eisenberg. The curve obtained with three counters is of a quadratic type, which may mean that in some cases a succession of elementary processes is involved, or the quadratic character may be due to the presence of soft radiation of tertiary origin.

A. Luyckx reports that when nitrogen and iron oxide are simultaneously irradiated by α-rays, an intense green glow is emitted by the gas. Spectroscopic study shows that mercury lines are only observable in presence of nitrogen; iron oxide increases their intensity, and causes new mercury lines to appear.

A simple experiment showing how a rotating fluid comes rapidly to rest when given a second rotation non-parallel to the first, is described by Prof. Kerr Grant. The experiment was devised as an analogy to the resistance to motion, due to electrical eddy currents, experienced by a conducting body rotating in a magnetic field.

The '*F*-type' of potato virus recently isolated in Ireland has been found by J. G. Bald also in Australian potato plants with a slight 'aucuba' mottling of the foliage. The virus causes necroses on pepper. *Solanum nigrum* acts readily as host for the virus, showing no symptoms except an occasional transitory vein-clearing or mottle.

Panus stypticus (Bull.) Fries, as found in North America and in Europe, is shown by Miss Ruth Macrae to be heterothallic and tetrapolar. The two forms are fertile among themselves and with each other. When monosporous mycelia of the luminous American form and the non-luminous European form are paired, the diploid mycelium produced is luminous.

A table showing the water and fat percentage of tsetse flies of different ages and at different stages of hunger, is given by Dr. C. H. N. Jackson. The author had come independently to the same conclusion as R. W. Jack concerning the importance of excluding the weight of fat when calculating the percentage of water, and gives instances showing that the new way of calculating the water content gives more significant results.

Dr. G. Bond reports that analysis of the sand in which soya bean plants had been grown failed to give evidence of excretion of fixed nitrogen from the root nodules of the plants. Prof. Virtanen has shown that such excretion takes place in the case of peas, vetch and clover.

Sir James Henderson, continuing the discussion on the dimensions of electrical and magnetic concepts, points out that insufficient consideration was given by the International Committee in arriving at their decision concerning those factors. He reiterates his contention that taking Ampère's theory into consideration, the magnetic field *H*, and the magnetic flux *B*, differ only in magnitude and direction and are physically identical, so that their ratio μ, the magnetic permeability, is undimensional.

Research Items

Spirit Beliefs in Suriname

In the course of a detailed account of the folk-lore of the negroes of Suriname (Suriname Folk-lore: by Melville J. Herskovits and Frances S. Herskovits, *Columbia Univ. Contrib. Anthrop.*, 27), based on material collected in Dutch Guiana in 1928 and 1929, it is pointed out that the essential factor in the beliefs of the Paramaribo town negroes, is divination, for through the work of the diviner all the elements of their system are drawn together, explained and controlled. These elements are four in number: the *akra* or soul, the *winti* or the gods, *obia* and *wisi*, good and evil magic, and the spirits of the dead. *Winti*, the negroes say, means wind. It is in every place, and is the air we breathe. The spirit too is everywhere. The term defines the gods and spirits, which rule the universe; among the bush negroes gods are usually termed *gadŏ*, and in both city and among the bush negroes other terms are encountered. Although among the bush negroes a term for Supreme God frequently occurs, it is seldom that a sky-god is invoked in the town. The only reference is in the dance to the seven gods of the sky, the thunder gods. The earth gods are headed by the Earth Mother, who even in ritual is referred to by this euphemism, and is named correctly only in songs sung by those under possession. The Earth Mother has a large number of these 'strong' names, used only by initiates and in ritual performance. This variety of names may be due to the fact that the negroes are descendants of ancestors who hailed from very different parts of Africa. While other *winti* receive offerings only from their own devotees, the Earth Mother receives from all. The most prevalent type of *winti* among women are those associated with the snake. While some snake spirits may enter into possession of men, others possess women only. This seems to be connected with childbirth and the belief that ancestor spirits may make use of the snake. Other *winti* are connected with the river, or the bush, living in the ground, in trees and in holes. *Winti* may be acquired by inheritance, by choice of the spirit, or through the 'bad magic' of an enemy.

Expectation of Life in a Moth

MESSRS. RAYMOND PEARL and John R. Miner contributed a series of life tables for the pecan nut case-bearer moth (*Acrobasis caryœ*), of which a reprint has been received, to "Mélanges Paul Pelseneer" (*Mem. Musée Roy. d'Hist. Nat. Belgique*, ser. 2, fasc. 3; 1936). The details upon which the computations are based were taken from studies made on the insect by S. W. Bilsing and published in 1927. It appears that the proportional distribution of the imaginal life of the female moths into pre-reproductive, reproductive and post-reproductive phases, when compared with the equivalent divisions of the life of the human female, shows that the post-reproductive phase is substantially equally proportional in the two cases, while the *Acrobasis* female spends more than double the proportional amount of time in the pre-reproductive phase as compared with the human female. The mean duration of life of the moth shows an evident tendency to increase in the three successive generations after the first one. The female moths in all groups tend to be longer lived than the males by amounts that are probably significant. The relative variability in duration of life is roughly the same as that found in closely inbred strains of *Drosophila*. The above paper is part of a series of studies on life duration in the lower organisms: among insects complete life-tables have only as yet been calculated for the cockroach (*Blatta*) and *Drosophila*.

Root Systems

THERE is a general discussion of the technique of exposing and recording root systems by T. K. Pavlychenko in the *Canadian Journal of Research*, 15, No. 2, February 1937. This account describes much American work, but makes no mention of the studies of root systems of fruit trees carried out for some years at the East Malling Research Station, reports of which have been published in the *Journal of Pomology*. The author then describes the soil block washing method which has been developed at the University of Saskatchewan. All thorough methods of exposing and measuring root systems are of necessity laborious, and make big demands upon time and material; but this method, in which the roots are removed in soil blocks in specially constructed cases and then first soaked and freed from soil by constant gentle washing in a stream of water, must have been most successfully developed to judge from the photographs of root systems published. It is a little staggering to see the total length of the root system of a single wild oat plant, grown free from competition over a period of eighty days, estimated at fifty-four miles! The root systems of three-year-old plants of slender wheat grass, brome grass and crested wheat grass are estimated at 9·9, 65·2 an 315·4 miles respectively.

Necrotic Lesions of Virus Diseases

THE virus diseases known as tobacco mosaic and aucuba or yellow mosaic, produce local necrosis upor the leaves of *Nicotiana glutinosa*. Brown spots visible by the unaided eye, appear about two day after inoculation. A short paper by Dr. F. M. L Sheffield (*Ann. App. Biol.*, 23, No. 4, 752–758; 1936, traces the appearance of these areas where the tissu is killed. Necrotic material begins to form firs between the lower epidermis and the spongy parenchyma tissue of an infected leaf. It later extend upwards and outwards, until, about 72 hours afte inoculation, all the cells in the immediate neighbourhood are dead. The virus is isolated within th necrotic area. The outer cells of the necrotic regio are killed before the virus reaches them, and th virus cannot, apparently, traverse this dead tissue

Indian Lac Research

AMONG the investigations commenced in Februar 1930 at the Indian Lac Research Institute wer experiments which aimed at the improvement of th villagers' ordinary methods of exploiting the kusu tree (*Schleichera trijuga*) as a lac host (*Lac Researc Institute Bulletin*, Nos. 15 and 20. Criterion Printin Works, Jackson Lane, Calcutta, 1936). In Bull. 2

Mrs. Dorothy Norris, director of the Institute, discusses the success attained. By adopting the methods of pruning and cropping advocated, the kusum tree can be utilized in lac cultivation to much better advantage than under the rather crude methods of the Indian ryot (peasant). The hot weather crop (July) is known as *Jethwi* and the cold weather (February) as the *Kusmi* crop. The lines for the treatment of the tree were laid down in *Bull.* No. 15 and have proved highly successful. Trees pruned in February 1930 were ready for infection in February 1931, yielding a good crop of lac in July 1931, with a brood yield ratio of 1 : 3·1. A year later (the trees are rested for a year) in July 1932 the trees were again ready for infection and were cropped in February 1933, giving a brood ratio of 1 : 3·7. In February 1934 the trees were again ready for infection and gave a crop in July 1934 with a brood yield ratio of 1 : 3·2. In July 1935 the trees showed no sign of sickness or over-use, and were again infected and the crop, obtained in February 1936 was excellent in quality and gave a brood ratio of 1 : 3·1. It will be seen that these experiments were started six years ago only, and will require to be carried on for a much longer period to establish definite cropping figures; since so far only two *Jethwi* and two *Kusmi* crops have been compared.

The Arun River and Himalayan Uplift

THE Arun is one of those Indian rivers which rises north of the Himalayas and flows eastward, before turning southward and flowing through the Himalayas in a series of gorges between Mount Everest and Kangchenjunga. The theory that the river is an example of ordinary consequent drainage and that it has cut back and captured Tibetan drainage has been advocated by Hayden, Heron and others. The alternative explanation, that it is antecedent to the Himalayas and has maintained its course by vigorous erosion has also been suggested and is argued by Dr. L. R. Wager in a paper in the *Geographical Journal* of March. Dr. Wager pays particular attention to the remarkable Yo Ri gorge and the main gorge eleven miles lower down. In its upper course, the Arun flows over soft sedimentaries and forms a wide valley, but at the Yo Ri gorge it reaches hard gneiss in the Nyonno Ri anticline. This explains the change in form of the valley. West of the gorge lies the low pass of Kuyok La. Dr. Wager argues that if the original surface on which the Arun flowed had been anything like the present one, the river would have flowed through this pass. Since it did not do so, the Arun must have been established in its course before the present form of the land. The Tista River farther to the east probably shows a comparable history.

Temperature and Sunshine in the British Isles

Two interesting publications of the Meteorological Office have just appeared (London : H.M. Stationery Office). The first (No. 407) is entitled "Averages of Temperature for the British Isles" (1*s*. 3*d*. net), and the second (No. 408) "Averages of Bright Sunshine for the British Isles" (1*s*. net). In each case, the averages refer to periods ending in 1935, and are for individual months and the whole year. These averages correspond to some extent with the old 'normals', which were averages for a period, 1881–1915, which was assumed to be a whole Brückner cycle of weather, the length of which cycle was taken to be 35 years. As such a small part of our weather vagaries are consistent with such a cycle, it is doubtful whether very much is gained by using 35-year averages as representative of normal conditions. There is much to be said besides for having averages, such as these new averages, which do not include years like the early 'nineties, when the old-fashioned kind of winter with weeks of skating turned up fairly regularly each year. It is hard to give a satisfying definition of a 'normal'. If it is based on a short period, it will be objected to as too small a statistical sample. If the period is made very long, other critics will say that our climate has altered since the earlier years of the long period. Yet standards of reference of some kind seem necessary. For example, unless official forecasts give the actual range of temperature that is expected, which can scarcely be hoped for when places at different heights and different distances from the sea have to be grouped into a single 'district', the forecaster has to use expressions like 'cold' or 'rather cold', and these mean cold compared with the normal for the season. Those members of the public who want to know precisely what is implied must have averages of the kind given in these two booklets.

Viscosity of Air

G. KELLSTRÖM (*Phil. Mag.*, March) has made a new determination of the viscosity of air, using the viscous drag between concentric rotating cylinders. The mean value for the viscosity at 20° C. was found to be 18200×10^{-8} C.G.S. units. This value is about 0·7 per cent higher than the one used by Millikan in his determination of the electronic charge by the oil-drop method, and a substitution of the new value in Millikan's work raises the value of e from $4{\cdot}770 \times 10^{-10}$ to $4{\cdot}818 \times 10^{-10}$ E.S.U. The error in the viscosity data may therefore account for the difference between the oil-drop value of e and that obtained from absolute wave-length measurements of X-rays, namely, $4{\cdot}805 \times 10^{-10}$ E.S.U. (cf. NATURE 137, 655; 1936).

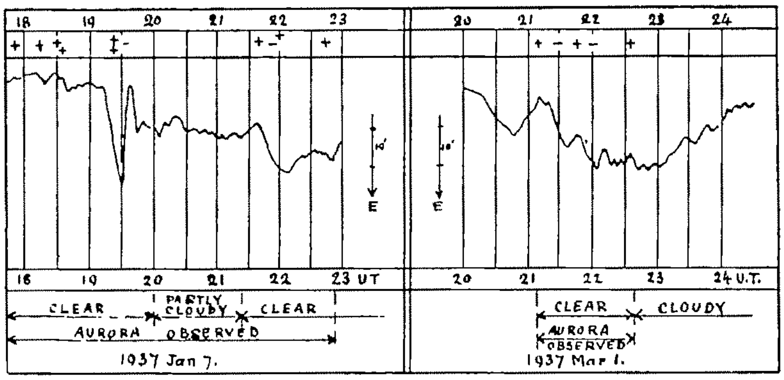
The Mysterious Number 137 Again

As mentioned in NATURE of May 23, 1936, p. 877, Euler and Kockel, working on a form of Born's unitary field theory, obtained the value 82·4 for the dimensionless pure number the explanation of which Born has declared to be the central problem of natural philosophy. An estimate of 130, which is much closer to the experimental value 137·2, has now been obtained by L. Infeld (*Proc. Camb. Phil. Soc.*, 33, 70; 1937) by using a different action function. It is shown that most of the consequences of the unitary field theory at first developed by Born and Infeld hold good for a whole range of action functions, all giving a static solution with central symmetry and finite energy, both for the electric and magnetic field, and reducing to Maxwell's action function for weak fields. That chosen by Born was distinguished by perfect symmetry between the electric and the magnetic field. A paper, not yet published, by Infeld and B. Hoffman will lay down a physical criterion to determine which function should be chosen. An even wider generalization of part of Born's electrodynamics has been made by P. Weiss (*ibid.*, 33, 79; 1937), who shows that every self-conjugate analytic function of a complex variable characterizes an electrodynamic field theory of the type proposed by Born. More stringent physical conditions, not yet available, are needed to thin out this over-luxuriant growth.

The Solar and Magnetic Conditions Associated with Recent Auroras

By the Rev. J. P. Rowland, S.J.

As already noted in NATURE (Feb. 13, 20 and 27), notable displays of the aurora were observed on January 7 and February 3, and it was anticipated there might be a recurrence after the 27-day interval of solar rotation on March 2. Weather was generally cloudy or overcast and unfavourable for observation on the last-mentioned date, but Mr. W. N. Craig, of Fortrose, Ross-shire, writes that an observer near Cambridge reported seeing the aurora between 20h. and 21h., with a maximum brightness at 20h. 45m. U.T., and another observer at South Queensferry, near Edinburgh, in a small clearing at 19h. 45m., noted the sky to be brighter than usual. Two persons near Stonyhurst, in a brief partial clearing of the sky, reported seeing auroral rays between 20h. 20m. and 20h. 30m., and an observer in the vicinity of Preston noted indications of aurora with rays, between 23h. and 23h. 25m. On the other hand, Mr. W. B. Housman, director of the Aurora Section of the British Astronomical Association, observing over the Solway Firth from Seaton, Cumberland, reports: "On March 2nd there was no aurora seen throughout a cloudless night here, observations being at very frequent intervals". On the Stonyhurst magnetic traces there was a moderate magnetic disturbance from 18h. 40m. to 19h. 40m., after which conditions were quiet, with only very slight movements.



On March 1, however, a prolonged and bright quiescent aurora was observed at Stonyhurst, from 20h. 45m. to 23h. 30m., which was especially bright between 21h. 30m. and 23h., extending to an altitude of 35° or 40°, gradually fading away to a slight glow by 23h. 30m. when observation ended. This aurora, and that of January 7, were observed in great detail by Mr. Housman at Seaton, and from a correlation of his log with the Stonyhurst magnetic declination traces, some interesting inferences may be drawn. This correlation, as made by Mr. Housman, is shown in the diagram above; the signs + and − above the declination trace, indicate respectively when a homogeneous arch was in being at the time indicated, and when the arch dissolved into streamers and luminous activity. The sign ‡ indicates the existence of a double arch, during the large easterly deflection of the magnet between 19h. 15m. and 19h. 30m. on January 7.

As Mr. Housman points out, it appears that in general the arch forms during an easterly swing of the magnet, and dissolves into an outburst of streamers and other luminous effects at or near the end of the easterly swing. It also appears from these observations, that auroral features may be seen when there is very little disturbance of the magnets, though a greater disturbance accompanies a more vivid display, as on February 3.

Mr. Craig mentions an aurora seen in Maine, U.S.A., "in the middle of December", but as no date is given, it is not possible to correlate this with the magnetic conditions, which were, in fact, remarkably quiet throughout the month, with the exception of a moderate disturbance on December 27 and 28. The auroral display of October 16, 1936, discussed by Prof. Vegard in NATURE of November 28 (p. 930), was accompanied by a very notable magnetic disturbance, lasting from October 16d. 15h. to 17d. 7h., with oscillations in declination of 28′ between 18h. and 20h., a rapid easterly deflection of 23′ at 22h. 30m., and a range of 39′ over the whole disturbance.

When we come to consider the relation of these phenomena to solar activity, we are on less sure ground. According to generally accepted theory, both auroras and magnetic disturbances are attributable to the emission of streams of corpuscles from disturbed areas on the sun, which travelling with high velocity under the action of radiation pressure enter the earth's upper atmosphere, and there set up ionization currents and electrical discharges in the rarefied gases, which manifest themselves in the disturbance of the earth's magnetic field, and the glows of the auroral light. The frequency of both auroras and magnetic storms, and the mean annual magnetic ranges, show a close correlation with the 11-year sunspot cycle, and both show a recurrence tendency after 27-day intervals, corresponding to the mean solar rotation period.

When we come, however, to the consideration of individual correspondences, the position is not so clear. There are cases where large sunspots cross the disk without any obviously corresponding magnetic disturbance, and conversely, magnetic disturbances occur when there are no spots on the sun. It should be remembered that sunspots are not the only manifestation of solar activity, and magnetic disturbances may be associated with the presence of faculæ, bright or dark flocculi, and eruptions on the disk, which, at the limb, would be seen as prominences. In the case of magnetic disturbances which are apparently associated with individual spots, statistical investigations show that the magnetic disturbance may occur from 1–2 days before to 3–4 days after the central meridian passage of the spot, corresponding to mean corpuscular velocities of 1,100–270 miles per second.

There is good ground for believing that the recent auroras and accompanying magnetic disturbances were due to the activity of a region of the sun centred in approximately lat. 10° S., long. 200°. In this area, the centre of an enormous spot group, extending over 8° in latitude and 16° in longitude, crossed the sun's central meridian within 4° of the centre of the disk at approximately midnight of January 30–31. It was therefore in a most effective position for a roughly radial stream of corpuscles to be intercepted by the earth, and the magnetic disturbance and aurora of February 3 must be attributed to it. The same region crossed the central meridian on January 3 and February 26, in each case showing a spot of moderate size, the times of central meridian passage being Jan. 3d. 9h. and Feb. 26d. 18h. respectively, and it is reasonable to suppose that the phenomena of January 7 and March 2 were associated with this area. The aurora and magnetic disturbance of March 1 were probably not associated with this area, but with a small group of spots in lat. 11° S., long. 228°, which crossed the central meridian on Feb. 25d. 0h. If these inferences are correct, the time intervals between the central meridian passages of the spots and the respective auroras, and the deduced corpuscular velocities are as follows :

Date of Aurora.	Time Interval.	Corpuscular Velocity.
Jan. 7.	4d. 10h.	250 miles per sec.
Feb. 3	4d. 19h.	220 ,, ,, ,,
Mar 1.	4d. 22h.	217 ,, ,, ,,
Mar. 2.	4d. 0h.	280 ,, ,, ,,

On February 25 there was an extensive belt of spot groups stretching almost across the disk in the northern hemisphere of the sun, but as there was no corresponding sustained magnetic disturbance, these groups appear to have been magnetically comparatively inactive, probably on account of their distance from the centre of the disk, which averaged about 20°. A large naked-eye spot in lat. 9° N. crossed the central meridian on March 2d. 0h., but it is unlikely that this was associated with the aurora on that day or the previous one, both on account of the lack of the requisite time interval, and because, owing to the backward tilt of the sun's axis, it was 16° from the centre of the disk, where it would be less effective. It may, however, have been responsible for a moderate magnetic disturbance on March 5.

Mr. Craig suggests that the aurora of October 16, 1936, may belong to the same series as the recent displays, but this seems unlikely, as it would involve a mean interval of 27·5 days, corresponding to the solar rotation period in latitude 20°, whereas the spots involved in the recent cases had a latitude of 10°, with a rotation period of 27·05 days. A spot of appreciable size in lat. 12° S., long. 225° crossed the central meridian on October 11·8, and may have been responsible for the aurora and magnetic storm of October 16. As this position is very nearly the same as that of the group which has been suggested above as probably responsible for the display of March 1, it would appear that these two occurrences may be considered as belonging to a separate series different from that of the displays of January 7, February 3 and March 2. This case, however, illustrates the difficulty of assigning individual correspondence between solar and terrestrial phenomena, for on October 12 a sporadic group of small spots crossed the central meridian in lat. 18° N., which, owing to the forward tilt of the sun's axis at that time, was only 12° from the centre of the disk, and therefore in a more favourable position to produce terrestrial effects than the southern spot, the distance of which from the centre was 18°.

With the approach to the time of sunspot maximum, conditions for the production of the aurora are likely to be frequent during the next two years, but owing to the decreasing hours of darkness, conditions for observing the displays will not be favourable until next autumn or winter, when it is to be expected many displays may be seen.

The Development Commission

THE twenty-sixth report* of the Development Commissioners, covering the year ended March 31, 1936, reviews the expenditure from the Development Fund on agricultural and rural economy, fisheries, the construction and improvement of harbours and on the acquisition of land for road improvements. Advances recommended from the Fund amounted to £555,201 on agricultural and rural industries and £85,925 on fisheries as against £402,859 and £88,109, respectively, in 1934–35. For the maintenance of agricultural research, advisory services for farmers, experiments on field crops and livestock and the provision of buildings and equipment £421,762 was advanced as against £361,691 in 1934–35. Of this, £285,984 was advanced to the Ministry of Agriculture and Fisheries, £67,101 to the Department of Agriculture of Scotland and £16,982 to the Agricultural Research Council, in addition to £43,000 to the latter Council for capital expenditure. The advances to the two Agricultural Departments include £198,170 for maintenance grants to Research Institutes in England and Wales and £40,966 for those in Scotland. The total provision recommended during the year for research and advisory activities in agriculture in Great Britain amounted to £369,977, a generous figure in comparison with State assistance to other industries, although even at this figure research expenditure only amounts to about 0·14 per cent of the value of the year's output.

For the first time since 1931 a considerable sum was approved for the erection of new buildings at institutions engaged in research or agricultural education. Grants have been approved for this purpose to the Studley College for Women, the Royal Agricultural College, Cirencester, the University College of North Wales, Bangor, the Midland Agricultural College, the Avoncroft Agricultural College, and the Royal (Dick) Veterinary College, Edinburgh. Assistance given to rural industries has three principal aims : the provision of technical advice for craftsmen by the Rural Industries Bureaux ; the interest of local residents, usually members of Rural Community Councils, in the welfare of village craftsmen; and the employment by Rural Community Councils of a Rural Industries Organizer. Details of the work of the Rural Community Councils and of the Rural Industries Bureaux are included in the report.

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* Development Commission. Twenty-sixth Report of the Development Commissioners, being for the Year ended the 31st March 1936. Pp. 184. (London: H.M. Stationery Office, 1937.) 3s. net.

Although the Commissioners are not directly concerned with the provision of work for the unemployed, assistance has been given to two admirable schemes relating to land cultivation—the Allotment Scheme of the Society of Friends and Central Allotments Committee and the Land Settlement Association. Stress is laid upon the experimental character of these schemes for converting the unemployed industrial worker into an independent landholder and on the need for organization in this field if our natural resources are to be used to full advantage. Assistance has also been given to the Agricultural Camps Committee.

While the agricultural section of the report is concerned only with administrative matters, the section on fisheries includes an account of work reviewed by the Commissioners' advisory committee on fishery research as well as progress reports submitted by the directors of institutions receiving grants in aid of fishery investigations. The difficult situation at Armstrong College, Newcastle-upon-Tyne and the Dove Marine Laboratory, Cullercoats, since the financial emergency of 1931, due to the fact that the staff were partly engaged in 'directed' research on the local herring fishery and on pollution in the Tyne for the Ministry of Agriculture and Fisheries, for which the Minister's vote was drastically reduced, has been met by initiating a new grant period of five years in the form of a single block grant towards the total maintenance expenses of the Laboratory. Tribute is paid to Prof. Hobson's determination and ability in overcoming the difficulties and re-organizing research and to the value of the Laboratory in supplementing the fishery researches of the Ministry. Continued support of Prof. A. C. Hardy's investigations at University College, Hull, on the influence of plankton on fisheries is recommended; and reference is made to the development at Conway through investigations on shellfish of a cleansing process for mussels which eliminates the danger of carrying typhoid, and this process has been adapted to the purification of oysters. Other investigations in this field are concerned with the reliability of bacteriological methods for the routine testing of shellfish for sale, and grants have also been given for the development of freshwater fisheries, including investigations of salmon and sea-trout.

Grants for fishery research are made from the Development Fund either to the Fishery Department for 'directed' researches on problems immediately affecting the economic development and exploitation of fisheries, or to universities, colleges and marine laboratories for 'free' research, with the object of increasing our knowledge of the animal and plant life of the sea in relation to its whole environment. In the first category fall the important investigations on the difficult problems connected with herring fisheries, which differ for England and for Scotland. In Scottish waters the Fishery Board's investigations have shown that the shoaling of the herring on the drift-net grounds in early summer is associated with the search by groups of fish from different sources and of different types for the rich food-plankton then present in northern waters. In the great autumn fishery off Yarmouth and Lowestoft, however, the fish are on a migration preliminary to spawning and the shoals are not feeding. The investigations of the English Fishery Department have led to the issue of much more accurate forecasts of this autumn fishery. Other directed investigations have been concerned with inshore fisheries such as the population of small plaice in sand bays on the east coast of Scotland with a view to determining how far the stock needs protection by regulation of fishing. Diseases of freshwater fish, such as furunculosis, have also been studied, while among the 'free' researches assisted may be mentioned Dr. H. B. Moore's investigations on animal and plant life of the seashore, the cause of the dying out of eel-grass or grass-wrack and on artificial hatching and stocking of salmon fisheries.

Enough has been said, however, to indicate the wide range and importance of the Development Commissioners' contribution to scientific research. Equally it would seem that the Development Fund contains possibilities of co-ordinating the national effort in research, which might well be applied in very much wider fields.

The Chemist in Industry

THE Society of Chemical Industry concerns itself very largely with the practical application of chemistry, and in the main operates through its subsidiary groups, of which there are four, and its numerous sections in Great Britain, in the Dominions and in the United States. Once a year, at the annual general meeting, the Society as a whole meets at the headquarters of one of the sections and like the British Association it visits the Dominions and the United States from time to time. This year the annual meeting will be held at Harrogate, though Leeds is the headquarters of the Yorkshire Section, and next year the meeting will be in Canada. At these meetings the business of the Society is dealt with, addresses are delivered, a few papers are read, works and places of interest are visited, but the social atmosphere predominates.

About a year ago, however, the Council came to the conclusion that some matters of general interest to chemists and the chemical industry as a whole could only be dealt with at conferences specially convened, and accordingly it appointed a strong committee with Dr. Wm. Cullen as convenor to give effect to its decisions. The Manchester Section was anxious that the first conference should be held there, and no more appropriate place could have been chosen.

As the subject chosen for the symposium held on April 2, namely, "The Chemist in Industry", was somewhat wide, and indeed vague, it was decided that there should be two sessions, one in the afternoon and the other in the evening, at which sub-divisions of the general subject should be discussed. The subject of the afternoon session was the "Induction and Functions of the Chemist", and that of the evening session, "His Influence and Reward".

Eight short papers were prepared and all were published in advance of the meeting in *Chemistry and Industry*. In addition, reprints were available at the meeting. Two *rapporteurs* were appointed to summarize the papers, namely, Dr. R. H. Pickard, director of the Shirley Institute, for the afternoon session, and Mr. C. J. T. Cronshaw, managing director of the British Dyestuffs Corporation, for the evening session. In the unavoidable absence of Lord Leverhulme, president of the Society, Mr. W. A. S. Calder, a past president, presided over the conference.

By adopting this arrangement, practically the whole of the time available was devoted to the discussions, and it may be said that the speeches on the whole were excellent. The immediate point under discussion was seldom lost sight of, and so far as the first session is concerned, it looks as if the Committee would be in a position to come to definite conclusions which it is hoped will be helpful to the universities and colleges on one hand and industry on the other. As might have been expected, the discussions centring around the subject for the evening session were less helpful, but inspiring nevertheless.

No attempt will be made to summarize these discussions here. In due course they will no doubt be published, together with the conclusions of the Committee, but it is quite clear that the symposium has justified itself, and others will no doubt follow in due course.

The following is a list of the writers of the papers, all of whom were requested to confine themselves, so far as possible, to their own experiences: *Afternoon Session*: Dr. J. J. Fox (Government Chemist); Prof. J. C. Philip (Imperial College of Science and Technology); Mr. F. Scholefield (College of Technology, Manchester); Mr. C. M. Whittaker (Courtaulds, Ltd.). *Evening Session*: Mr. H. Ballantyne (Lever Bros., Ltd.); Mr. G. E. Collins (Shirley Institute); Dr. A. E. Dunstan (Anglo-Iranian Oil Co., Ltd.); Mr. J. Rogers (Imperial Chemical Industries, Ltd.).

It will be observed that the writers of these papers covered a very wide field, from both the academic and industrial points of view, and though the whole field could not be covered, this defect was remedied largely by the discussion in which twenty-five persons, all men of standing, took part.

It is just as impossible to summarize the papers as the discussion, but one or two points have emerged:

(a) For certain classes of work, graduate chemists do not appear to be sufficiently trained in manipulative technique, possibly through the attempt to put too much into the curriculum.

(b) There has been too little contact between industry and the teaching institutions generally.

(c) There is a large demand for chemists whose training from the start is along definitely technical, as opposed to purely academic, lines.

(d) For success in other walks of life, such as administration, business, salesmanship, and even finance, chemical training forms just as good a background as any other.

Probably the most striking statement made during the symposium was by Mr. C. M. Whittaker, who said: "In my experience there are just as many fools walking about with high academic qualifications as there are able men walking about with lesser academic qualifications, but of greater ability and deserving of greater financial reward."

In this connexion the views of many of the speakers, which seemed to be endorsed by the very large audiences present, were that the avenues to inclusion in the profession should not be closed in the slightest degree to those who had the desire to better themselves.

Forestry in the Gold Coast

THE annual report of the Forestry Department of the Gold Coast for the year 1935–36 (Accra: Govt. Printing Dept., 1936) by Mr. R. C. Marshall, conservator of forests, is written in non-technical language and gives evidence of progress in the introduction of a sound forest administration.

Cocoa forms one of the staple exports of the Colony, and the protection of a certain area of forests in the right situations is indispensable to this industry. It has been established by the research work carried out under the Cocoa Research Scheme at the Imperial College of Tropical Agriculture in Trinidad that an even moisture status is one of the characteristics of a good cocoa soil, and environmental studies have demonstrated that the moisture status of both soil and atmosphere have important bearings on crop productivity. The chief function of shade trees in cocoa cultivation is to provide a buffer against fluctuations in environmental conditions. This lesson was learnt many years ago in Madras and Ceylon in connexion with coffee and the tea gardens and other forms of planting cultivations. The clearing of large blocks of forest and the hacking which took place in those remaining in the neighbourhood led to serious erosion, desiccation of the soil and so forth; this led to heavy losses and considerable areas going out of cultivation. If the conditions in the Gold Coast are to be adequately preserved, where such preservation is not altogether too late, "the requirements of this industry need to be considered from time to time by the Forest Agricultural Departments in collaboration with the Administration".

Mr. Marshall considers three types of protection forest reserves as required in the Colony: (a) headwater reserves, (b) barrier reserves, and (c) shelterbelt reserves. It is said that reservation has been so far concentrated on (a) the protection of headwaters and (b) the barrier reserves situated between the edge of the closed forest zone where it marches with the drier open (savannah) forest; the idea being to stay the encroachment of dry conditions. During the year, the chief attention has been paid to what are termed (c) the shelterbelt reserves. These latter are to be oriented so far as possible at right angles to the prevailing wind and spaced at intervals through the countryside: their function is to protect agricultural cultivation, especially cocoa; to assist in maintaining the necessary environment of a closed forest climate, and to afford additional lines of defence against the encroachment of open-forest conditions. How far this aspiration will be possible in view of the considerable area of forest which has already been swept away or reduced to a condition in which it will prove useless for the purpose in view it is impossible as yet to say. But this matter has not been taken up any too soon.

It is apparent from the report that the Conservator has been able to increase considerably his gazetted staff (from 12 in 1934 to 18 in 1936) and is making progress in an even more desirable matter—that is, in "bringing the Forest Department district organization into line with the political district organization which itself follows tribal distribution as far as possible. At present forest districts consist of two to three political districts".

With a strengthened staff, the Conservator rightly decided that the first work to deal with was the selection, demarcation and cultivation of the forest reserves still demanding constitution, and a considerable amount of work in this connexion was undertaken during the year.

With the sub-division of the country into definit forest districts, each to be in charge of an assistan conservator of forests, the management of the fores districts will receive more attention and the advanc in the introduction of working plans will prov feasible, when sufficient stock mapping of the growin stock in the forests has been accomplished.

Fuel will be required so far as can be foreseen i increasing amounts in the Colony, both for domest consumption and for power in connexion with wate work schemes. The exotics *Cassia siamea* and th Indian neem are both giving satisfactory results, e elsewhere in West Africa. Good fuel wood is succes fully produced in seven years or less. The total are of fuel plantations amounts to 1,000 acres, th greatest area at Achimota, where the highly successf School is situated, within a short distance of Accr the capital on the Coast. Other plantations of th same type exist at Cape Coast, Kumasi and oth centres. Assistance is also given by the Departmen in connexion with water-works schemes. The su tained supply of fuel to the mines is proving a mor difficult matter.

The report has some interesting remarks on th subject of the prevalent practice of firing the sc called open or savannah forest lands and shiftin cultivation. It is the most informative forest repor on the Colony which has appeared for some time.

Oak-galls in Theophrastus

PROF. GUSTAV SENN, of Basle, has published a short but interesting note on this subject (*Verh. Schweiz. Naturforschende Gesellschaft*, Solothurn, p. 372; 1936). Theophrastus mentions, in his "Historia Plantarum", no less than ten species of oak-galls. Some are well known and unmistakable, such as the common Turkey or Aleppo gall; and one, or the insect which produces it, *Andricus Theophrasteus*, bears the old Greek's name. But no one seems ever to have studied the Theophrastean account as a whole, and even Sir Arthur Hort made no attempt to identify the several species. Prof. Senn finds little difficulty in doing so, and the result is a remarkable testimony to Theophrastus's diagnostic skill.

The 'little gall' with which the account begins (H.P., 3, 7, 4) is the valuable Aleppo gall, or 'ink marble', formed by *Cynips tinctoria*. The common 'black resinous' gall is the Bassorah gall, made by *C. insana*; it is the only one with a coat of resin. A scarce one, very hard in texture, mulberry-like in form, is identified by Prof. Senn as the gall of *C. culiciformis*. Another, phalliform in shape, growing into something like a bull's head at one end and with a hard interior like an olive-stone, is identified as the gall of *C. Quercus-Tozæ*. Fluffy balls, serving for lamp-wicks, are the woolly or cotton galls of *Andricus Theophrasteus*, akin I suppose to *A. ramuli*; and other hairy or bristly galls, covered with sweet honey-drops in spring, but quite useless, are those of *A. lucidus*. Certain stalkless galls, looking like a cluster of leaf-scales and growing in the axil of a leaf or twig, are the hop galls or artichoke galls of *A. fecundator*. The rare, elongated, close-textured foliaceous balls are the galls of *A. multiplicatus*; and, last of this catalogue, the clear juicy globules, grow ing on the midrib of a leaf, are the well-know currant galls of *Neuroterus baccarum*.

In another passage (H.P., 3, 3, 8), Theophrast mentions, with the same brief accuracy, the gall which the tanner uses and the black ones whic serve for the dyeing of wool; these being, onc again, the Aleppo galls of *C. tinctoria* and the Bassora galls of *C. insana*. A little gall, something like th Aleppo gall but smoother, and of no commerci value, is in all probability the oak-marble, or oa apple, of *C. Kollari*. Connold, in his "British Oa galls" says of it: "*C. tinctoria* bears a very clo resemblance to *C. Kollari*, and many specimens o the latter might easily be mistaken for the Alepp gall"; but the latter, he adds, yields 40 per cent tannin, while *C. Kollari* gives only 17 per cent. Th last identification may be a little doubtful, but th other nine oak-galls mentioned and characterize in a word or two by Theophrastus are easily an safely identified. The fact is that, great philosoph biologist as Aristotle was, Theophrastus was f ahead of him as an observer and recorder of speci from a modern botanist's point of view.

Sir Thomas Browne, in his notes on the "Natur History of Norfolk" (ed. T. Southwell, 1902 found on the oak just about as many galls a Theophrastus knew, and characterized them wit equal skill. His "*Juli pilulæ*, little balls on th flower catkins", are a form of the currant gall his *excrementum lanatum* is a woolly gall; an his *capitula squamea jaceæ æmula*, "little scaly hea like the heads of knapweed", are without doubt o hop or artichoke galls.

D. W. T.

Science News a Century Ago

Heathcoat's Steam Plough

IN the *Gentleman's Magazine* of 1837, under the date April 18, it is said: "A deputation named by the Highland and Agricultural Society of Scotland met at Red Moss, near Bolton, according to appointment, to inspect the steam plough invented by Mr. Heathcoat, M.P. for Tiverton, and working under the direction of Mr. Parkes, Engineer. The deputation was composed of the Marquess of Tweeddale, Vice-President, Sir John S. Forbes, Mr. Oliphant, M.P., and other Members, with Mr. Gordon the Secretary. The machine has been made by Mr. Heathcoat, to operate in the first instance on moss, in which it is very efficient. The engine is of 15 horse-power, and the plough is attached by a band of the width of about two inches. The length of the furrow in the ground operated upon was 304 yards, breadth 18 inches and depth 9 inches. The furrows were cut on an average in four minutes and a half, which is equal to about half an acre turned over by the hour. The deputation, and many other gentlemen present, from different parts of the United Kingdom, expressed themselves highly gratified by the efficiency of the machinery."

John Heathcoat (1783–1861) was famous as the inventor of lace-making machines, and had a mill at Loughborough which was destroyed during the Luddite riots of 1816. After this, he removed to Devonshire and in 1832–59 represented Tiverton in Parliament. His plough was patented in 1832.

Natural History Collections from New Zealand

IN *The Times* of April 19, 1837, is the following note from a correspondent: "It will, perhaps, not be uninteresting to your readers who are lovers of natural history to know that the bark *Guiana* arrived this morning from Van Dieman's Land, on board which is a young naturalist (whose name I did not learn) who has been out to Van Dieman's Land and New Zealand, collecting in the various branches of natural history. I was favoured with a sight of his splendid collection of insects, shells and bird skins; but more particularly with three fine living opossums, one of which is white, the only one which has left its native woods. As they are to be deposited for a short time in the Surrey Zoological Gardens, previous to their removal to the country, this paragraph in your valuable and widely circulated paper will give many naturalists an opportunity of seeing them previous to their removal. I also saw a box containing from 400 to 500 roots, of the curious and splendid terrestrial orchidiæ of the above countries, many of which are new and will be a grand acquisition to our gardens; they are valued at the sum of £700."

David Douglas's Observations in America

WHEN David Douglas (1798–1834), a Scottish botanical collector, was killed in the Sandwich slands, he left various manuscripts which ultimately ame into the hands of Major (afterwards General Sir) Edward Sabine (1788–1883), brother of Joseph Sabine (1770–1837), secretary of the Horticultural Society, to whom Douglas had been recommended by Sir W. J. Hooker. The manuscripts consisted of several volumes of lunar, chronometrical, magnetic, meteorological and geographical observations, and these formed the subject of a paper entitled "Observations taken on the Western Coast of North America by the late Mr. Douglas" read to the Royal Society on April 20, 1837, by Major Sabine.

Douglas began life as a gardener, and was sent to the United States as a collector first in 1824. After his return home, to make himself fit to render service to geographical and physical science, he began to study the principles of science and the methods of observations, and at one time worked at these subjects for eighteen hours a day. The observations he left in manuscript included among other things observations of the magnetic dip and intensity at various stations in North America and the Sandwich Islands.

Comparative Anatomy of the Brain

AT a meeting of the Royal Institution on April 21, 1837, Mr. Solly, of St. Thomas's Hospital, gave a lecture on the comparative anatomy of the nervous system and especially of the brain, and illustrated his views by reference to a number of well-executed drawings. Avoiding all minute details, he confined himself to the leading parts of his subject, of which he conveyed a very clear idea to his audience. He commenced with some remarks on neurine and its two kinds—the pulpy and the fibrous—whose offices he explained, and then proceeded to trace the nervous system, from the state in which it exists in the lowest kingdom of Nature in which its existence has been demonstrated, up to that in which it is found in man. In doing so he explained the most interesting points in the nervous system throughout the various divisions of the animal kingdom, and how the different senses are more or less developed according to the wants of each individual, as for instance, the sense of sight in birds. He also demonstrated most clearly that the simplest forms in which it has been possible to detect the nervous system are accurate types of its more complicated forms, and ended by briefly explaining the anatomy of the human brain. (*London Medical Gazette*, April 29, 1837.)

Conditions in Germany

THE following extract is taken from an editorial article in the issue of the *British Annals of Medicine* for April 21, 1837:

"Germany at present is in a very anomalous position. Her people are the best scholars in Europe, but they are without political freedom; they know nothing practically of representative self-government. The descendants of Arminius remain passively obedient to the princes under whose feet they happen to be born; and if in the different states the burthen bears unequally, this depends in no way on the will of the people, but on the accidental temper of the government. Government—paternal government—is carried to a revolting extent. Absolute ministers dictate to the people—a full-grown adult people—what they shall read. Only a certain number of foreign newspapers can enter Prussia, the press is submitted to censorship; an Austrian student could under no pretext obtain permission to visit France or England. Schönlein, Oken, Arnold—names which pronounced before a German student make his countenance light up with recollections of glowing thoughts and revelations of Nature—the most illustrious men have been driven, for liberal opinions, from their natural spheres—from the unnatural country, of which they were the glory, and are the shame".

University Events

Cambridge.—At Trinity College, the electors to the Wyse studentship in social anthropology have awarded a studentship of £300 for three years to Gregory Bateson, of St. John's College.

It is announced by the Philosophical Society that the adjudicators for the Hopkins Prize for the period 1930–33 have awarded the prize to Prof. P. M. S. Blackett, for researches on cosmic radiation.

St. Andrews.—At the graduation ceremonial to be held on June 30, the honorary degree of LL.D. is to be conferred on the following, among others: Dr. W. O. Kermack, Royal College of Physicians, Edinburgh; Dr. Angus MacGillivray, ophthalmic surgeon, Dundee; and Sir Arthur Rose, chairman of the Carnegie Trust for the Universities of Scotland.

Societies and Academies

Paris

Academy of Sciences, March 8 (*C.R.*, 204, 733–828).

Marcel Godchot and Mlle. Germaine Cauquil: The molecular transpositions obtained in the dehydration of 4-methylcyclohexylisopropylpinacone.

N. Gunther: Nuclei of the Fourier type.

Lucien Malavard and Joseph Pérès: The corrections for the walls in the case of a tunnel of elliptical section.

Albert Métral and François Raymond: A method of measuring the resistance exercised by the air on a railway train.

Jean Dufay: Nitrogen lines in the spectra of comets.

Jean Roubaud-Valette: The equations of the photon.

René Dugas: Quantum mechanics and the last multiplier according to Jacobi.

Ernest Baumgardt: The ultra-sound yield of piezo-electric quartz.

Nicolas Kurti, Paul Lainé and Franz Simon: Experiments on the thermodynamic scale of temperature below 1° K. Results of experiments by the method of adiabatic demagnetization using the large Bellevue magnet.

Douchan Avsec and Michel Luntz: Some new forms of electro-convective vortices.

M. Haïssinsky and Mme. H. Emmanuel-Zavizziano: The preparation of thin layers of titanium by the electrolytic method. Details of a method of preparing thin films of metallic titanium on a lead cathode, of a thickness about 0·1–0·2 mgm./cm.^{2}.

Pierre Mesnage: The molecular emission spectra of some metallic salts. Description of results obtained with manganese chloride, ferrous bromide and ferrous iodide.

Mlle. Hoàng thi nga: The photo-voltaic effects of the naphthalene diamines.

Marcel Chatelet: The partial precipitation of cobalt by ammonia in excess and the formation of cobaltammine ions.

J. Bénard and Georges Chaudron: The preparation of ferrites by the substitution of ferrous ions in magnetite.

René Delaplace: A method of analysis of saturated and unsaturated gaseous hydrocarbons under very low pressures. Application of the method of fractional distillation of the liquid gases under low pressures, with subsequent separation of the saturated and unsaturated gases by chemical means.

Jens Boe and Mlle. Madeleine Gex: Modifications of the spectra of aqueous solutions of phenylpyruvic acid as a function of the pH and of the time.

Albert Portevin and Pierre Chevenard: The cooling transformations of steels.

Marcel Prettre: The heterogeneous combustion of mixtures of carbon monoxide and oxygen on a vitreous surface.

Jean Baron and Paul Laffitte: The influence of nitrogen on the inflammation of diethylether. The results obtained for the variations of the temperature of inflammation of mixtures of ether, oxygen and nitrogen produced by varying the proportion of nitrogen present are in agreement with the theory of chain reactions.

Christian Aall: The influence of the impurities silica, alumina and magnesia on the melting point of calcium carbide. The experimental results are given graphically: the curves showing the lowering of the melting point have not the same form.

Mlle. Denise Hibert and Clément Duval: Cobaltic chloride. Of various methods available, the best consists in treating a suspension of cobaltic oxide in ether with dry gaseous hydrochloric acid, afterwards removing the ether and excess of acid with a current of dry air.

René Sutra: The formation of acetone derivatives of the mercaptals.

Mlle. Simonne Caillère: A special mode of alteration of anorthite and a calcium variety of thomsonite.

Marcel Gigout: The Palæozoic series of Adrar n'Dgout (Marrakech Atlas).

Edmond Saurin: The Trias of the Phu-Tinh-Gia sheet (North Annam).

Léonce Joleaud: The very recent morphological evolution of a group of archaic Ungulata, the Damans.

Frédéric Marie Bergounioux: The faunal relations between the fossil Chelonians of Spain and France.

Pierre Dangeard: The zones of marine Algæ of western Morocco.

Paul De Graeve: The evolution of puric nitrogen during germination.

Henri Gaussen: Young forms and future evolution.

Mlle. Fernande Flous: The transmission o characters in the hybrids of firs.

Constantin Dawydoff: A new metanemertean belonging to a purely marine group, from the Grand Lac of Cambodia.

Léon Binet and M. V. Strumza: Variations o the resistance to anoxhæmia according to the degre of narcosis.

Léon Képinov: Synergy of adrenalin and of th pituitary hormone. The mechanism of the glycogenolytic action of adrenalin.

André Paillot: The polyembryonic developmen of *Amicroplus collaris*, a parasite of the larvæ o *Euxoa segetum*.

Mme. Véra Dantchakoff: The effects of sexua determinism in a feminized male.

André Dognon, Wladislas Kopaczewski an Stanislas Marozewski: The absorption of ultraviolet rays by the serum and anaphylaxy.

Mme. Raymonde Duval and Jean Marie L Goff: The detection of small quantities of cobal in human urine. The cobalt is concentrated b electrolysis and detected by the α-nitroso-β-naphth reagent.

Nicolas Bezssonoff and Mlle. Mélanie Woloszyn: The duality of the oxidized forms and the polarization of vitamin C shown by two reversible reactions with phosphomolybdic acid.

Léopold Negre and Jean Bretey: The anti-tuberculous immunization of the ape by injection of tubercle bacilli from smooth colonies.

Fernand Arloing, Albert Morel and André Josserand: New researches on the action towards cancers of the soluble organo-metallic complex compounds of ascorbic and dehydrascorbic acids, where the iron is replaced by copper or titanium.

Jean Nageotte: Remarks on the surgical repair of losses of traumatic substances of the peripheral nerves.

Amsterdam

Royal Academy (*Proc.*, 40, No. 2, 1937).

F. K. T. van Iterson: Separation of substances by flotation. Mathematical treatment which shows that the greater the angle of contact the better the flotability of a substance.

J. A. Schouten: The differential geometry of groups of contact transformations (1). Doubly homogeneous treatment of contact transformations.

F. M. Jaeger: The relative and absolute spatial configurations of isomorphous optically active complex salts (2). Comparison of the tri-diamino salts of cobalt, rhodium and chromium.

F. M. Jaeger and L. Bijkerk: Investigations on the complex salts of the racemic and optically active cyclohexanediamines with trivalent cobalt and rhodium (2). The complex tricyclohexanediamine rhodium salts.

A. H. Blaauw and Miss H. G. Kronenberg: The epoque of the flower formation of the hyacinth and Darwin tulip in Holland and in southern France.

C. S. Meijer: Products of Whittaker functions.

J. Popken: An arithmetic property of certain integral functions.

J. A. Barrau: Self-projective point-casts in space.

A. L. T. Moesveld: Fundamentally wrong methods for establishing the non-existence of polymorphy.

J. H. C. Merckel: Relations between the melting points, boiling points and critical magnitudes and the number of carbon atoms in homologous series.

C. H. Andreas: Plant growth hormone and growth of the aerial roots of *Vitis gongyloides*.

F. Florschütz: Palæobotanical investigation in connexion with a supposed human settlement on the plateau of the Belgian peat moor (Houtes Fagnes).

H. D. M. Burck: Fauna of the Bartonian in Eastern Holland.

G. H. Voorwijk: Foraminifera from the upper Cretaceous of Havana, Cuba.

A. E. Walker: Experimental anatomical studies of the topical localization within the thalamus of the chimpanzee.

W. J. Roberts: Detection of gold in the brain and in the fœtuses of animals injected with sanocrysin.

F. Krüger: "Cellophane" as a substitute for kymograph paper.

A. de Buck: Some observations on the salivary and stomach secretion of *Anopheles* and other mosquitoes.

C. Visser: A certain class of conformal mappings.

Cracow

Polish Academy of Science and Letters,
January 11.

St. Loria and J. Klinger: The diffraction of electrons of average velocity.

Th. Banachiewicz: The calculation of determinants with the aid of Cracovians.

L. Chrobak and J. Chojnacki: The striped spots of Laue radiograms. The lines on the spots of the Laue photograms are due to the characteristic spectrum emitted by the anticathode.

K. Dziewonski, W. Gumulka and J. Moszew: New studies on compounds of the type of 2-aryl-4-amino or 4-hydroxyquinolines.

J. Lilpop: New plants from the Permo-Carboniferous in Poland.

Mme. J. Janiszewska: The third and fourth stage of the development of the larvæ of *Contracæcum aduncum* of the intestine of the flounder.

L. W. Wisniewski: The evolutive cycle and biology of *Parafasciolopsis fasciolæmorpha*.

M. Gatty-Kostyal, Mme. M. Paszkowska and Z. Zakrzewski: The influence of certain plant substances on the growth of grafted tumours. The aqueous extract of the tissues of a representative of the family Polyporaceæ, of species not yet exactly defined, has an intense inhibitive action of grafts of sarcoma on mice and rats.

H. Grossfeld: Metabolism and amœboid movement. The conditions producing visible amœboid movements in the Metazoa.

Moscow

Academy of Sciences, *C.R.*, 4, No. 9, 1936.

M. Krein: Differential oscillating operators.

P. Kalantarov: Selection of a system of units for measuring electromagnetic and mechanical values.

M. Kondakova and M. Kacnelson: 1-Ethyl-2-methyl-valeric acid.

M. Kacnelson and B. Dubinin: Researches in the series of normal acids with long chain closed by a cyclohexyl or a cyclopentyl (1). Cyclohexylvaleric acid and its derivatives.

M. Kacnelson and M. Kabačnik: Some derivatives of lupinine.

M. Kacnelson and J. L. Goldfarb: Synthesis of the furanic isomer of cocaine (methyl ester of 2-furoyleggonine).

M. P. Gerčuk and M. Kacnelson: Preparation of anhydrides of naphthenic acids.

G. Čelincev and E. Osetrova: Amide condensations. Preparation of benzoylacetone by condensation of N_1N-diphenylacetamide with acetophenone.

Ch. S. Koštojanc and T. I. Bekbulatov: Comparative study of the importance of respiratory rhythm for the condition of the central nervous system.

A. A. Isakova: The problem of the nature of the action of bacteriorhizal micro-organisms on plants. The action of the micro-organisms is of the hormonal type.

T. I. Privolnev: Respiratory rhythm during the segmentation of eggs of *Lampetra fluviatilis*.

G. A. Schmidt: (1) Development of the external gills from the ectoderm in Anura and from the entoderm in *Triton*. (2) Differences in the induction abilities of the organizing centre in Urodela and Anura.

Forthcoming Events

Monday, April 19

Royal Geographical Society, at 8.30.—Captain A. Dunlop: "The Dadessa Valley".

Tuesday, April 20

Institution of Civil Engineers, at 6.—Prof. S. M. Dixon, G. Fitzgibbon and M. A. Hogan: "The Flow of the River Severn, 1921–1936".

Thursday, April 22

Institution of Electrical Engineers, at 6.—Prof. J. Chadwick, F.R.S.: "The Elementary Particles of Matter" (Kelvin Lecture).

Friday, April 23

Royal Institution, at 9.—Prof. H. Mark: "The Synthesis of Large Molecules".

International Association for Testing Materials, April 19–24.—Second International Congress to be held in London.

Sir William Bragg: President.

Faraday Society, April 22–24.—General discussion on "The Properties and Functions of Membranes, Natural and Artificial" to be held in University College, Gower Street, London, W.C.1.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Lecturer in Chemistry in the Woolwich Polytechnic, London, S.E.18—The Secretary (April 20).

Assistants (grade II) at the Royal Aircraft Establishment, South Farnborough, Hants.—The Chief Superintendent (April 28) (quote Ref. 342/B).

Assistant Investigator (roof control and haulage) for the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (April 23).

Lecturer in Mathematics and Elementary Physics in the Polytechnic, Regent Street, London, W.1—The Director of Education (April 26).

Lecturer in Biology in the Polytechnic, Regent Street, London, W.1—The Director of Education (April 26).

Research Chemist for the Bone Research and Development Association, Ltd.—Prof. W. A. Bone (April 26).

Assistant Investigator for the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, London, S.W.1 (April 27).

Scientific Officers and Assistants (grades I, II and III) in the Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1—The Chief Superintendent (April 28).

Assistant (grade II, aeronautical materials) at the Royal Airship Works, Cardington, Bedford—The Superintendent (April 30) (quote Ref. B. 352).

Junior Scientific Officer in the Headquarters Office of the Department of Scientific Research, 16 Queen Street, S.W.1—The Establishment Officer (April 30) (quote J. 37/9).

Three Technical Officers (electrical engineering), One Assistant (grade II, physics or electrical engineering), and Two Assistants (grade III, physics or electrical engineering), in the Signals Experimental Establishment, Woolwich Common, S.E.18 (April 30).

Professor of Organic Chemistry in the Egyptian University, Abbassia, Cairo—The Dean of the Faculty of Science (April 30).

Assistant Veterinary Officer for the Essex County Council—The Clerk of the Council, County Hall, Chelmsford (May 1).

Lecturer in Mechanical Engineering in the Derby Technical College—The Clerk to the Governors (May 10).

Junior Engineer at the E.M.I. Laboratories—Electric and Musical Industries, Ltd., Employment Department, Hayes, Middlesex.

Temporary Assistant Engineers, Engineering Assistants, and Junior Engineering Assistants for trunk road survey of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1.

Official Publications Received

Great Britain and Ireland

The Teaching of Science in the Education of the Citizen. By Prof. Lancelot Hogben. Pp. 16. (London: National Union of Teachers.) [233

The Second Conference on Mechanized Farming, Rhodes House, Oxford, January 5–8, 1937. Report of Discussions. Pp. 37. (Oxford: Institute for Research in Agricultural Engineering.) [243

The Ramblers' Federation Handbook: Official Year-Book of the Ramblers' Federation (Manchester and District) for 1937. Vol. 4. Pp. 81–164+10 plates. (Manchester: E. Royce, 5 Byrom Avenue.) 1*s.* net. [303

The Journal of the Institute of Metals. Vol. 59. Edited by G. Shaw Scott. Pp. 323+22 plates. (London: Institute of Metals.) 31*s.* 6*d.* [313

The Future of our Population? By Dr. C. P. Blacker and D. V. Glass. Pp. 31. (London: Population Investigation Committee.) 6*d.* [313

National Smoke Abatement Society. Proceedings of the Conference held at the Science Museum, South Kensington, October 1936. Pp. 114. (Manchester: National Smoke Abatement Society.) 2*s.* [14

Other Countries

Institut de France: Académie des Sciences. Annuaire pour 1937. Pp. 416. (Paris: Gauthier-Villars.) [253

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 15: Authority of State Executive Agencies over Higher Education. By John H. McNeely. Pp. iii+57. (Washington, D.C.: Government Printing Office.) 10 cents. [253

Report of the President of the Carnegie Institution of Washington for the Year ending October 31, 1936. Pp. 72. (Washington, D.C.: Carnegie Institution.) [253

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 89. The Occurrence of Flints and Extinct Animals in Pluvial Deposits near Clovis, New Mexico. Part 4: Report on Excavation at the Gravel Pit, 1936. By John Lambert Cotter. Pp. 16+7 plates. (Philadelphia: Academy of Natural Sciences.) [303

Smithsonian Miscellaneous Collections. Vol. 95, No. 21: The Dependence of Carbon Dioxide Assimilation in a Higher Plant on Wave Length of Radiation. By W. H. Hoover. (Publication 3406.) Pp. ii+18+3 plates. Vol. 95, No. 23: On the Corrections to be applied to Silver-Disk Pyrheliometry. By C. G. Abbot. (Publication 3409.) Pp. ii+7. (Washington, D.C.: Smithsonian Institution.) [303

Bulletins of Indian Industrial Research. No. 6: The Preparation of Alumina and Sulphur Dioxide from Bauxite-Gypsum Mixtures. By Dr. V. S. Dubey, M. B. Rane and M. Kanakaratnam. Pp. ii+7. (Delhi: Manager of Publications.) 3 annas; 4*d.* [303

Indian Forest Records (New Series). Vol. 2, No. 8: Some New Carabidæ from India. By H. E. Andrewes. Pp. ii+177–180. 4 annas; 5*d.* Vol. 2, No. 9: Immature Stages of Indian Coleoptera (20) (Carabidæ). By J. C. M. Gardner. Pp. ii+181–202+4 plates. 1 rupee; 1*s.* 9*d.* (Delhi: Manager of Publications.) [303

Nyasaland Protectorate: Geological Survey Department. Bulletin No. 5: The Chilwa Series of Southern Nyasaland; a Group of Alkaline and other Intrusive and Extrusive Rocks and Associated Limestones. By Dr. F. Dixey, W. Campbell Smith and C. B. Bisset. Pp. 85+7 plates. (Zomba: Government Printer.) 5*s.* [303

Carnegie Institution of Washington. Year Book No. 35, July 1, 1935–June 30, 1936, with Administrative Reports through December 11, 1936. Pp. xxxiv+424. (Washington, D.C.: Carnegie Institution.) [303

Mémoires de la Société géologique et minéralogique de Bretagne. Tome 3: Contributions à l'étude géologique des Iles de la Manche et du Trégorrois. Pp. 100+5 plates. (Rennes: Institut de Géologie; Jersey: The Museum.) 30 francs; 5*s.* [303

U.S. Department of Agriculture. Circular No. 418: Parasites and Predators of the Mexican Bean Beetle in the United States. By N. F. Howard and B. J. Landis. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents. [303

U.S. Department of Agriculture: Soil Conservation Service. Topsoil: its Preservation. Pp. 24. (Washington, D.C.: Government Printing Office.) 10 cents. [303

University of Minnesota: Agricultural Experiment Station. Technical Bulletin 116: Studies on the Freezing Process in Insects. By R. W. Salt. Pp. 41. (Minneapolis: University of Minnesota.) [303

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 24: Indices generales. Edición oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 732. (La Plata.) [303

U.S. Department of Agriculture. Miscellaneous Publication No. 256: Early Erosion-Control Practices in Virginia. By A. R. Hall. Pp. 31. (Washington, D.C.: Government Printing Office.) 10 cents. [313

Geological Survey of Southern Rhodesia. Provisional Geological Map of Southern Rhodesia. Revised edition. 34 in. × 30 in. (Salisbury: Geological Survey of Southern Rhodesia.) [313

Catalogues, etc.

Catalogue of Important Botanical and Gardening Books (including Floras and Cryptogams). (No. 256.) Pp. 40. (London: Dulau and Co., Ltd.)

The Brown-Firth Research Laboratories. Pp. 72. (Sheffield: Brown-Firth Research Laboratories.)

Médecine et Sciences anciennes. (Bulletin No. 3.) Pp. 16. (Paris: Émile Offenbacher.)

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No. 3521 SATURDAY, APRIL 24, 1937 Vol. 139

Social Responsibilities of Science

ONE of the most significant features of representative scientific gatherings in recent years, even of such widely differing types as the British Association, the World Power Conference, the Society of Chemical Industry, or the Association of Scientific Workers, as in the reports of Carnegie Institution of Washington or the Carnegie Endowment for International Peace, is the concern which has been expressed at the social consequences of the application of scientific discoveries. The necessity for concrete action in this field has been emphasized in recent months in different ways by the attention being given to the problems of the Special Areas, the rearmament programme and the growing *malaise* in Europe. We are witnessing a race between scientific progress and social instability.

It is accordingly appropriate and welcome that the International Council of Scientific Unions, meeting for the first time in London, should have before it a proposal submitted by the Royal Academy of Sciences at Amsterdam for the appointment of a committee to endeavour to co-ordinate views advanced in recent years regarding the social responsibilities of science and scientific workers (see p. 697).

At present, however, it is difficult for any scientific worker to get a sufficiently clear and ample picture of the problems confronting us and their implications. The proposal, therefore, aims at providing a means of collecting the various opinions which have been brought forward in this sphere and presenting them in a form which may help individual scientific workers and scientific organizations to obtain a better view of their work and of their position in relation to social problems. In support of the proposal a memorandum which has been forwarded to the General Secretary of the International Union bears the signatures of seventy-four scientific workers from different countries, although in inviting support of its proposal the Amsterdam Academy did not address itself to men of science in Germany, in Italy or in the Union of Soviet Socialist Republics, on the ground that in these countries at present scientific workers are bound much more closely to their respective Governments than is the case elsewhere. Nor has support been sought from scientific workers who have emigrated from these countries; in the first instance, an endeavour has merely been made to ascertain the attitude to the proposal of men of science in countries where there is more freedom to express individual opinions.

That such a discrimination should be necessary in the twentieth century is a striking reminder that science has a spiritual message as well as its material aspect, and that it demands a supreme loyalty to truth which must over-ride all other claims if error and delusion are not to result. The search for truth is not fulfilled by giving bare facts, numbers or abstract theories only; there must be also some sense of values and of perspective.

The cherishing of such ideals is a primary function of professional associations whether on a national or an international plane, but to turn to such a programme of research as that set forth in Sir Josiah Stamp's "The Science of Social Adjustment" is to realize the imperative need for scientific organizations to draw together if the beginnings of an attack on these problems is to be contemplated. Equally it is clear that a bridge must be built from the general but indefinite consciousness of social responsibilities to a definite practical campaign in this field. Clear thinking about the social implications of scientific work, of the uses that are being and could be made of science, of the abuse of scientific knowledge, and of the fuller use which could be made of it for promoting general social welfare, is the prelude to effective action.

For such thinking, data must be assembled as basis for judgment, and it will still remain to determine the means of making such judgments more effective in the struggle of opinions by which the world is ruled. In the memorandum which accompanies the proposal of the Amsterdam Academy, the possibility is reviewed of interesting existing organizations in this work, and reference is made in particular to the admirable work of co-operation which has already been fostered by the League of Nations in the field of international health and intellectual co-operation. It is suggested that fuller use might be made of the scientific point of view in the work which the League undertakes in adjusting political and social conditions.

The largest general scientific organization, however, is the International Council of Scientific Unions, and it was at first suggested by the Amsterdam Academy that the International Council might regard it as part of its task to consider opinions brought forward from various sides concerning the attitude which should be taken by scientific workers in relation to the dangers at present menacing the future of our civilization. On this basis consideration of the social responsibilities of science could be introduced into various aspects of the Council's work, particularly that carried out on behalf of the League of Nations.

A mere statement of this kind, however, is too wide to lead to the initiation of any concrete piece of work, and the resolution finally submitted to the Council accordingly proposes the appointment of a special committee in the following terms :

"The International Council of Scientific Unions, already at a former occasion having expressed its faith in the possibility and the necessity of peace between the world's peoples, and being convinced that the 'brotherhood of scientists' can be an important factor towards the establishment of a desire for mutual understanding and helpfulness, considers it to be a part of its task to give attention to the opinions brought forward from various sides concerning the attitude which should be taken by scientists in relation to the dangers which at present menace the future of our civilisation.

"The International Council therefore decides to appoint a Committee, which should attempt to arrive at a co-ordination of what has been proposed in respect to the social responsibilities of science and of scientific workers."

It is intended that this work should be carried out in a way which will relate the points of view expressed so that the result may be a guide for those interested in these matters. Moreover, such a committee would no doubt attempt to formulate some general conclusions which might indicate where scientific thought or the personal influence of scientific workers could assist in analysing and attacking social problems, and which might also help individual scientific workers to choose their own point of view in co-operating to safeguard our cultural advance. At the same time, the committee should serve as a centre of contact for organizations and persons interested in this type of cultural work, and assist in creating between these organizations and persons a feeling of mutual sympathy and of solidarity.

It can scarcely be challenged that such a committee could render almost invaluable service, both in the education of public opinion as to the contribution of science in social matters, and in the stimulation of scientific investigation, as well as of effective co-operation between professional organizations, to provide not merely a definite professional code but also a permanent anchorage or shelter from which members of the profession of science would be free to render their special service and exert their full influence undeterred by political or any other type of prejudice. It is indeed only from some such vantage ground that scientific workers can assist humanity to link up science with ethical values, and derive the courage and the authority needed at times to denounce the abuse of scientific effort or results, and to point out positive means of promoting the well-being and co-operation of mankind.

It is unnecessary at this stage to go further into the programme of activity for the committee sketched by the memorandum. The opportunities which confront us in such matters as nutrition, the problems of the Special Areas and the location of industry, the prevention of accidents and industrial disease, are only a few examples of questions to which reference has recently been made in these columns, in respect of which scientific workers might make an important or decisive contribution. Surveys of these fields, of the possibilities of assuring a certain standard of life through a full use of scientific and technical means of production and distribution of food and general commodities, and of the alleviation of poverty and misery; the prostitution of scientific knowledge for ignoble uses and in particular for purposes of war, and the development of a code of ethics and the question of a right attitude to preparations for war; the study of racial relations and feelings are all touched upon in some detail by the memorandum, and indicate the vast field in which fruitful work could be done. No scientific worker who realizes the benefits which science is able to give to society, or who desires to exert his full influence in social affairs, whether as a citizen or in his special capacity as a scientific worker, can be indifferent to the proposal or programme outlined by the Amsterdam Academy.

What matters above all, even in the collection and co-ordination of the existing material, is the spirit in which the work is carried out. Only as that is dominated by the highest ideals and finest loyalty to that spirit of service inherent in science itself can we expect to arouse the devotion and to create the vision which will enable the many difficulties in the way of effective action to be overcome. Even if the committee starts with a comparatively restricted field, that need not hinder it from rekindling the finest ties of professional loyalties and a vision of the possibilities and benefits which the scientific spirit linked with a sense of human values might bring to mankind. Once that is kindled, the human spirit will not long delay to break the shackles with which craven and retrograde political creeds and nationalist systems have sought to restrain its advance into an age of freedom and plenty, where man's mind and spirit, released from the cramping influence of poverty, disease and war, may achieve a stature and creative fertility hitherto unknown.

Personalities in Natural History

Green Laurels:
the Lives and Achievements of the Great Naturalists. By Donald Culross Peattie. Pp. 38+429 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1937). 12*s*. 6*d*. net.

THE author enjoyed his book, coining happy and striking phrases and suggesting interpretations of great characters. Goethe is "the father of the German romantic movement in poetry and science" and the Nordic interprets himself as "everything upstanding, gifted, pure, great and superior". Darwin is a "kindly English gentleman known by his good works", whose twenty years' record of silence is unsurpassed. Wallace was the greatest of professional collectors, because "he thought as he collected", but he was an "humanitarian before he was a scientist . . . a virtue only in a Romantic"; "disgraceful wrangles . . . never between these two". The old ideas were ancestors of theirs; "they built upon the sunken piers of obsolete wisdom". It is to sketch these "piers of nature's unfolding in the mind of man" that pleasures the author, not a history of biology and an orderly sequence of discovered facts. Plato, Aristotle, Theophrastus, Dioscorides, Galen and Pliny held the field until sixteenth-century Gesner published his "Historia Animalium" with Dürer's illustrations. In this man is seen the universality of science, for, from his Swiss home, he corresponded among others with Belon, whose picture of the bones of man and bird founded comparative anatomy, Rondelet (fish-lover), Aldrovandi (traveller), and Turner.

We are rather pleased to escape Vesalius and Harvey and to think of Borelli and Redi as unruly members of the first "Accademia del Cimento", unknown adventurers "on the rim of a volcano". There is sympathy for, and understanding of, Malpighi, Swammerdam and Leeuwenhoek in the first great days of microscopy. Réaumur is a brilliant of purest water, meteorologist, metallurgist, biologist, creator of entomology. In contrast, Buffon, protégé of the Pompadour, recreator of the Jardin des Plantes, prolific writer, courtier, in his jealousy and pride true forerunner of Cuvier, his fame crushed in our minds by his championship of spontaneous generation against the experiments of Spallanzani. Here were gleams of evolution, but the next volume affirms a belief in the scriptural creation "both as to order of time and matter of fact". Linnaeus appeals, a country "sport", great collector and systematizer without whose work further progress had become impossible. He had forerunners, of course, especially Ray, and they, too, had made approach to the idea of sexuality in plants and its analogue in animals.

It was a glorious age, the collecting of Nature from every clime and isle—and in the story there is no elimination of that personality, which never gives enduring fame, but on which is founded human love. Thus is approached that great "chevalier" Lamarck, who founded the "concept that evolution is possible, is real, is more characteristic of life than motion or breathing". There was no success here, a penniless old age, no helping hand from Cuvier, the man and all his work ungratefully contemned by him, his bones consigned to the pauper's tomb. Happy it is that Owen was no Cuvier in Darwin's days, and that Lyell preceded and Huxley lived. Personal humility, genius and confidence are, indeed, three factors in science.

Later, a few chapters to tell us about the early collector-naturalists of North America. We all know of sour Wilson with his pictures of museum-stuffed birds, and flighty Audubon with his nature brush. Few know C. S. Rafinesque, of the University of Transylvania, literally built in the backwoods, its golden age synchronous with his professorship, 1819–26. Here was a picturesque and eccentric genius, dabbler in every field of biology with incursions into Indian archæology and language, member of a score of scientific societies, but yet a failure, since never a single idea or suggested thought was carried to fruition. Returning from an excursion, Rafinesque found his museum swept bare and was denied his classroom, the villain of the piece, President Holly himself, driven out next year by his fundamentalist students. Here again a death in abject poverty, the body almost cased in the nine hundred books and pamphlets it had written.

Then there were the Bartrams, father and son and families, the father fresh from the plough to become the correspondent of Linnæus and the fashionable world of England, all collectors then. The gorgeous *Franklinia* was theirs, those living now descended from a single tree of Georgia never since found wild. Michaux, a French farmer, was sent over in 1785 to collect trees and plants for the forest of Rambouillet, but, although he shipped a vast abundance, Nature in Europe formed too close a "society" for them; he is better known for his later contributions from the East. Jefferson, third President of the United States, was a naturalist, but surely the strangest enterprise and settlement must have been that of New Harmony, the communistic State founded in 1825 by thirty-five ladies and gentlemen from the cultivated purlieus of Philadelphia. Kindly Robert Owen was the founder, an immigrant from Lanark, not appreciated there—the experiment a failure, but New Harmony a place of pilgrimage for fifty years. Here the great "American Conchology" of Say took shape, its author's name-seal to be ever associated with a large share of the animals of North America, his associate Lesueur responsible for its exquisite plates. A most pleasant book.

J. S. G.

Secret Languages of Ireland

The Secret Languages of Ireland: with Special Reference to the Origin and Nature of the Shelta Language, partly based upon Collections and Manuscripts of the late Dr. John Sampson. By Prof. R. A. Stewart Macalister. Pp. x+284 (Cambridge: At the University Press, 1937.) 16*s*. net.

SHELTA, or more correctly Sheldrū, a secret language found among a certain class of tramps in England and current among Irish tinkers, was discovered in 1876 by Charles Godfrey Leland, that enthusiastic, if somewhat erratic, student of everything appertaining to the customs and beliefs of peasantry, gypsies and vagabonds generally all the world over. The results of his investigations of Shelta were ultimately passed to the late John Sampson, the great authority on gypsy languages, and through him brought to the notice of Kuno Meyer, the Celtic scholar, by whom the language was at once hailed as a survival of the old Celtic used by the Druids. Unnoted until the time of Leland, it has since been investigated by a number of Celtic and Romani scholars, with results which would now seem to have failed to justify early enthusiasms.

The book on the language, which was to be produced by Leland, Meyer and Sampson, was never completed; and on the death of the last named, the material which had been collected for it was passed to Prof. R. A. Stewart Macalister. Very wisely, while using this material, he has written his own book, enlarging the scope of the inquiry to include as a whole the intriguing problem of the occurrence of a number of 'secret' languages in early and medieval Ireland, and the evidence for their survival until recent times. It is a problem which not only has provided material of interest to the phonetician and the philologist, but also as a development which can be traced back to early historic times in Ireland, of no little significance for the student of the growth of social order and religious belief in that country.

Prof. Macalister discusses the whole problem with thoroughness. Beginning with the use of oghams as a method of alphabetic writing, which he believes, probably with justice, to be a deliberate archaism, intended to preserve, if not to create, an esoteric atmosphere, he goes on to discuss in considerable detail the various methods of cryptographic record which were adopted by the Irish scribe. This he follows with a discerning sketch of the social and religious conditions, which would have tended to preserve the Druidic custom of using at need a language understood only by the initiated ; and from this traces the rise of those bastard dialects, Hisperic Latin and Hisperic Irish, as well as the jargon known as Bog Latin. In regard to Hisperic Latin, he might, perhaps, have pointed out that this development is not peculiar to Ireland, and have found a parallel in the language of the macaronic verse of "The Battle of the Frogs and Mice", the Italian burlesque in imitation of the Aeneid. The vocabularies and analyses which Prof. Macalister gives of these secret languages, as well as of the modern Shelta and "Vernacular of the Masons" are of extreme interest.

The author completes his picture of the conditions which favoured the production and perpetuation of these languages by a brief sketch of the vagrants of Ireland. The accession of declassed clerics to these vagrant bands will explain, he holds, some anomalous evidence of learning which appears in the secret languages. As regards the central theme of inquiry, his conclusion is that Shelta does not represent an ancient language, though there are, not unnaturally, archaic elements in it, and that while its vocabulary is Irish, its syntactical construction is essentially English.

Bibliography of the Exact Sciences

Sotheran's Bibliotheca Chemico-Mathematica: Catalogue of Works in many Tongues on Exact and Applied Science. Second Supplement. Vol. 1. Pp. xi+840. Vol. 2. Pp. iii+841–1396. (London: Henry Sotheran, Ltd., 1937.) 21*s.* net.

THE second supplement to Sotheran's "Bibliotheca Chemico-Mathematica" lists no less than 22,895 items, thus exceeding in length not only the first supplement, but also the original two volumes. The arrangement of the contents is similar to that adopted in the first supplement. The individual items are arranged under a series of subject headings, instead of under a general alphabet, as is the case in the earlier volumes. This supplement has in fact been produced by binding together thirteen different special subject catalogues that have appeared separately during the last fourteen years. For this reason, presumably, the compiler has not thought it necessary to prepare a detailed subject index, a feature that rendered the original work especially valuable. However, the new arrangement may well prove more convenient to many users. The main subject headings in this great catalogue are as follows: aeronautics, astronomy and astrology, chemistry, chemical technology, engineering, geology and meteorology, horology and dialling, mathematics, microscopy, mineralogy, mining and metallurgy, navigation and physics. Some of these subjects are further subdivided, and there are also sections dealing with scientific works of general interest, collected works and sets of scientific periodicals. In the new supplement, nautical, aeronautical, mining and engineering works are more fully represented than in preceding volumes of the "Bibliotheca".

Those familiar with the catalogues of scientific books issued from time to time by the old-established firm of Henry Sotheran, Ltd., will realize the value of this supplement. To others it may be pointed out that, as catalogues of second-hand books, they are among the select few that have permanent interest and value. Comparable catalogues are issued by only a very few antiquarian booksellers, either in Great Britain or elsewhere. Those issued by Henry Sotheran, Ltd., excel, in the first place, in sheer numbers of books listed, these including both modern and standard texts and old, historically interesting publications of the sixteenth, seventeenth and eighteenth centuries. Secondly, the catalogues are not restricted to the more important (and therefore more valuable) works, but include also the lesser known writings of well-known men of science, and many books by obscure and almost unknown authors. Moreover—and herein lies the especial value of these catalogues—a very large proportion of the entries are annotated with bibliographical, biographical and historical notes. These notes, sometimes of considerable length, are drawn from many different authorities, and are remarkable for their accuracy.

No comprehensive bibliography of the exact sciences exists, and indeed the preparation of such a work would be a monumental task. Very few of the separate sciences have, in fact, formed the subject of special bibliographies. Such as exist are invariably incomplete, and are often either inaccurate, or lacking in bibliographical detail. It may fairly be claimed that this new supplement, together with the three preceding volumes of Sotheran's "Bibliotheca Chemico-Mathematica", comprising in all 47,480 entries, form the nucleus of a complete bibliography of the exact sciences, and an essential addendum to the few special bibliographies already existing. It is therefore a work of very definite value to librarians, bibliographers and historians of science.

The "Bibliotheca", being compiled from successive priced catalogues of an antiquarian bookseller, suffers from the unavoidable defect that a proportion of the entries are repeated. This repetition throws an interesting sidelight on the value of old scientific books. A comparison of the prices asked in earlier volumes of the "Bibliotheca" with those asked for the same work in Sotheran's latest catalogues indicates unmistakably that a marked increase in the value of at least the more important early scientific books has taken place during the last fifteen to twenty years An outstanding example is afforded by Newton's "Principia", the first edition of which might have been purchased in 1919 for £30; in 1934, £120 was asked for it. Other examples could be quoted in confirmation of this trend in prices, which must indicate not only an increased demand for this type of book, but also a growing scarcity. Librarians throughout the world are filling gaps in their collections, and it seems probable that before many years pass it will be extremely difficult, if not impossible, to obtain copies of the outstanding early works of science at any price.

The compilation of the "Bibliotheca Chemico-Mathematica" is entirely the work of Mr. H. Zeitlinger, a member of the staff of Henry Sotheran, Ltd. Mr. Zeitlinger is obviously equipped, not merely with a critical sense of the value of the books he catalogues, but also with an exceptionally wide knowledge of the bibliography and history of science, qualifications which render valuable the notes with which he enriches his catalogues. Both he and the publishers are to be congratulated on the production of a work of such interest and lasting worth.

Marine Zoo-geography

Tiergeographie des Meeres
Von Prof. Sven Ekman. Pp. xii+542. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 32 gold marks.

THE collection of specimens of marine animals by individual workers and on fully organized expeditions has been carried on for many years, and still continues. To the systematic zoologist, much of the interest in these collections lies in the discovery of new or rare species which may throw light on evolutionary trends and classification. But the gradual accumulation of publications giving the faunistic results of collections, and often comprising lists of already known species, serves another purpose. Each record marks a pin prick on the globe to add to our picture of the geographical distribution of that species. It is only after many years of such recording of already described and well-known species have passed that this second purpose can reach fruition in an outline of marine zoo-geography.

Already in 1896, Ortmann had produced his well-known "Tiergeographie der marinen Organismen", giving a preliminary outline of the different faunistic regions; but almost all the results of the collections of the great oceanographical expeditions have been published since that date, and we have now a wealth of data out of all proportion to that available in Ortmann's time. Many of these reports contain summaries of the known distribution of separate groups or families, but there has been no comprehensive survey of all these results as a whole. Prof. Sven Ekman's book is therefore welcome and timely. He gives an outline of all the marine faunistic regions as they exist to-day and their relationships one with the other. In order that the relations between the different faunas might be disclosed, their composition has had to be studied in the light of geological evidence, and this is one of the main aspects of the book, which is not only an outline of present-day marine zoo-geography but also a history of its past and of the causes that have produced its characters to-day. All types of faunas are dealt with, from the littoral to the abyssal, including the pelagic and planktonic animals, of all the oceans and seas as well as of the Caspian Sea and the Sea of Azov.

As might be expected, it is the tropical littoral fauna with its limited methods of dispersal that shows the least geographical uniformity at the present day. In the Cretaceous and early Tertiary, the tropical fauna of the Indo-Pacific and Atlantic regions had much in common, being united by the shallow Tertiary sea of Tethys. Climatic change in the Atlantic and the gradual emergence of land destroyed much of the tropical Atlantic fauna, and initiated the present era with its strong contrast between Atlantic and Indo-Pacific faunas. Results have shown that the term Indo - West Pacific must replace the older expression Indo-Pacific, since the faunas of east and west Pacific are radically different, the former having affinities rather with the Atlantic region The vast island-free area between Polynesia and America was presumably the barrier between the littoral faunas of east and west Pacific. Later climatic change in the North Atlantic with its warm conditions also impeded the evolution of an endemic boreal fauna, which is so much richer in the Pacific.

Such are the type of conclusions brought forward in this most interesting book. Although much of the theoretical picture has previously been constructed by workers in individual animal groups, the probable truth gains added strength by Ekman's work, which has shown how different groups of the animal kingdom follow the same trends. The book is well illustrated, and contains a valuable literature list of some twenty-six pages. This list has an additional attraction in that all titles of papers are given in full, and it thus forms a most useful guide to many of the most important reports on all the marine animal groups.

Prof. Ekman's book is more than a text-book, and is one of the most important additions to marine biological literature since Murray and Hjort's "Depths of the Ocean". Perhaps one of the most striking features brought out is how very great has been the advance in knowledge of species of marine animals within the last century. We cannot be far wrong in saying that in many groups the identification and description of the component species is nearing completion in certain regions. It behoves us now to pay increasing attention to the biology of the species themselves and their interrelationships one with another. It is only with such knowledge that we shall reach a correct understanding of the factors which bind the species to the different ecological associations in the zoo-geographical regions which Prof. Ekman has so ably outlined.

F. S. R.

Catalytic Reactions

Catalytic Reactions at High Pressures and Temperatures

By V. N. Ipatieff. Pp. xxii+786. (New York: The Macmillan Co., 1936.) 30*s*. net.

THIS is a chemical autobiography; it concerns the life researches of a great Russian chemist, now an exile and professionally active in the United States in the field of catalysis and its industrial application. The author seeks to have correct significance placed upon his investigations, which he claims has not always been done; he retaliates by making little reference to the work of others. As a result, the reader is presented with a mass of information often stimulating and suggestive, which however should be approached critically. It is most valuable to have a subject presented in this way instead of the judicial form necessary in the text-book; instead there is the zeal of the author convinced of the importance of his discoveries and the soundness of his hypotheses. Such are developed here for the reactions of dehydration, alkylation, polymerization and isomerization, in some instances for the first time.

The name of Ipatieff is in particular associated with his pioneer work on catalytic reactions at high pressures and temperatures, and his method is followed industrially in the preparation of such products as cyclohexane, tetralin and decalin. A summary of the main lines of his researches is given in an introduction. He was the first to observe in 1900 that a catalyst could influence the course of decomposition of an organic substance and force the decomposition to go in a certain direction only, and also to recognize that the material of the vessel might play the part of a catalyst. He showed how, according to the nature of the catalyst, alcohol could break down almost quantitatively in three different ways, to aldehydes, to ethylene, to butadiene. To-day such principles are universally recognized and made use of in diverse branches of the chemical industry.

The book is divided into thirteen chapters in which under appropriate headings the various sections of the subject are collected: these are sometimes rendered more useful by a series of numbered conclusions at the end. It can serve no useful purpose, even it it were possible, briefly to summarize some of Ipatieff's hypotheses and results, nor are all of them generally accepted.

The book will be read eagerly by workers in the field, particularly by those in industrial laboratories, and few will do so without some gain either in ideas or knowledge. The author's work has not been in vain; his contribution to progress is a substantial one.

The Human Foot:

its Evolution, Physiology and Functional Disorders. By Prof. D. J. Morton. Pp. xiii+244+14 plates. (New York: Columbia University Press; London: Oxford University Press, 1935.) 15*s*. net.

The author of this book, though he bears the name, is not responsible for the designation which we know as Morton's metatarsalgia. The most important statement in the book is that the disabilities of the foot start in the first instance from defects of the bones and ligaments. The evidence for this statement is assembled from diverse sources.

Approximately one third of the book is devoted to an account of the evolution of the foot. This is quite interestingly and well done, and is in accordance with the prevailing ideas at the moment. It is inevitable that its truth should be more general than particular. From gaps in our knowledge, detailed speculation as to the way individual muscles may have changed to meet new functional demands must remain speculative and have little value as proof. From his evolutionary studies, the author arrives at the conclusion that the foot has become a coherent elastic arched contrivance in which bone and ligament differ only in calcium impregnation, but otherwise are short or long trabeculæ answering to the stresses and strains imposed upon them. The muscles have but to balance the legs and the body upon the foot.

The analysis of the postural and locomotory activities of the foot but bear out this contention, and the disabilities of the foot are of course interpreted in the same way In the examination of nurses and students, the author estimated the power of the muscles in those who had static change of the foot and found this the same in those who had no such disabilities. The opposing view asserts that in the maintenance of the configuration of the foot the muscles stand in the first line of defence; the ligaments are resistances invoked against external forces only after the muscles have failed. The reflex postural activity of muscles maintains not only the equilibrium of the body but also the form of the foot. It is the penetration of this conception into the practice of orthopædics that has elevated its teaching and enhanced its results. The work of British medicine in bringing this about has been very considerable, and it has become widely adopted elsewhere. The problem at issue is one of clinical investigation and cannot be settled by appeals to a more or less speculative evolutionary background.

A National Encyclopædia of Educational Films and 16 mm. Apparatus available in Great Britain, 1936

Edited by William L. Lally. Pp. 479+7 plates. (London: The Central Information Bureau for Educational Films, Ltd., 1937.) 15*s*.

This is a new, enlarged, and again improved edition of a work first published under its present name in 1935 but really dating back to 1933. The improvement—and it is an immense improvement—consists in the inclusion first of a film title index giving reference to both 35-mm. sound and silent and 16-mm. sound and silent films, and secondly, of a new subject index to the main classification. The first meets a criticism which we made of the first edition that there was no possibility of direct reference to any specific film when the title was known, and the second enables us to find films that deal with any particular topic. The encyclopædia is now in fact usable without a great expenditure of energy and temper.

Although it is now possible to trace films, the process is not even yet quite so simple as it might be. If we wish to obtain a film on a particular subject, we first turn to the subject index and choose a name. Then we look up this name in the index to titles. Perhaps we were unlucky, but when we looked up 'Cacao–Trinidad' and 'Cocoa from Trinidad' we could find neither. If the name is given, we find whether it is 35-mm. sound or silent or 16-mm. sound or silent, and on what page further particulars are given. We turn to that page, identify the film and find the source of supply and its length. 'Identify' is the word to be used, for when we looked up "Hop Gardens of Kent" as given on the title index, we found "Hoplands" not on the page named but the next. Nor is this the sole example of transmutation of titles.

The lengths are still given in reels. This is not quite satisfactory; for it makes a great difference to the suitability of the film whether it runs for 7 or 15 minutes. But this, with some other matters, can be attended to in future editions. It is a great advance to have a catalogue that is usable.

Grundlagen, Methoden und Ziele der Hygiene:

eine Einfuhrung fur Mediziner und Naturwissenschaftler, Volkswirtschaftler und Techniker. Von Prof. Dr. Werner Kollath. Pp. xvii+508. (Leipzig: S. Hirzel, 1937.) 18 gold marks.

The preface declares that this book is intended as an introduction to hygiene for the student of medicine and also as a stimulus for the interested layman to introduce hygienic methods wherever this may be possible. The plan of the book is good in that the first part is devoted to the scientific foundations of hygiene, the association of physics and chemistry with biology and of biology with medicine. Subsequent parts deal with environmental hygiene, with nutrition, with medical statistics and public health organization, and the last part with bacteriology and serology.

The book, however, is too ambitious in trying to cover too much in five hundred pages. Balance is not maintained, the writing being either too discursive or too laconic. Twenty-three pages are devoted to atomic physics, ten pages to oxidation-reduction potentials, but immunology is accorded only nine and medical statistics only thirteen pages. Epidemiology receives only passing mention, and even the problems of milk-borne infections are dismissed by giving an incomplete list of the diseases which may be spread by milk. The bibliography makes mention of a number of text-books and gives references to fifty-six papers on a large variety of subjects by the author himself. The book is not likely to appeal to the English reader.

The International Council of Scientific Unions

THE International Council of Scientific Unions, formerly the International Research Council, will meet at the rooms of the Royal Society, for the first time in Great Britain, on April 26. The original statutes laid down that the triennial meetings of the Council should be held at Brussels, but these were altered in 1931 to empower the General Assembly to accept invitations from other countries

The present Council was established in 1919 after its predecessor, the International Association of Academies, had lapsed during the Great War after actively promoting international science for about sixteen years.

For some years before 1898, the Academies of Munich and Vienna, with the Royal Societies of Gottingen and Leipzig, had been in the habit of meeting annually at one or other of these places as an association to discuss matters of common interest, and in 1898 they were to meet at Göttingen. The Royal Society of Göttingen invited the Royal Society to send delegates to take part in the meeting and its discussions, and also intimated that the four institutions would be glad to learn the views of the Royal Society on the possibility and desirability of its joining them. The Council of the Royal Society accepted the invitation and instructed its delegates to say that the Society would be disposed to join the association provided that it were so extended as to assume a fully international character. The suggestion was accepted in principle, and the Royal Society was requested to take such steps as might be desirable to ascertain how far the formation of such an international association might commend itself to the leading scientific bodies of other countries. As a private institution, the Royal Society was very favourably situated for opening such negotiations.

In the following year the Académie des Sciences of Paris, the Academia dei Lincei of Rome, the Imperial Academy of Sciences at St. Petersburg, and the National Academy of Sciences at Washington, approved of the proposal and expressed their readiness to join such an international association. A preliminary conference was therefore held at Weisbaden in October 1899, at which a draft scheme for the organization was prepared providing for triennial meetings of the General Assembly, which would consist of delegates from each adhering Academy. The Assembly was to be formed of two sections, one for the natural sciences, and the other for literature and philosophy. The Council of the Association held its first meeting at Paris in 1900.

By the organization of the association an academy might be admitted either to the literary section alone, or to the scientific section alone, but not to both unless its constitution showed that the sphere of its labours included both literary and scientific subjects ; and as at that time there was no society in existence in England dealing with the subjects of the literary section in such a manner as to satisfy these conditions, the United Kingdom could only be represented in the scientific section by the Royal Society. The Council, therefore, consulted several distinguished men of letters, a number of whom afterwards submitted a memorandum in which it was suggested that the Royal Society might either enlarge its scope so as to include a section corresponding to the philosophical, historical and philological division of some foreign academies ; or that it might address a memorial to the Government pointing out the exceptional position in which Great Britain was placed as compared with other European countries through the absence of any academy representing departments of study other than mathematics and natural sciences, and advocating the formation of such an academy.

In 1900 the Council of the Royal Society appointed a committee of fellows of the Society to consider this memorandum and to report. The committee went into the whole matter very thoroughly and, after conferring with a number of representatives of historical and philological studies, presented a report, which was laid before a special meeting of the fellows, at which a very full and interesting discussion of it took place on May 9, 1901. The report came before the Council again at its meeting in July, and after full consideration it was resolved "that the Council while sympathising with the desire to secure corporate organisation for the exact literary studies considered in the Report, is of the opinion that it is undesirable that the Royal Society should itself initiate the establishment of a British Academy".

At the end of 1901 a number of those who had taken part in these discussions formed a new body, the British Academy for the Promotion of Historical, Philosophical and Philological Studies. This body drew up a petition to His Majesty in Council for the grant of a Royal Charter, and in 1902 the British Academy for the Promotion of Historical, Philosophical and Philological Studies was constituted, and incorporated by Royal Charters.

During the Great War, the periodical meetings of the International Association of Academies and of many other international organizations could not be held, though some of them were continued in neutral countries. In 1918, therefore, the Royal Society, the Academy of Sciences, Paris, and the National Academy of Sciences, Washington, discussed informally the question of the future organization of the scientific undertakings which had been carried on before the War by international co-operation; and ultimately the academies of all the allied countries were invited to send representatives to a conference which took place at the rooms of the Royal Society in October 1918. This was followed by a meeting at Paris at the end of November, when it was agreed to form an International Research Council and a number of affiliated International Unions to deal with matters of international scientific interest, which was done at Brussels in the next year.

Besides the ordinary routine of the triennial meeting, which is being held in London on April 26–May 4, the Council will have for consideration the report of the standing committee on the Study of Solar and Terrestrial Phenomena, and also that of the committee which was appointed three years ago to report on the relations which should exist between the Council and the Committee of Intellectual Co-operation of the League of Nations concerning matters of international science.

The Royal Academy of Amsterdam is proposing that the International Council should appoint a committee to study what co-ordination can be achieved in the opinions which have been put forward regarding the social responsibilities of science and of scientific workers towards the dangers at present menacing the future of civilization.

Public lectures will be given on April 28 and April 30 at the Royal Institution; the former by Sir William Bragg, on "Classical Experiments made at the Royal Institution", and the latter by Prof. E. V. Appleton, on "International Co-operation in Radio Research". The Government is giving an evening reception to the delegates at Lancaster House on April 29.

Arrangements have been made for the delegates to visit a large number of scientific institutions in and near London, where they will receive assistance from members of the scientific staffs in the objects of their visits.

The General Assembly will hold its closing meeting on Monday, May 3, and the delegates will attend the soirée of the Royal Society on Tuesday, May 4.

On Tuesday, April 27, there will be a reception of the delegates at the University of London, when the Chancellor of the University, the Earl of Athlone, will confer the honorary doctorate of science on Dr. N. E. Nörlund, the president of the International Council.

The Total Solar Eclipse of June 1937

THE total eclipse which starts on June 9 next and, crossing the date line, ends on June 8, will be the longest visible for many years, the maximum duration of totality being 7 minutes 4 seconds. It is most unfortunate that the belt of totality lies almost entirely over the ocean and that the maximum duration available from land is reduced to 4 minutes 8 seconds. This is from Enderbury Island in the Phoenix Group (lat. 3° 8·5′ S., long. 171° 10·0′ W.) which is described in the *Sailing Directions, Pacific Islands Pilot*, vol. 2, 1932, as "30 feet high, uninhabited and surrounded by a coral reef, which is steep to. There is no fresh water, no anchorage and landing is difficult". The island is about 2·5 miles long and 1 mile wide. Of the other islands in the Phoenix Group, which lie within the belt of totality —Gardner, McKean, Hall, Birnie, Canton and Phoenix, all uninhabited—the most suitable island for landing eclipse apparatus appears to be Canton Island (lat. 2° 28·9′ S., long. 171° 42·6′ W.). Here totality lasts 3 minutes 45 seconds The island is a coral atoll 10–12 feet high, with a spacious lagoon: there is anchorage, in 10 fathoms, unsafe with westerly winds, close to an entrance to the lagoon on the west side. Coco-nuts have been planted on the island, which is nine miles long by four miles wide. The islands are leased by the Colonial Office to Messrs. Burns Philp (South Seas) Co. Ltd., and come under the jurisdiction of H.E. the High Commissioner for the Western Pacific at Suva, Fiji.

The belt of totality east of the Phoenix group never strikes land until at sunset it reaches the coast of Peru. The U.S. Navy reported an island, Sarah Anne Island, which would have lain in the track of the shadow, but the island must have sunk below the ocean as it is no longer to be found. In Peru the maximum altitude of the sun is 8° and the maximum duration of totality 3 minutes 20 seconds. The Faculty of Science of the University of San Marcos has formed a committee to help visiting scientific expeditions in all matters of transport, meteorology, health conditions and camp installation. The Dean of the Faculty, Prof. Godofrich Garcia, is president of the Committee.

So far, three expeditions have been announced as going to observe this eclipse. With the aid of a sloop of the New Zealand Navy, Mr. C. B. Michie, of Kaitaia, N.Z., is taking a party consisting of Dr. W. C. Burns and Mr. F. Gawith—all three being members of the 1930 expedition to Niaufou' or Tin-can Island—and Mr. Thomsen and some other member of the staff of the Dominion Observatory. The 19-foot coronagraph used at the eclipses of 1926, 1929, 1930, 1932, and 1936, has been sent to Mr. Michie from Japan and will be taken by him to Canton Island. By kind permission of the Royal Irish Academy, the 8-inch Grubb cœlostat will be used to feed the coronagraph. Photographs of the corona will, it is hoped, be secured through various colour-filters. Other details of the programme are not available here.

Another party will be organized by the U.S. Navy, the National Geographic Society and the National Bureau of Standards, and will proceed to Canton or Enderbury Island. Prof. S. A. Mitchell, director of the Leander McCormick Observatory, will be the scientific leader of the expedition, while Captain J. F. Hellweg, Superintendent of the U.S. Naval Observatory, Washington, will be responsible for the naval side of the work. Dr. H. D. Curtis, director of the Ann Arbor Observatory, Michigan, Dr. P. A. McNally, director of the Georgetown College Observatory, Dr. F. K. Richtmyer, of Cornell University, Dr. I. C. Gardner, National Bureau of Standards and Mr. J. W. Willis, of the Naval Observatory, accompany the expedition and assure a wealth of valuable eclipse experience. The party will be completed by a naturalist (a naval surgeon), and a photographer from the National Geographic Society.

The spectrum of the chromosphere and corona will be photographed by Dr. Mitchell and Dr. Curtis respectively. Dr. McNally will photograph the corona through a variety of filters, while Dr. Richtmyer will measure the total light of the corona. Colour photographs of the corona will be attempted by Dr. Gardner, who will repeat some of the photographs secured by him in Siberia last June (*see* NATURE, March 13, p. 434). Time observations of contacts will be made by the observers from the Naval Observatory.

This party will be taken from Honolulu by the U.S. Navy mine-sweeper *Avocet* early in May. They may have a difficult time in preparing for the eclipse. We can only hope that the good weather, which has generally, though not invariably, attended Dr. Mitchell and Dr. Curtis, will hold for both parties on the morning of June 8 next.

A Japanese expedition, under the leadership of Prof. I. Yamamoto, of the Kwasan Observatory, Kyoto, will proceed to the coast of Peru to observe the eclipse of next June at sunset. The other members of the party are Prof. T. Araki and Messrs. Y. Sibata and M. Horii. The programme includes photography of the corona and of the spectra of the chromosphere and corona, photometry of the corona and some geodetic observations. The equipment will include some cinematograph cameras.

F. J. M. S.

Radium Treatment in Great Britain

RADIUM treatment is an established medical service in Great Britain, as may be gathered from the reports which are issued from year to year, especially by the four important organizations which have the responsibility of encouraging its practice and of helping research bearing upon its many problems. These organizations are the National Radium Commission, now in its eighth year of existence, and King Edward's Hospital Fund for London, both of which are primarily concerned with treatment; the British Empire Cancer Campaign and the Medical Research Council, whose interests in the subject are primarily research, their common matters of discussion in the first instance usually being referred to a joint Radiology Committee. The allocation of radium by these four organizations at present exceeds 40 grams of radium element.

The seventh annual report of the Radium Commission[*] includes a statistical report of 47 pages which teems with interest. It being no longer a question whether radium is of *any* use in the treatment of cancer, one of the first questions which the Commission has tried to answer is how much use it is. To this end, an elaborate plan was laid, and the first fruits of this are now at hand. The present report gives the 3-year and 5-year results of radium treatment of five common sites of cancer, namely, breast, cervix uteri, lip, tongue and floor of mouth. From the data contained in thirty-nine tables it is now possible to obtain the answer to almost any question that can normally arise concerning the probable results of treatment, as practised throughout the country. The report is based upon an analysis of the records of more than 5,600 patients, and the hospitals from which the patients have been drawn are widely distributed throughout the whole of Great Britain.

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[*] Seventh Annual Reports of the National Radium Trust and Radium Commission 1935–1936 including a Statistical Report. (Cmd. 5342.) Pp. 91. (London: H.M. Stationery Office, 1937.) 1*s*. 6*d*. net.

Little is said throughout this statistical report of the efforts which the Radium Commission made in its preparation of suitable clinical record sheets and statistical cards so as to ensure that the right kind of information was eventually received from its National and Regional Centres, preferring to report upon the fact that the accuracy of this material has shown signs of steady improvement. How loyally these Centres have contributed in the work of the follow-up of patients is shown by the fact that only 3·9 per cent of the total patients has been lost sight of.

The spirit of co-operation is further shown by the arrangement made by the authorities of King Edward's Hospital Fund, that the data from hospitals receiving allocations of radium from the Fund should be put at the service of the Commission.

Though radium is used in the treatment of other diseases, its outstanding medical interest is its use in cancer, and one of the chief difficulties in the preparation of data is to agree upon some common and acceptable method of classifying the various stages of the disease. This had already been done in 1929 for uterine cancer by the Radiological Sub-Commission of the League of Nations Health Organization, but for no other sites. The Commission therefore undertook this for the other sites of cancer already mentioned.

The general scheme of the report follows the same lines for each site under investigation; the completeness of the information may be gathered from the following tabular headings: percentage net survival rates; patients who have died classified according to cause of death; percentage three-year net survival rate according to whether or not a histological examination was made; number of patients treated by different methods or combinations of methods; percentage net survival and symptom-free rates at three and five years after treatment according to method of treatment and stage of disease; age distribution of patients; three-year net survival rate according to age of patient and stage of treatment.

In only one of the five groups, namely, carcinoma of the cervix uteri, is there any appreciable difference in the three-year net survival rate according to whether or not a histological examination was made. Table 13 is here reproduced; while no explanation is available, it may be suggested that the failure to have this valuable histological evidence was only one indication of inadequate treatment.

TABLE 13 CARCINOMA OF CERVIX.

Percentage three-year net survival rate according to whether or not a histological examination was made

Stage of Disease	Histological examination made	No histological examination
I	63 4 (304)	50 8 (66)
II	51·2 (440)	35·7 (99)
III	32 4 (678)	15·5 (120)
IV	15·0 (266)	5·0 (85)
All stages	40·0 (1,688)	24·8 (370)

Numbers in brackets are the number of patients.

The dangers of malignant disease are two-fold; primarily the growth with its local spread, secondarily its extension into other structures of the body. The extent to which the latter adds to the difficulty of radiological treatment is well shown in the section of the report devoted to carcinoma of the tongue. The patients were classified according to the stage of the disease as follows:

I. Primary growth limited to the tongue: (*a*) glands not involved; (*b*) glands involved.

II. Primary growth limited to the tongue and floor of mouth: (*a*) glands not involved; (*b*) glands involved.

III. Primary growth has spread from the tongue to other structures within the mouth: (*a*) glands not involved; (*b*) glands involved.

This should be read in conjunction with the following data contained in Table 27.

TABLE 27.—CARCINOMA OF THE TONGUE.

Percentage net survival rates from all methods of treatment in which radium was employed.

Stage of Disease	Net Survival Rate at:	
	3 years	5 years
Ia	49 7 (339)	26·2 (83)
Ib	12·6 (310)	5 1 (85)
IIa	39·6 (143)	18 5 (29)
IIb	11 5 (265)	11·1 (57)
IIIa	31 0 (47)	— (6)
IIIb	7·5 (136)	3·3 (30)
All stages	25·7 (1,240)	13·9 (290)

For those who prefer composite figures, the following data (p. 701) are available, giving net survival rates in percentages.

The impression should not be formed that these patients have been treated by means of radium only; this is far from the case. In breast cancer, for example, no less than 86 different conbinations of methods of treatment come under analysis, in uterine cancer 66, and so on. This arises from the fact that there are three main methods in radium treatment, each of which may be associated with varied surgical or X-ray treatment.

Site	Earliest Stage of Disease		All Stages of Disease	
	3 years	5 years	3 years	5 years
Breast .	70 1	50 0	37 2	24·6
Cervix Uteri ..	61·1	49·4	37 3	31·1
Lip .. .	77·5	77·8*	68 8	53·6
Tongue	49·7	26·2	25·7	13·9
Floor of Mouth ..	62 0	53·6	36 2	31·0

* Small group of patients.

Difficulties in treatment are many, but no sentence in this report brings these difficulties more acutely to mind than the following:

> "The proportion of patients in whom the disease is still localised to its original site and in whom there are no signs of local or metastatic spread when the patient is first seen amount, for all sites investigated, to only 25 per cent. of the patients. The marked difference in the survival rates shows that for these patients the chances of survival are much more favourable than when either local spread or metastasis has taken place."

Of necessity the results of individual centres cannot be gauged when merged into the larger groups, so invaluable for statistical work. From the reports entitled "Medical Uses of Radium" issued for the last fifteen years by the Medical Research Council, this can be done for the centres taking part in its scheme of research. These reports also from time to time show the important results of radium treatment in certain non-malignant gynæcological conditions.

Radium has proved of service in the treatment of cancer, especially when the direction of the medical services has been in competent and inspiring hands. The tendency in treatment is for less interstitial work to be done, giving way to surface and distant applications of radium, the latter involving the use of bigger units, 1-5 grams. There is little doubt that, as the warrant is shown for the use of these bigger units, the country will see to it that the necessary radium is provided.

S. RUSS.

Centenary of the University of Göttingen

From a Correspondent

GÖTTINGEN is celebrating its bicentenary on June 30 of this year. Perhaps no university has maintained so high a standard of learning over so long a period as Göttingen. Among its illustrious professors have been Albrecht von Haller, a man of most varied genius and the first modern physiologist, Gauss, supreme alike as mathematician, astronomer and experimenter, Blumenbach, the humane and wise father of anthropology, the brothers Grimm, begetters of modern scientific philology, whose name is known in every nursery, Wilhelm Weber, associated with the measurement of electrical quantities, with terrestrial magnetism, with the electric telegraph and, along with his brother Ernst, with a multitude of physiological researchers, Ewald, the Hebrew scholar, commonly regarded as the father of scientific biblical criticism, Wüstenfeld, who traced the debt that European science owes to the Arabic-speaking world, and Henle, one of the greatest of anatomists, founder of the science of histology, whose name is attached to more than one structure of the body. These men and their colleagues and successors taught and inspired innumerable English-speaking students.

During the first third of the twentieth century, Göttingen fully maintained its historic standards. Its mathematical disciplines, especially, were held in the highest esteem. The great mathematical-physical group at Göttingen was, beyond all cavil, the most important scientific school in post-War Germany. Members of this school were among the first to re-establish contact with English colleagues after the War, and Göttingen was the first German university to receive English students.

The University of Göttingen was founded by George II of England, and opened on October 31, 1734. Thus an appropriate occasion for a bicentenary would have been the early autumn of 1934. At that time, however, both Germany and her neighbours were still very conscious of the effects of the official massacre, known as the 'clean-up', of June 30 of that year. The number who perished on that day is still not exactly known—the German Government has published no list—but a list of persons of political importance who disappeared about that time contains no less than 1,184 names. Further, it was towards the end of June 1933 that students and "black guards" (S.S. men) secured a great number of books from the University library at Göttingen and burnt them in public without protest from the Rector. Memories are short, but it has been found impossible to secure complete forgetfulness of these events. The German authorities have, therefore, taken the prudent line of associating the day with other events. Last year the Heidelberg centenary celebrations were arranged to culminate on June 30, and this year June 30 is chosen for Göttingen.

Though 1934 might have been more appropriate for the celebration, 1937 is certainly the centenary of important events in Göttingen history. On September 17, 1737, the University occupied new buildings. In 1837, the liberal constitution that had been granted to the Hanoverians a few years earlier, was revoked by their sovereign, Ernest Augustus, son of George III of England. Seven of the most distinguished professors of Göttingen—the famous *Göttinger Sieben*—protested. They were expelled. The displaced professors included some of the greatest scholars of the age. Among them were Wilhelm Weber, the brothers Grimm and Ewald. These three events, therefore, the massacre of June 30, 1934, the burning of the books about a year before, the abrogation of the liberal constitution of 1837 and the expulsion of the professors in the same year, will be in the minds of many on June 30, 1937, when the Rector of the University of Göttingen has bidden guests from universities and learned bodies throughout the world to rejoice with him.

Those who join in the celebrations at the University of Göttingen will ask in what spirit that body interprets learned anniversaries. The question has been answered by its professor of ancient history, Dr. Kahrstedt, in an address at Göttingen on German Empire Day. He explained that that day was :

> "the day to take this vow :— We renounce international science. We renounce the international republic of learning. We renounce research for its own sake. We teach and learn medicine, not to increase the number of known microbes, but to keep the German people strong and healthy. We teach and learn history, not to say how things actually happened, but to instruct the German people from the past. We teach and learn the sciences, not to discover abstract laws, but to sharpen the implements of the German people in competition with other peoples. If the German universities make and keep this vow, then it will naturally come about again that they are the first to be consulted in all cultural and spiritual questions."

These sentiments and this confidence were echoed by the Minister of Education, Herr Rust, at the centenary celebrations at Heidelberg on June 30, 1936. Herr Rust said that "the National Socialist Government has, since 1933, got rid by a series of institutional measures of what was outworn and superfluous in the Universities". We may now therefore glance at these "outworn and superfluous" elements at Göttingen.

In its institute for mathematics, in its institute for theoretical physics, in its two institutes for experimental physics and in its institute for mathematical statistics, there were gathered together at Göttingen in 1932 as active and brilliant a group of investigators as were to be found anywhere in the world. Wholesale dismissals began in 1933, earlier at Göttingen than at any other seat of learning, and they affected especially these institutes which were the chief glory of the University. At the mathematical institute there was only a single survivor, while the other great institutes were also 'cleaned-up'. Of the 238 members of the staff, 52—twenty-two per cent—were displaced. The readers of NATURE may be interested to learn the names of a few of these.

(1) Prof. Felix Bernstein at the time of his dismissal had been on the staff at Göttingen for twenty-five years. He was director of the Institute for Mathematical Statistics which was developed under his supervision. He now holds a chair at Columbia University, New York.

(2) Prof. Max Born has become famous for his work on the quantum theory and on atomic structure and is generally recognized as one of the most distinguished living exponents of theoretical physics. He now holds a chair at Edinburgh.

(3) Prof. Richard Courant is a specially stimulating teacher. He was the chief organizer of mathematical research at Göttingen. He is now a professor at New York University.

(4) Prof. James Franck won the Nobel Prize for physics in 1925 for his experimental confirmation of the basis of the quantum theory. At the time of his resignation he had been an "ordentlicher" professor at Göttingen for eight years. On resigning he wrote that he could not remain silent while his colleagues were being dismissed. Thirty-three professors and lecturers at Göttingen signed and published a protest against his "impertinent resignation", accusing him of "sabotage" ! Prof. Franck now occupies a chair at Johns Hopkins University.

(5) Prof. Hermann Fraenkel is very well known as an Hellenic scholar. He is now professor of Greek at Leland Stanford University, California.

(6) Prof. V. M. Goldschmidt, a geologist and mineralogist of international reputation, was liable to dismissal as a foreigner. He is of Norwegian nationality, having been born at Oslo where his father was professor. Many professors of geology and mineralogy in Germany signed a memorial that he might be retained. He was allowed to stay for a time, but his life was rendered unendurable and work impossible. He was given no sort of protection by the Rector or by the other authorities. He resigned and accepted a chair at Oslo.

(7) Prof. Edmund Landau is generally regarded as one of the great pure mathematicians of our time. His name is specially associated with the theory of numbers and the theory of functions At the time of his dismissal he was director of the Mathematical Institute and had been for twenty-four years an "ordentlicher" professor at Göttingen. He is sixty years of age.

(8) Prof. Otto Neugebauer is one of the most distinguished living exponents of the history of science and especially of Greek astronomy and mathematics. He is now professor of the history of mathematics at the University of Copenhagen.

(9) Miss Emmy Noether had an international reputation. She was widely regarded as the most distinguished woman mathematician of our time and perhaps of all time. Her name is especially associated with the theory of groups. She died in exile in the United States soon after her dismissal.

(10) Dr. Karl Saller, an anatomist who specialized on questions of 'race', was dismissed because he could not teach the official doctrines concerning an 'Aryan race'. Dr. Saller was himself once a Nazi, but he could not endure the limitations laid by the Party on scientific inquiry, and his anthropological knowledge prevented him from accepting its racial doctrines. He resigned and was treated with great severity.

(11) Prof. Hertha Sponer is a distinguished experimenter whose name is associated with the analysis of molecular spectra. She is now professor of physics at Duke University, North Carolina.

(12) Prof. Hermann Weyl was called to Göttingen from Zurich in 1930 to succeed the mathematician Prof. Hilbert for whom the famous Mathematical Institute had been built, partly from Rockefeller funds. Prof. Weyl had difficulties because of his wife's Jewish origin and therefore took the opportunity to leave Göttingen when invited to Princeton. Prof. Weyl is known as a philosopher as well as a mathematical physicist.

In estimating the influence of the new régime on German universities several factors have to be considered :

(1) The actual losses can now be estimated with fair accuracy. The number of teachers known to have been displaced from the universities and seats of higher learning is 1,684 ; that is about fifteen per cent of the scholars of Germany. To this must be added a number of quiet resignations and retirements. The true number of displacements is probably not far from 2,000. No institution has suffered more than the University of Göttingen by the loss of distinguished members of its staff ; and of the universities, only Berlin, Frankfurt and Heidelberg have lost as high a percentage.

(2) The intimidation of the staff has a profoundly unsettling effect on their work. Moreover, a stream of edicts—often of a contradictory nature—constantly pours from the Ministry of Education. Merely to master this mass of 'official German' is a considerable task. The excited and threatening political atmosphere in which all officials must live—and German university teachers are now more than ever officials—militates against careful scientific work. Estimates in all departments are unanimous in reporting a rapid and continuous fall in quality. This fall is somewhat masked, partly by the inclusion of foreign contributions, which are eagerly accepted by German scientific journals, and partly by the output of text-books.

(3) The most deadly enemy of German science is the method of recruitment of the junior teaching staff. There is now in operation a complex apparatus that effectively bars studious, scholarly and objectively minded young men from joining the junior staffs of German universities. Beginning in the elementary schools and ending with 'habilitation', there is a whole series of searching tests of the opinions, the political reliability and the military value of every academic aspirant. Two recent orders must suffice to illustrate these points.

The official *Völkische Beobachter* issued a statement on April 5, 1937, that sword practice would shortly become compulsory in all the universities. The statement ends thus :

> "Soon, when we hear again the words of command for the duel in the universities and seats of higher learning, and the arms clash again, we shall know that this bodily exercise that belongs equally to the whole nation, is no longer a class distinction as formerly. And everywhere, when a man challenges the offender of his honour, there will no longer be any such thing as academic privilege, but only the manly settling of an offence against honour for every Folk-Comrade trained to arms."

The following decree of the Minister of Education was issued last month in his official journal :

> "*Disciplinary Procedure against Student Leaders.* I request the Rectors of the German Universities that in future, *before* initiating disciplinary procedure against students who hold office in the German Students' Federation or in the Nazi Students' Union, they report to me with the presentation of the evidence and await my decision."

Thus not only are students being selected at the universities for qualities irrelevant to their scholarship but also the universities themselves are being deprived of their disciplinary power. The whole organization of the German university from rector to student is on a new basis. Göttingen ceased in 1933 to be a scientific centre. On June 30, visitors to Göttingen will celebrate a unique series of losses of learning, liberty and life.

Obituary Notices

Brigadier-General Sir H. C. L. Holden, K.C.B., F.R.S.

SIR HENRY CAPEL LOFFT HOLDEN died on March 30 at the age of eighty-one years. He was a man of great vision, a distinguished scientific investigator, mathematician and mechanician. His was a versatile and inventive mind which knew no bounds. No matter what the nature of the work or investigation he undertook, he would bring to it an active, keen brain, with freshness of outlook and freedom from the trammels of past practice. He sought to improve on what already existed, or to develop something fresh which would be more effective in its application.

It is now nearly forty years since I came into contact with Sir Capel Holden, when he was superintendent of the Royal Gun Factory, Woolwich Arsenal. He at once impressed me as a man of forceful character and of considerable scientific attainment.

At a time when electric transmission in connexion with machine tools was almost unknown, Holden was a pioneer and applied his talents to the development of an electric drive on machines for the manufacture of guns. He introduced an ingenious magnetic chuck which has had many applications and is still in use in the Royal Arsenal. These pioneer efforts were the forerunners of many of the electrical devices applied to up-to-date machinery of the present day.

Prior to my contact with him, Holden had already shown a flair for experimental work and electrical investigation. Nearly fifty-five years ago when in India, he was given permission to erect a special area line, and the knowledge gained by his tests led to his appointment in the Royal Arsenal, Woolwich, in 1885 as Captain Inspector in the Royal Gun Factory, and afterwards as Inspector of Warlike Stores in 1888. But his innate genius for experimental and electrical work did not find full scope for his abilities until his appointment in the experimental establishment in the Royal Arsenal. Here he built up a reputation as one of the foremost ballistic experts and authorities on gun construction. Among other scientific developments, he modernized and improved the Boulengè chronograph for measuring velocities of ammunition in flight.

At this time, Holden was continuously at work designing instruments and making experiments in internal ballistics and investigating the burning of explosives, which materially improved our knowledge of such matters and led to great savings in expenditure. The most important results of his experiments were embodied in the rules and methods for calculating explosive charges and ballistics in guns. These had formerly been a matter of guesswork, and were actually obtained by trial and error. Since his methods have been in use, it has been easy to predict what are the best proportions of the charge of projectile and what ballastics can be obtained as a maximum from a given gun under different conditions. For his special work in connexion with the foregoing investigations he received a substantial reward from the Government.

In 1899, Holden was appointed superintendent of the Royal Gun Factory, Woolwich, and acted as Chief Superintendent of Ordnance Factories for a short period in 1903. When the Royal Gun Factory and the Royal Carriage Departments were amalgamated in 1907, he was selected for the joint post, which office he held until his retirement in 1912. During this period, he completely revolutionized safety devices for guns and introduced many ingenious mechanical and electrical devices. Standing to his credit are many inventions and improvements which evolved from the fertile brain of this scientific investigator and born engineer. He again received a substantial reward from the Government for these further services. For many years, Sir Capel served as an official member of various committees, where his wisdom and advice were greatly sought after.

Yet, amid all the activities directly connected with his official post, Holden's inventive powers sought other fields of investigation. His energies directed him to take up motor engineering, in which he sought to perfect an engine for use in a motor-car and motor-cycle, and a four cylinder 'Holden' motor-cycle of his design, which embodied many ideas in advance of the then current practice, was put on the market. In 1905 he became chairman of the Royal Automobile Club, and afterwards, in 1921, chairman of the Royal Aero Club.

Holden's scientific attainments brought him early to the fore-front as a clear-thinking investigator of a high order. This was recognized by his election to the Royal Society more than forty years ago. He was called from his retirement to be Director of Mechanical Transport at the War Office in 1914, and served at the Ministry of Munitions in 1917–18. For his further services to the Government he was honoured by His Majesty the King by being made a Knight Commander of the Order of the Bath.

Sir Capel's services to electrical science and its application to electrical and mechanical development were clearly recognized by his election to full membership of the Institution of Electrical Engineers, and afterwards he became a vice-president of the Institution. He was also a vice-president of the Royal Society of Arts and in 1927 president of the Radio Society of Great Britain.

It is difficult, if not impossible, to estimate with any degree of accuracy, the value of the service Sir Capel rendered to his country and to the armament and engineering industries; but it may be said of him, as of other great engineers, that he wrested from Nature some of her secrets and used them for the benefit and convenience of mankind.

FRANCIS CARNEGIE.

Prof. S. Young, F.R.S.

PROF. SYDNEY YOUNG, after a brief illness, died in a nursing home in Bristol on April 8 at the age of seventy-nine years. He received his training in chemistry at Owens College, Manchester, and the University of Strasbourg, and in 1882 was appointed lecturer under William Ramsay in University College, Bristol. From that date until Ramsay went to London in 1887, he and Young published a series of joint papers dealing with such subjects as evaporation and dissociation, the properties of water and steam, and the thermal properties of many liquids.

It was not, however, until Young was appointed to the chair of chemistry in Bristol in 1887 that the long series of investigations commenced which established his reputation as one of the leading physical chemists of his day. The earlier papers dealt with the generalization of van der Waals, the determination of critical volume and density, the law of Cailletet and Mathias, the thermal properties of iso-pentane, *n*-pentane and *n*-hexane, and the boiling points of different liquids at equal pressures.

The preparation of the substances Young investigated necessitated a new type of still head, and after much experimental work, those he devised and made himself were so remarkably efficient that he was able for the first time to obtain liquids of an exceptional degree of purity, and with them he was able to investigate in a way that had been previously impossible the nature of the lower boiling fractions of American petroleum. The determination of the vapour pressure and boiling points of mixed liquids, such as the lower alcohols and water, and the alcohols, benzene and water, led to the 'azeotropic' method for the preparation of absolute alcohol, which proved of considerable technical importance.

The whole of this fundamental work was characterized by a very high degree of accuracy, and demanded great experimental skill and extraordinary patience. Dr. Young gave an account of this work in "Fractional Distillation", published by Messrs. Macmillan and Co., Ltd., in 1903, and in a second enlarged edition called "Distillation Principles and Processes" in 1922.

It was whilst Young was in Bristol that he was elected to the Royal Society in 1893. In the laboratories there the numbers of students were small, and in consequence both administration and teaching left him ample time for experimental work. Although some of his communications were joint papers with Miss E. C. Fortey, Dr. G. L. Thomas, Dr. F. Francis and Prof. F. R. Barrell, by far the larger number were the result of his own individual work. When he accepted the invitation to the chair of chemistry at Trinity College, Dublin, in 1903, he found the conditions there entirely different, and the large amount of teaching and administration made such heavy demands on his time that his experimental work suffered, although he still made contributions to various societies.

Young was president of Section B (Chemistry) of the British Association at the Cambridge meeting in 1904. "Stoichiometry" was published by Messrs. Longmans, Green and Co., Ltd., in 1908, and a second edition in 1918. In 1917 he was elected one of the vice-presidents of the Chemical Society, and between 1920 and 1925 he served on the Advisory Council of the Department of Scientific and Industrial Research. His work for Trinity College, Dublin, was highly appreciated, and a leading article in the *Irish Times* when he retired stated that "he was a proof that Irish and English mentalities are not among the things which resist combination".

Young's connexion with the Royal Irish Academy, of which he was president in 1921–26, gave him an importance in Ireland's intellectual life, and his tact, kindliness and known moderation, together with the able co-operation of his wife, did much to ease a difficult period of transition. On his retirement from Trinity College in 1928, he received a remarkable, and perhaps unique tribute, for on that occasion he was presented with an address containing 210 signatures of old students and eminent men of science from all over the world. They expressed their high appreciation of his work, and wished him many years of leisure. In the last year of his life he was greatly pleased at being elected president of the Manchester University Old Students' Association.

Prof. Young married Grace Martha Kimmins in 1896, and she survives him. They had twin sons, of whom Sydney Vernon was killed in the Great War and Charles Edgar is headmaster of Lincoln School and headmaster designate of Rossall.

JUST at a time when preparations are being made to celebrate the hundred and fiftieth anniversary of the birth of the Czech biologist, Jan Evangelista Purkyně (Purkinje) comes the news that his grandson, Prof. Cyril Purkyně, died in Prague on April 5 after a long illness at the age of seventy-four years. Prof. Cyril Purkyně had been professor of geology and mineralogy at Prague Technical University since 1907, after having taught geology and palæontology at Pilsen from 1895 until 1907. Whilst there, he began his work on local geological cartography and this was extended after his appointment as the first director of the Czechoslovak State Geological Institute in 1919

WE regret to announce the following deaths:

Prof. A. W. Borthwick, O.B.E., first professor of forestry in the University of Aberdeen, and formerly chief research and education officer to the Forestry Commission, on April 19, aged sixty-four years.

Lord Conway, known for his explorations in the Himalayas, Spitsbergen, the Andes, etc., author of many well-known works on exploration and travel, on April 18, aged eighty-one years.

Prof. A. Gravis, emeritus professor of botany in the University of Liège, on January 1.

Sir George Hart, K.B.E., C.I.E., formerly Inspector-General of Forests in India, on April 16, aged seventy-one years.

News and Views

Prof. G. G. Henderson, F.R.S.

THE medal of the Society of Chemical Industry has been awarded to Prof. G. G. Henderson, regius professor of chemistry in the University of Glasgow. The Medal is presented every alternate year for conspicuous service to applied chemistry. Prof. Henderson began a life-long association with teaching in 1884, when he became assistant to the professor of chemistry in the University of Glasgow. He also possesses the unique distinction of having been president of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry. For a number of years, he was one of the secretaries of Section B (Chemistry) of the British Association, in 1905 he became recorder, and in 1916 he was president. Much time and energy has been devoted by Prof. Henderson to the prosecution of original research —mostly in the organic field and particularly the chemistry of terpenes—and to the supervision of the research work of students.

Destruction of the Bed Bug

A PROMISING advance in solving the problem of the destruction of bed bugs is reported in the *British Medical Journal* of February 27, p. 459, by Messrs. S. A. Ashmore, of the Government Laboratory, and A. W. McKenny Hughes, of the Natural History Museum, acting for the Committee of the Medical Research Council. That the evil is a grievous one, although often passed by on account of the unsavoury nature of the subject, can be gathered from conversations with medical officers of health, who have been known to declare that they can identify streets with infested houses from the paleness of the children due to sleeplessness produced by bites. It has been said that in hot weather children are driven from their beds to play in the streets in some quarters during the light night hours. Disadvantages attach to most of the treatments previously tried. Thus hydrocyanic acid in the gaseous form is lethal to the insects and also to their eggs, but the use of this highly toxic substance obviously requires great precautions, especially, for example, in treating a room situated in the midst of tenements. Certain chlorinated aromatic derivatives appeared promising, but were found to act as liver poisons on the animal organism, and presumably on man, if traces were left unevaporated.

THE authors put forward a simpler method with which they have had promising results both in the laboratory and in about two hundred infested houses. It consists in spraying the room at a temperature not below 60° F. with a quantity of fairly high boiling coal-tar naphtha for which a specification is given, the room being thereafter sealed for eighteen to twenty-four hours. It is claimed that this substance is not only lethal to the insects, but is also an ovicide, and that it is not harmful to other animals. The concentration of vapour necessary is well below that of the flash-point of its mixture with air. Research is going on at the Field Biological Station of the Imperial College of Science to determine which of the many constituents of this coal-tar naphtha is specially efficacious, but the above-quoted report points to a remedy, by the careful use of a cheap and easily obtained product. It is greatly to be hoped that this method proves successful, for this social evil is a very great and widespread one.

The Boulder Dam

A LECTURE on the remarkable engineering achievement, known as the Boulder Dam, across the Colorado River about thirty miles south-east of Las Vegas, Nevada, where the river forms the boundary between the States of Nevada and Arizona, was delivered to the Institution of Civil Engineers on April 15 by Mr. John Lucian Savage, chief designing engineer, Bureau of Reclamation, United States Department of the Interior. The Dam has already been referred to in NATURE (Feb. 9, 1935) and the leading particulars will be given in one of a series of articles on "Water Power Developments in the United States", already prepared and awaiting publication. Mr. Savage's lecture was a very detailed account of the engineering features of the undertaking and of the constructional methods employed. It is interesting to note that the four diversion tunnels for the river (which were a necessary provision at the outset of operations) each 56 ft. diameter bore and 4,000 ft. long, were driven through unusually sound monolithic rock, with the result that 1,500,000 cubic yards of excavation in the three miles of tunnel were removed without the use of timbering or roof supports of any sort. "The ideal character of the andesite breccia rock for tunnelling purposes, as evidenced by this record, is one of the marvels of Boulder Dam." The reservoir behind the dam, called "Mead Lake" in honour of the late Dr. Elwood Mead, has a capacity of 30,500,000 acre-feet, of which 9,500,000 acre-feet has been reserved for flood control. This volume of flood storage, combined with the 520,000 cusecs (cubic feet per second) of flood discharge capacity, provides for an estimated inflow into the reservoir of nearly a million cusecs without overtopping the dam. This extraordinary provision for inflow is made in view of the remote contingency of the failure of an upstream dam.

A Film of the Royal Botanic Gardens, Kew

A PRIVATE view of a new 'documentary' film of the Royal Botanic Gardens, Kew, was given to a number of men of science in London on April 14. The film, which was made by Short Film Productions, Ltd., and produced by Mr. Harold Lowenstein with the co-operation of Sir Arthur Hill and his staff, gives a 'cross-section' of the activities of Kew as a public garden and as the centre of economic botany and horticulture in the Empire. The opening views give a picture of the Gardens as seen by the ordinary visitor, followed by sequences showing some of the work that goes on behind the scenes, both out of doors and under glass, in order to keep the Gardens in good condition and to provide a constant succession of bloom throughout the year. The most interesting section of the film from the scientific point of view is that illustrating the work that is carried out in the Herbarium, Jodrell Laboratory and Museums. The process of drying, pressing, mounting and storing botanical specimens is shown in the film in detail, and the method of examining and describing new species is also dealt with. The work of the Jodrell Laboratory consists largely of identifying fragments of plants (roots, stems, leaves, etc.) by microscopical examination, and one of the best sequences in the film illustrates the technique of examining a portion of stalk found in the stomach of a poisoned cow. The film ends with an impressionistic treatment of the part that Kew has played in the foundation and improvement of many of the important agricultural enterprises throughout the Empire. The introduction of Para rubber and cinchona (quinine) from South America via Kew to the East in the middle of last century is illustrated, and more recent instances show that this type of work is still being undertaken. This film will undoubtedly be of value in spreading a knowledge of the great importance of the Royal Botanic Gardens in the botanical and horticultural work of the Empire, and it is hoped that it will obtain a wide circulation, especially among schools and other educational institutions.

Palestine Folk Museum

AN appeal for financial assistance towards the needs of the Palestine Folk Museum, appearing in *The Times* of April 19, should meet with a sympathetic reception from the widespread public in Great Britain and America, which is interested in the history and culture of Bible lands. The museum, which is situated in Jerusalem, was opened in 1936 under a committee formed in the preceding year and composed of representatives of the resident English, Arab and Jewish communities. Unfortunately it has no funds, and its work is carried on by voluntary helpers—no inconsiderable burden, even with a tolerant standard of efficiency. No Government grant has been made towards the expenses of the Museum, nor is it eligible to receive assistance from the funds provided by the Carnegie Corporation to aid the museums of the Empire through the Museums Association, Palestine being a mandated territory. Until something in the nature of an assured income is provided, it will not be possible to appoint a curator, an obvious necessity, or to carry on research. Folk museums now have a recognized and an increasingly important part to play in the record and study of cultural history; but the value to the student, whether archæologist or historian, of a folk museum in a country in the near East, such as Palestine, is exceptional. A prolonged period of little cultural change has preserved peasant arts and industries, with their characteristic implements and appliances, domestic and other, virtually unchanged for many centuries, so that objects can be seen in daily use in the villages, which are identical in form and purpose with finds from Palestinian sites of the Bronze and Iron Ages. This period of comparative immobility is rapidly drawing to a close under the impact of an expansion of population and industry under Western influence.

Science and the Conservation of Food

IN his Friday evening discourse at the Royal Institution on April 16, Mr. T. Macara described some special problems of "Science and the Conservation of Food". While the term 'conservation of food' may be applied to many aspects of the production and handling of foods, he confined himself to problems connected with some common types of manufactured food. The first problems discussed were mould growth and fermentation, crystallization, and absence of jelly property in jam. As regards mould growth and fermentation, Mr. Macara put forward the theory that their prevention depends on the production of a jam having a higher osmotic pressure than that of mould spores or yeast cells, and he showed how this result could be achieved. The jelly property of jams is due to the fruit pectin, and it was shown how the jellifying property of this pectin may be lost or destroyed through lack of knowledge of its properties. Problems connected with the preservation of fruits, vegetables and meat products were then discussed. The British Food Manufacturers' Research Association has found certain bacteria the spores of which show an extraordinary high resistance to heat. Boiling for 8 hours or heating to 230° F. for an hour fails to destroy them. It was pointed out that these times apply to small quantities of materials, and that when larger quantities have to be sterilized it is necessary to know the rate at which heat penetrates the product. The question of food storage in cans is surrounded with difficulties on account of defects in the coating of tin on the cans. A number of cases have been met with where the cans became perforated after three or four months' storage.

Joint Committee on Materials and their Testing

A COMMITTEE having the above title has now been set up by leading technical institutions and societies in Great Britain to act as the British national organization in matters relating to materials and their testing. The need in Great Britain of some means to provide for more adequate co-ordination of the study of materials and their testing has, during the past year, received the earnest consideration of the principal technical institutions and societies which are concerned directly and indirectly with these important subjects. Twenty-two institutions and societies are represented on the Joint

Committee. Essentially, the work of the Joint Committee will be divided into two fields of activity, national and international, of which the former will no doubt be of major importance. As a commencement in this field, the Committee is now engaged in making arrangements for a general discussion on the subject of the notched bar test to be held in Manchester in the early autumn of the present year. The activities of the International Association for Testing Materials in Great Britain are at present entrusted to the keeping of a British Committee, and the latter has agreed that, at the conclusion of the London Congress of the International Association for Testing Materials now being held (April 19–24), the Joint Committee shall take over the representation in Great Britain of all matters connected with the International Association. The first chairman of the Committee is Dr. H. J. Gough, largely through whose initiative the Joint Committee has come into being; the secretary is Mr. C. W. J. Taffs, of the staff of the Institution of Mechanical Engineers, the Council of which has kindly offered the necessary facilities for office work at Storey's Gate, St. James's Park, London, S.W.1.

New Commonwealth Society

THE fourth annual report of the New Commonwealth Society and Institute for the year ended September 30, 1936, refers to the way in which the events of the year have emphasized the soundness of the thesis of an equity tribunal and an international police force which the Society was created to advocate, and the report indicates that the New Commonwealth Society is rapidly gaining ground. Forty-four countries are now represented in the membership, which including the international members shows an effective increase of 252 on the year. The position of the group associate membership is less satisfactory. In addition to the publication of the journal and numerous pamphlets during the year, the British Section has initiated a scheme for a "Writers Panel" to develop publicity in the Press. Brief reviews of the activities of other national sections are included in the report. The section dealing with the New Commonwealth Institute outlines the progress of collective research on procedure for peaceful change, a basis for which has been provided by a report prepared by Prof. K. Strupp dealing with the possibility of an international peace convention and peace charter. A department for collective research on the organization of some form of international force has been initiated under Capt. E. Abraham, and similar activity has also been initiated on the reform of the League of Nations. Detailed proposals have already been forwarded to the members of the Advisory Research Committee and to the Foreign Offices of all States members of the League. A further development in the year is the organization of an information department.

Additional Food for the Special Areas

A MEMORANDUM on the Special Areas Bill dealing with the provision for additional food, etc., for mothers and children in distressed areas has been submitted to the Prime Minister by the Children's Minimum Council. The memorandum submits evidence of the inadequacy of incomes in distressed areas based, in respect of food, on figures given in "A Revised Estimate of the Poverty Line" by R. F. George (*J. Roy. Statistical Soc.*). The figures indicate broadly the increasing extent to which the incomes of the unemployed fall below the requirements for health as the size of the family increases. Other evidence of the lack of nourishment of mothers and children in these areas is presented, and the limitations of the present provision by local authorities in England and Wales in consequence of the inability of local rates to support it are also reviewed and discussed. The memorandum urges that the Government should provide in the forthcoming Bill for grants from the national exchequer to local authorities in the Special Areas to cover the whole cost of the supply of free milk to all children in public elementary schools and to scholarship children in secondary schools; the supply of free school meals to all children belonging to families where the amount available for food falls below a scale to be determined by the Ministry of Health; the supply of free boots to school children in such families; and the supply of free milk to expectant and nursing mothers and to children under school age in such families.

Lancashire and Cheshire Fauna

THE twenty-second report of the Lancashire and Cheshire Fauna Committee, just issued, which covers 1935, is probably the most useful publication of the Committee apart from its Check List. It deals chiefly with vertebrates, and in addition to the records of the occurrence of rare species, includes detailed tables of the distribution of the woodcock, grey squirrel and great crested grebe in Cheshire, and the pochard, great spotted woodpecker and redstart in both counties. The committee which announces it is also to include the recording of the marine fauna within the three mile-limit in its work, makes an addition of 101 species new to both counties and 25 new to one county, the former consisting of 28 Coleoptera, 20 Diptera, 20 Hymenoptera, 12 sawflies, 8 Acari, 5 Hemiptera, 2 Mallophaga and Neuroptera and 1 each of Mollusca, Lepidoptera, Anoplura and Siphonaptera. The more interesting specific records are: a new colony of Natterjack toads at Storeton, Cheshire; a November golden oriole at Macclesfield; numerous reports of the invasion of crossbills; a meadow-pipit at Heywood, Lancashire, with an abnormal clutch of five sky blue eggs spotted with red, and a magpie that has developed the habit of nesting on the ledge of a steep moorland cliff there; a chiffchaff wintering there, although it does not nest in the district; a December immigration of blackbirds; an investigation of swallow broods showing that 35 broods in Lancashire averaged 4·05 young and 97 broods in Cheshire averaged 4 young; a kestrel taken in Manchester and found to have its plumage and its nostrils so heavily laden with soot that none of the usual parasites inhabited it.

Horticultural Science in France

M. Georges Truffaut lectured to the Royal Horticultural Society in October of last year, on the experiments on manuring, pest control and microbiology of the soil, which have been carried out under his direction at Versailles. The text of this lecture appears in the Society's *Journal* (62, Pt. 3, March) and portrays results which are in sufficient accord with the findings of research institutes in Great Britain to warrant thankfulness, and yet are original enough to provide great stimulation. M. Truffaut and his colleagues have shown that only when the nitrogen, phosphoric acid and potash are combined upon a basis of their atomic weights will the soil yield its fullest increase in response to artificial manures. The insistence of the earlier agricultural chemists on the necessity of lime for the growth of most crops is countered vigorously by the workers at Versailles, who find that the presence of calcium ions is often undesirable in garden soil. The most welcome contribution of the lecture to the science of pest control is perhaps the description of a new spray fluid known as 'Elgetol'. This is a mixture of a synthetic yellow dye with wetting agents. It has a milder action upon the tree than lime sulphur or tar oil winter wash, but it is quite effective against the overwintering eggs of various insect pests. Workers at the Versailles laboratories have established the fact that soil bacteria can obtain their energy exclusively from carbohydrates and organic salts excreted by the root-hairs of plants. "Living green plants are thus the main source of energy for soil micro-organisms." The lecture also reviewed a wider field of work than the results here mentioned; the sections on calcium metabolism and the control of pests during winter are most informative.

The Post Office and Broadcasting

IN the *Journal of the Institution of Civil Engineers* of March, a report is given of the interesting discussion of a recent paper by Sir Noel Ashbridge on broadcasting. Sir George Lee pointed out that the Post Office acts in several ways as an auxiliary to broadcasting. An important function which it fulfils is reducing the interference which many listeners experience on their wireless sets from electrical machinery. Last year, it investigated 40,000 cases of interference. The total circuit mileage used by the B.B.C. in the P.O. network last year was about 6,000. A large number is also in use for Continental broadcasts. Every country in Europe has now these special circuits, and they are often used for the broadcasting of special events. It is estimated that if 80 per cent of the mains-operated receivers were in use during some important event, such as the coronation, when most people switched on their receivers, the load on the grid system due to this cause alone would be 250,000 kilowatts. The annual consumption of receivers is about 270 million units, quite an appreciable fraction of the load on the grid. Another interesting statistical fact which Sir George Lee gave was in connexion with the three short-wave and one long-wave station which work to America every day. Several hundred kilowatts are radiated from Great Britain towards America but all the power picked up in America would be only sufficient to raise a fly seven inches high in one year. On land-lines, amplifiers are put in at about every fifty miles and there is therefore a large number of amplifying stations between Great Britain and San Francisco. Each amplifier receives such feeble signals that they are just distinguishable from the inherent noise in the circuit, and it amplifies them only sufficiently for the signals to be received at the next station; yet the total amplification received in that repeated process is 10^{156}, a number inconceivably great!

Electric Locomotives for the Natal Railways

FROM the Metropolitan-Vickers Electrical Company's *Gazette* of March 1937, we learn that during the year 1935 it had received orders for twenty-five new 1,200 h.p. electric locomotives for the railways of Natal from the South African Government. The new locomotives had become necessary because of the increased traffic and the doubling of the route mileage. The company had already supplied ninety-five locomotives which had been in constant service in Natal for terms varying from nine to twelve and a half years. The line from Glencoe to Pietermaritzburg is very hilly. Glencoe is situated near the centre of the Natal coal-field, and the transport of coal to Durban constitutes a large part of the traffic on the line. Power is supplied from Colenso through a three-phase 88,000 volt transmission system. The new locomotives differ from the original ninety-five in many details, but they are suitable for multiple unit working in combination with any of the ninety-five original locomotives. Each locomotive is of 1,200 h.p. capacity with four axles each driven by a 300 h.p. traction motor. The auxiliary machines in each locomotive consist of an air compressor, an exhauster and two motor generators of 16 kW. and 28 kW. capacity respectively. The compressor supplies compressed air for the operation of the locomotive brakes. The exhauster produces the vacuum for the train brakes. Of the many improvements embodied in the new locomotives the most important are in the control gear and the pantagraphs for collecting the current. The latter work with a line pressure of 16 lb. as against the original 26 lb. and weigh about 400 lb. less. They can now be raised to the collecting wire without mechanical shock, and similarly there is no shock when lowered to the roof.

Recent Solar Activity and Auroras

A NOTE received from MM. Eigenson and Gnevishev of the Pulkovo Observatory directs attention to the high degree of sunspot activity on and about January 31 last (when the Tashkent Observatory recorded a total spotted area of 4000 millionths of the sun's hemisphere) and a series of auroras which were extensively observed from the U.S.S.R. between January 31 and February 3. The solar activity and associated terrestrial phenomena (including the aurora observed in England on February 3) have been described in NATURE (Feb. 6, p. 228; Feb. 13, p. 277; Feb. 27, p. 375; and April 17, p. 680).

The Royal Veterinary College and Hospital

THE new governing body of the Royal Veterinary College has now been set up according to the constitution granted by the new Royal Charter of 1936, by which its name has been changed to the Royal Veterinary College and Hospital. The government of the college is now vested in a court of governors and an executive council. The Duke of Gloucester is president of the court, which consists of eighteen members nominated by the Royal College of Veterinary Surgeons, the Royal Agricultural Society of England, the National Veterinary Medical Association, the County Councils Association, the Medical Research Council and the Corporation of London.

Colonial Officers and Scientific Research

A FURTHER series of grants have been made by the Trustees of the Carnegie Corporation of New York to the Secretary of State for the Colonies to enable selected officers of the Colonial Service to spend a period of absence from their official duties in study, research and travel. Those who have received grants include the following: H. L. Collett, agricultural and soil erosion officer, Basutoland, for the purpose of investigating methods for the prevention of soil erosion in the United States; H. R. Phillpotts, assistant superintendent of public works, Jamaica, for a course of study in water purification and chlorination in the United Kingdom, and in sanitary engineering; W. Fotheringham, veterinary research officer, Kenya, for a course of study in pathology and bacteriology at the University of Edinburgh, and at the Royal Veterinary College, Camden Town, particularly in relation to the respiratory diseases of sheep; W. C. Gee, assistant engineer, Wireless, Posts and Telegraphs Department, Malaya, for the study of short-wave telephony transmission and ultra-short wave transmission and reception at various institutions in the United Kingdom, in the United States, and elsewhere; A. G. Beattie, agricultural officer, Nigeria, for a visit to India for the purpose of studying peasant husbandry, dairying and cattle breeding, and irrigation from wells; H. M. O. Lester, deputy director of Sleeping Sickness Service, Nigeria, for visits to the Congo, Tanganyika, the southern Sudan, and other parts of Africa, to study methods of sleeping sickness control; J. D. Martin, assistant conservator of forests, Northern Rhodesia, for a course in sylviculture and ecology at the Imperial Forestry Institute, Oxford; J. G. M. King, district agricultural officer, Tanganyika, for a visit to Nigeria to study methods of mixed farming introduced in that colony; R. A. M. Mackay, assistant inspector of mines, Tanganyika, for a course of study connected with the ore bodies of the Lupa Gold Field at the Royal School of Mines, London; A. C. G. Palmer, science master, Grenada Boys' Secondary School, Windward Islands, for a course in education with particular reference to agriculture.

Announcements

LIEUT.-COLONEL J. H. M. GREENLY has been elected chairman of the British Non-Ferrous Metals Research Association in succession to the late Mr. Thomas Bolton.

PROF. L. A. ORBELI of Leningrad, who is in charge of the late Prof. Pavlov's laboratories, has been appointed a member of the Permanent International Committee of Physiological Congresses in succession to Prof. Pavlov.

SIR HUMPHRY ROLLESTON has been appointed chairman in succession to the late Lord Moynihan of the Medical Board of the Eichholz Clinic, 204 Great Portland Street, W.1, which employs a staff of blind chartered masseurs, and is administered by the National Institute for the Blind.

THE February issue of *Forschungen zur Alkoholfrage* is dedicated to Dr. Emil Abderhalden, professor of physiology in the University of Halle, on the occasion of his sixtieth birthday.

THE Health Section of the League of Nations has nominated Prof. Giuseppe Bastianelli, director of the Institute of Malariotherapy at Rome, as president of the Special Committee for Malaria.

THE second Rumanian Congress of Radiology and Medical Electricity will be held at Cluj on May 21–23 under the presidency of Prof. Negru. Further information can be obtained from the secretary, M. Hananut, Calea Motitol 7a, Cluj, Roumania.

THE first International Congress of Infantile Psychiatry will be held at La Maison de la Chimie, 28 rue Saint-Dominique, Paris 7^e on July 27–August 1. Further information can be obtained from the treasurer, M. Gimbert, 11 rue Duroc, Paris 7^e.

THE twenty-sixth Congress of the German Society for Historical and Social Medicine will be held at Breslau on May 12–14, the subject for discussion being the present state of our knowledge of electropathology. Further information can be obtained from Prof. Gerhard Schrader, Lahnstrasse 9, Marburg.

AN International Congress for a discussion on short waves in physics, biology and medicine will be held in Vienna under the honorary presidency of Dr. Arsonval, Marconi and Zonnek on July 12–17. Further information can be obtained from the Secretariat, Alserstrasse 4, Wien IX.

THE Paris laboratory known as "La Biothérapie" has founded a Besredka prize of 15,000 francs for an essay on the therapeutic applications of local immunity. The first award will be made in June 1938. Further information can be obtained from La Biothérapie, 5 rue Paul-Barruel, Paris XV^e, before December 31.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 720.

Correspondents are invited to attach similar summaries to their communications

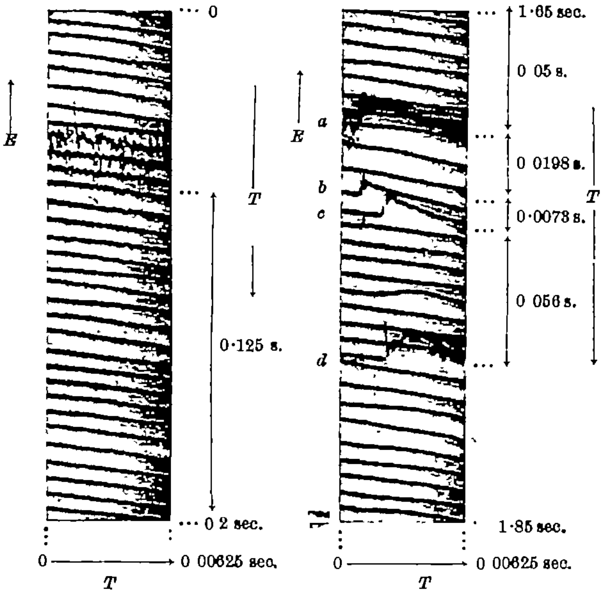
Atmospheric Disturbances due to Thundercloud Discharges

It is generally recognized that the phenomenon of lightning is extremely complicated, and many attempts, notably by Schonland[1], using a special camera, have been made to analyse and classify lightning flashes.

The problem has been attacked in another way by the study of the variations in the earth's electric field due to the lightning discharges. I have already described in Nature[2] an automatic cathode ray oscillograph photographic method of recording these variations. In that work, as in similar observations on field changes made by others, it was recognized that the inherent limitations imposed by the particular time-scale employed resulted in the observer's interest being centred on a part rather than on the whole phenomenon. A convenient cathode ray oscillograph photographic method has now been developed to make a continuous record of all the electric disturbances resulting from thundercloud discharges over a period of seconds, yet providing sufficient resolution to separate pulses of only a few micro-seconds duration.

A linear time-base is employed to produce a horizontal deflection of the cathode ray fluorescent spot; the field changes produce a vertical deflection, while the photographic film is moved at right-angles to the time-base deflection at a speed of 16 cm./sec. In this way a trace of saw-tooth form is obtained with the wave form of the field changes superimposed in time order of arrival, and the records give the total duration of the whole discharge as well as that of the separate lightning strokes. The advantage of this method is apparent, for, to obtain the same resolution by a continuous film time base alone, the film speed would have to be 1·6 metres per second.

An example of a complete record of the atmospheric disturbance occurring during a thundercloud discharge is shown in Fig 1. Portion *A* extends over 0·2 sec. and after an interval of 1·45 sec. is followed by the further phenomenon of the type shown in Fig. 1 *B*. The advantages of this continuous recording are again illustrated since in Fig. 1 *A*, we see the extraordinary phenomenon of a volley of discharges. followed in Fig. 1 *B* after a quiescent interval of 1·625 sec. by the main lightning discharge. This is seen to be analysed into a series of pulses essentially different from the previous ones, but presumably to be correlated with the intermittent lightning phenomenon photographed by Schonland. In Fig. 2 is illustrated part of a volley of discharges of the type already noted in Fig. 1 *A*. The whole disturbance had a duration of 2·3 sec. and in this case there was no indication of any succeeding intermittent lightning discharge. These examples of the results were obtained on Friday, June 19, 1936, between 11 p.m. and 1 a.m., when an extremely active storm crossed London from the south.



(*A*) (*B*)

Fig. 1.

Now it is to be presumed that the extended phenomenon shown in Figs. 1 *A* and 2 is the type of brush discharge so often observed in an active cloud as a prolonged flicker or glow. Although this does not produce the large and rapid change in the electric moment of the cloud charge that the lightning flash does, it is, nevertheless, effective in radiating a long series of electromagnetic waves of peak value and duration sufficient to cause considerable interference in radio receivers. It is interesting to note in this connexion the aural observations of Ashmore[3] and Howard[4], who reported that noise was heard by them in a wireless receiver an appreciable time before the lightning was visible, and also the similar observations of Fyson[5] and Coursey[6] recently mentioned in Nature.

Turning now to the main lightning discharge illustrated in Fig. 1 *B*, the successive pulses *a*, *b*, *c*, *d*, represent partial discharges. It will be noted that the main change of field in *a* is accompanied by a characteristic series of perturbations of decreasing intensity which is usually followed immediately by a rapid intense discharge. No case has so far been recorded of this particular process *a* preceding any of the subsequent discharges *b*, *c*, *d* of the group. The perturbations are evidently due to radiation from the successive 'steps' of the 'stepped leader' pre-discharge mechanism always found by Schonland to initiate such a series of lightning flashes. A detailed analysis shows that the 'steps' are separated by an interval of between 30 and 100 microseconds, their quasi-period corresponding to a wave-length of between 15 and 30 km. Also, during this pre-discharge process, a considerable cloud charge is moved of sometimes even greater magnitude than that caused by the main lightning discharge, and evidently produces the rapid localization of high potential gradients by which the subsequent discharge is initiated.

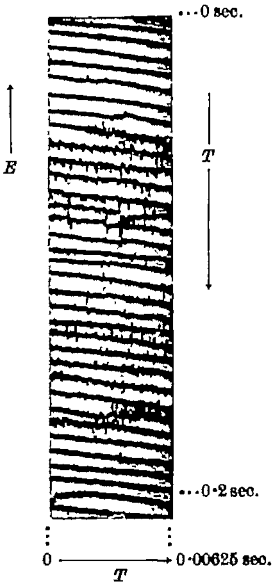


Fig. 2.

In Fig. 3 is shown the type of radiation field change resulting from the pre-discharge and main discharge of a distant lightning flash. This discharge was not preceded by the volley, and it must be emphasized that there is not sufficient evidence at the moment by which it can be asserted whether the volley of discharges is the usual or rare precursor of the lightning flash.

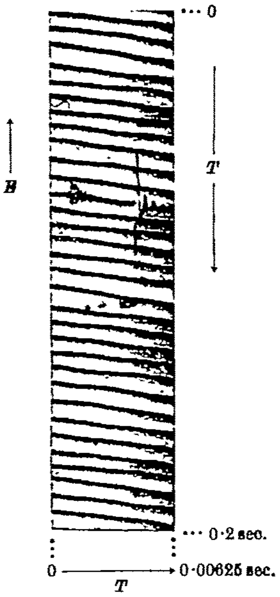


Fig. 3.

A careful study of many such records brings to light a number of interesting features concerning thundercloud phenomena which will be discussed in a subsequent paper.

F. W. Chapman.

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March 8.

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[1] Schonland, Malan and Collens, *Proc. Roy. Soc.*, A, **152**, 595 (1935).

[2] Nature, **131**, 620 (1933).

[3] *Met. Mag.*, **68**, 114 (1933).

[4] *Met. Mag.*, **68**, 139 (1933).

[5] Nature, **138**, 278 (1936).

[6] Nature, **138**, 509 (1936).

Chemical Detection of Helium formed in Beryllium by Gamma Rays

Some time ago, we showed[1] that micro-analytical methods are sensitive enough to identify spectroscopically and to measure the helium artificially produced by slow neutrons in boron. This reaction

$$^{10}_{5}\mathrm{B} + ^{1}_{0}n \rightarrow ^{7}_{3}\mathrm{Li} + ^{4}_{2}\mathrm{He} \qquad (1)$$

has been fully investigated by physical methods[2], so that chemistry can merely help in its quantitative study; but there are other processes of artificial disintegration where apparently at present only microchemical methods can decide between different possibilities.

Since the discovery of the 'nuclear photo-electric effect' by Chadwick and Goldhaber, it is known that gamma rays produce neutrons from deuterium and beryllium[3]; in the latter case the formation either of $^{8}\mathrm{Be}$ or of $^{4}\mathrm{He}$ is to be expected according to the equations

$$^{9}\mathrm{Be} + h\nu \rightarrow ^{8}_{4}\mathrm{Be} + ^{1}_{0}n \qquad (2)$$

or

$$_{4}\mathrm{Be} + h\nu \rightarrow 2^{4}_{2}\mathrm{He} + ^{1}_{0}n \qquad (3)$$

It is equally possible that both reactions take place. Now if reaction (3) occurs to any considerable extent, then we should be able to detect the helium by gas-analytical methods, while in the case of formation of a stable, or slowly disintegrating, $^{8}\mathrm{Be}$, no helium should be found.

In a first, semi-quantitative, experiment, lasting one month, we placed tiny radon sources in holes bored into a lump of 6·6 gm. of beryllium metal. After the decay of 0·6 curie of radon, we dissolved the beryllium in sulphuric acid and, by our micro-method, analysed for helium the 17 litres of hydrogen evolved; we found therein about 2×10^{-8} c.c. In another 8 gm. of beryllium, cut from the same piece but not irradiated, no helium could be detected; this means that less than 5×10^{-10} c.c. was present. The amount of helium which must thus be ascribed to the γ-irradiation is so considerable that it would appear to be formed by the main reaction; for if we assume the γ-rays of radium C′ of 1·8 and 2·2 million volts to be equally efficient, and the cross-section of the beryllium nucleus to be 5×10^{-28} cm.[2], we should expect a quantity of helium corresponding to the order found. Because of the uncertainties in these assumptions, however, we tried to decide by a more exact method whether helium is the main product of the reaction. Should this be so, then the number of helium atoms produced in beryllium would be twice that of the photo-neutrons; this latter figure can be determined from the equal number of helium atoms produced in boron according to reaction (1). With this aim in mind, we repeated the experiment, with larger quantities of radon, arranged as follows.

Into a sphere of metallic beryllium (radius 0·84 cm., weight 4·5 gm.) we drilled small holes towards the centre; in these we inserted glass capillaries (length on the average 6 mm., width 1 mm.) filled with radon. The sphere was placed during the whole irradiation in the pocket of the methyl borate vessel of 7·5 cm. radius, described in our previous paper[1]. Owing to their slowness, about 90 per cent of the photo-neutrons are caught inside this vessel. When, after 8½ months, 4·7 curie of radon had decayed near the centre of the beryllium sphere and the surrounding methyl borate, we analysed both the beryllium metal and the borate for helium; in the first we found $1 \cdot 8 \pm 0 \cdot 3 \times 10^{-7}$ c.c., in the latter $1 \cdot 1 \pm 0 \cdot 3 \times 10^{-7}$ c.c. of this gas. The theoretical ratio 2 : 1 is, therefore, approached closely enough to make it highly probable that the main product of the γ-irradiation of beryllium is ^{4}He, and not a stable ^{8}Be; thus, if reaction (2), and not (3), is the primary step, then the ^{8}Be nucleus disintegrates into two helium atoms with a half-value period of not more than a month.

Our grateful thanks are due to Prof. S. Russ, director of the Radon Department, Middlesex Hospital, London, for kindly supplying the radon tubes; and also to Dr. M. Goldhaber, Cavendish Laboratory, Cambridge, for suggesting the experiment and for helpful discussions.

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E GLÜCKAUF.

Imperial College of
Science and Technology,
London, S.W.7.
April 5.

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[1] Paneth and Loleit, NATURE, 136, 950 (1935). Paneth, Gluckauf and Loleit, *Proc. Roy. Soc.*, A, 157, 412 (1936).

[2] Chadwick and Goldhaber, NATURE, 135, 65 (1935). *Proc. Camb. Phil. Soc.*, 31, 612 (1935). Taylor and Goldhaber, NATURE, 135, 341 (1936). Amaldi, D'Agostino, Fermi, Pontecorvo, Rasetti and Segré, *Proc. Roy. Soc.*, A, 149, 522 (1935).

[3] Chadwick and Goldhaber, NATURE, 134, 237 (1934). *Proc. Roy. Soc.*, A, 151, 479 (1935). Szilard and Chalmers, NATURE, 134, 494 (1934).

Dilatometric Ultra-Micro-Estimation of Peptidase Activity

As appears from recent publications of Indian workers (Sreenivasaya and Bhagvat[1], compare also Rona and Fischgold[2]), a considerable volume change is observed in systems in which enzymatic cleavages take place. This volume change may be applied to the estimation of enzyme activity, and the dilatometric methods thus developed possess certain advantages, among which may be mentioned the continuous observation of the undisturbed enzymatic process. While looking around for possible means of refining the histochemical methods previously described (Linderstrøm-Lang and Holter[3]), I came across the falling drop method for the measurement of specific gravity (Barbour and Hamilton[4]), a method which recently was re-investigated and improved by Fenger-Eriksen, Krogh and Ussing[5]. Experience with this method led to the development of a static principle of measurement especially suited for estimation of volume changes in small drops and therefore for micro-estimation of enzyme activity. The following description is concerned only with the application of the method for this latter purpose, but the method may prove useful for the estimation of specific gravity also in other cases.

In a vertical glass tube, 30 cm. long, placed in a water-bath at 30° ± 0·005°, a practically constant specific gravity gradient was produced by mixing kerosene and bromobenzene in varying ratios. The gradient was measured by means of 0·1 c.mm. test drops of known specific gravities. Fig. 1 illustrates a characteristic experiment. The test drops were introduced at the top of the glass tube, a suitable micropipette being used, and fell in the course of ten minutes to the level given on the figure, where they remained practically constant for more than eight hours if the medium was well saturated with an aqueous solution of a suitable water vapour pressure. Their positions were observed in a horizontal microscope with ocular micrometer. The drops of enzymatic reaction mixtures were introduced in the same way and their positions were observed after about ten minutes.

In Fig. 1 the drop *A* (0·1 c.mm.) had the composition: 0·1 *M* with respect to *dl*-alanylglycine; 0·0173 *M* with respect to caustic soda; 0·0333 *M* with respect to phosphate buffer of *p*H 7·4; and it contained a suitable amount of peptidase (extract of pig stomach). During the enzymatic reaction the drop fell—corresponding to a decrease in volume—and its positions at different times were compared to those of the test drops. It reached a final position *A′* when the reaction was completed. Drop *B* contained boiled enzyme but was otherwise identical with *A*. In drop *C* the *dl*-alanylglycine was replaced by *dl*-alanine (0·1 *M*) plus glycocol (0·1 *M*). Both these drops remained constant at their respective

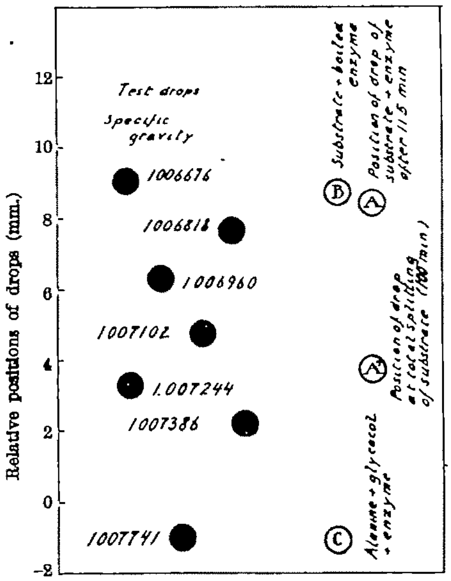
Relative positions of drops (mm.)
12
10
8
6
4
2
0
−2
Test drops
Specific gravity
1006676
1006818
1006960
1007102
1.007244
1007386
1007741
Substrate + boiled enzyme
Position of drop of substrate + enzyme after 11.5 min
Position of drop at total splitting of substrate (180 min)
Alanine + glycocol + enzyme
B
A
A′
C

Fig. 1.

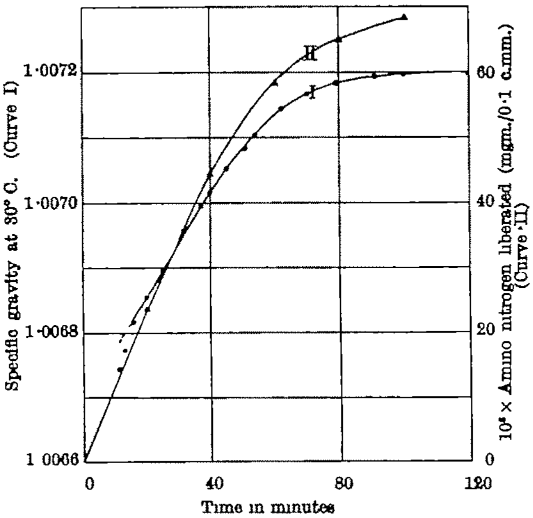

Fig. 2.

levels. The final position of A (A') is nearly halfway between B and C, in agreement with the fact that *d*-alanylglycine alone is split by the enzyme.

Fig. 2 (Curve I) shows graphically the results of this experiment. The chemical change (appearance of amino groups) during the enzymatic reaction was measured simultaneously in larger samples of the same reaction mixture and calculated as milligrams of amino nitrogen liberated per 0·1 c.mm. (Curve II). Finally, Fig. 3 shows the linear connexion between volume change and liberation of amino-nitrogen, 0·74 c.mm. disappearing per mgm. amino nitrogen formed. This agrees as regards order of magnitude with the volume changes found by Sreenivasaya, Sastri and Sreerangachar[6] for other proteolytic processes.

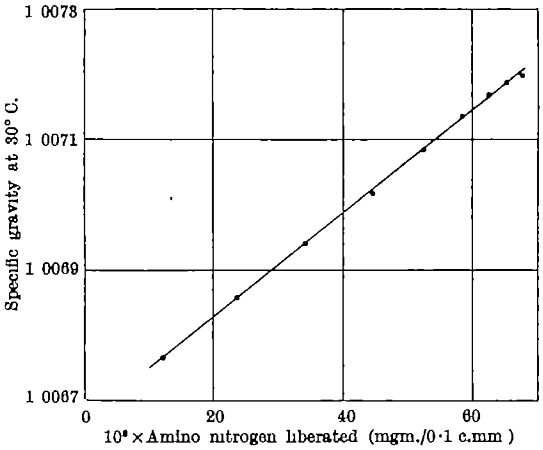

Fig. 3.

The method is being further developed and extended to include other enzymatic processes.

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March 9.

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[1] "Ergebnisse der Enzymforschung", 6, 234 (1937).
[2] *Biochem. Z.*, 261, 66 (1933)
[3] "Ergebnisse der Enzymforschung", 3, 309 (1934)
[4] *J. Biol. Chem.*, 69, 625 (1926).
[5] *Biochem. J.*, 30, 1264 (1936)
[6] *Biochem. J.*, 28, 351 (1934).

A Presumptive Culicine Host of the Human Malaria Parasites

IN controlled experiments with *Culex bitæniorhynchus* carried out during the past seventeen months, we have observed what we are unable to distinguish from the complete cycle of development of the parasites of benign and sub-tertian (malignant) malaria in laboratory-bred females fed on gametocytes of *Plasmodium falciparum* and *P. vivax* respectively. Presumptive sporozoites accompanied by a stomach cyst were also observed in an insect which was fed on gametocytes of *P. malariæ*, the parasites of quartan fever, those of sub-tertian being also present in much smaller numbers. Ross's black spores were found associated with sporozoites and cysts in several sub-tertian infected, and in one benign tertian infected, insect. These appearances were absent in laboratory-bred controls which had had no blood meals.

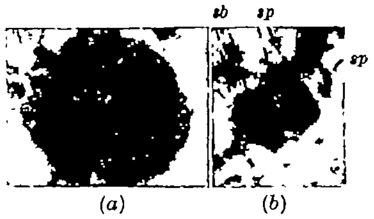

FIG. 1.

PRESUMPTIVE PLASMODIAL FORMS IN LABORATORY INFECTED *C. bitæniorhynchus*

(*a*). UNSTAINED SEMI-CHITINIZED-BLACK PIGMENTED CYST: S.T. INFECTION.
(*b*). BLACK SPORES: B.T. INFECTION, UNSTAINED.

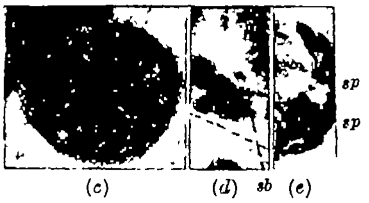

Fig. 2.

CORRESPONDING PHASES IN PLASMODIALLY INFECTED ANOPHELINE

(*c*). STAINED CYST (Q. OR S.T.). AFTER WALCH.
(*d*). UNSTAINED CHITINIZED SPOROZOITES AND 'SPOROBLAST'. AFTER WALCH.
(*e*). BLACK SPORES. AFTER WALCH.
sp = CHITINIZED SPOROZOITES. *sb* = CHITINIZED 'SPOROBLASTS'.

Apart from the fact that culicine mosquitoes have up to the present been held to be inhospitable to human malaria parasites, the interest of these observations is biochemical. Some years ago, one of us pre-indicated *C. bitæniorhynchus* as a possible malaria carrier[1] because it breeds in pure water among *Spirogyra*[2] (on which it also feeds), it being pointed out[1] that some of the most virulent anopheline vectors are likewise found in uncontaminated sources, a fact later confirmed by Covell's tables[3]. The practical, as well as the theoretical, implications of significant correlation between larval environment and power to transmit malaria are of great interest, but since they call for further discussion than is here possible, this together with details of our observations must await publication elsewhere.

We wish to express our obligations to successive Senior Health Officers, Penang, for opportunity to carry out our work, and further, especially to Dr. J. W. Scharff for his critical interest in it.

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Straits Settlements.
Feb. 20.

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[1] Williamson, K. B., *Malay Med. J.*, 2, 53 (1927).
[2] Senior White, R., *Bull. Ent. Res.*, 16, 187 (1926)
[3] Covell, G., *Ind. Med. Res. Mem.*, 7 (July 1927), also *Rec. Mal. Surv. Ind.*, 2, 1 (March 1931).

Biology of a Littoral Mite

DURING my work on the biology of the sea-shore, in East Greenland[1] I made some biological observations of the large, bright red littoral mite (*Molgus littoralis* L.); its distribution is almost circumpolar, especially on the shores of the more northern regions. In East Greenland it was commonly met with on the shore, but extending its domain beyond the shore, being found (also the eggs) up to an altitude of 120 m., most often in sandy and gravelly places. Trägårdh (p. 419[2]) has recorded this and explains it by the non-occurrence of big competing mites. In southern Spitsbergen, it seems to be a strictly littoral form; but in northern Spitsbergen (Low Island, c. lat. 80° N.; Hinlopen Strait) it also extends to the "fjœldmark", which is beyond the shore (Summerhayes and Elton, p. 250)[3].

According to the statements of Sig Thor (p. 97)[4], in southern Spitsbergen (Hornsund), more than one generation seems to develop in the year. This does not hold good for the species in East Greenland. June 25 (at Eskimonœs, lat. 74° 05′ N.), the snow having recently melted, I found eggs in abundance (in good agreement with the figures given by Trägårdh (p. 10, tab. I, figs. 1–2)[5].) They were found especially on the dry sandy shore, in dense cakes under almost every flat stone. Some of the eggs had not hatched, and others were just hatching, the larvæ swarming over the shore. They only had three pairs of legs. Adult individuals were definitely not found. Later in the summer, also in the other localities I visited, only empty egg-clusters and adult individuals were found. So there can be no doubt that the species in East Greenland only winter in the egg. The difference in behaviour from that in Spitsbergen is possibly due to the more severe climatic conditions.

Molgus littoralis is probably feeding especially upon Collembola; though I have seen it suck out the shore fly, *Fucellia ariciformis*, also gnats and even individuals of the same species.

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[1] Madsen, Holger, *Medd. om Grönl*, 100, Nr 8 (1936).

[2] Trägårdh, J, *Medd. om Grönl.*, 43 (1917).

[3] Summerhayes and Elton, *J. Ecology*, 16 (1928).

[4] Thor, Sig, *Skrifter om Svalbard og Ishavet*, No. 27 (1930).

[5] Trägårdh, *Bih. K. Svenska Vet. Akadl Hand.*, 26, Afd. IV, No. 7 (Stockholm, 1900).

Effect of Unilateral Elimination of the Horizontal Semicircular Canal in the Pike

IN a recent publication[1] it was shown that in the dogfish the sense organ situated in the ampulla of the horizontal semicircular canal is in a constant state of excitation. This activity is maintained in the resting animal in the absence of any obvious external stimulus. The result raises the question as to whether the inflow to the centre of the spontaneous discharge from the ampullary sense ending has any noticeable effect on muscle tone.

In order to investigate this, the horizontal semicircular canal of the pike (*Esox lucius*) was eliminated by severance of the nerve branch supplying the ampulla. The operative technique used in the experiments permitted the elimination of a single canal without any damage to the rest of the labyrinth. A fish in which the left horizontal canal has been eliminated shows a persistent tonic deviation of the eyes towards the side of the eliminated canal, that is, the left eye is deviated backwards and the right eye forwards. This deviation is obviously due to the inflow to the centre of the spontaneous afferent discharge from the remaining right horizontal canal, which is no longer counterbalanced by a similar discharge from the corresponding left canal. The asymmetry in eye muscle tone which causes the forced deviation of the eyes clearly indicates a tonic function of the horizontal semicircular canals.

During clockwise rotation in the horizontal plane, that is, during rotation of the fish towards the side of the intact right canal, the eye deviation is increased and a normal horizontal eye nystagmus follows. During anticlockwise rotation the spontaneous eye deviation is abolished, that is, the eyes return to their normal positions. These eye responses are in full accord with the behaviour of the ampullary sense organ as studied in the dogfish, where the spontaneous activity of the ampulla of the horizontal canal is increased by ipsilateral rotation (that is, rotation towards the side of the intact canal) and decreased by contralateral rotation.

It is of interest that during contralateral rotation the eyes not only return to their normal position but also continue to deviate beyond the 'neutral' point in a way which is characteristic of the slow phase of the eye response of the normal animal during rotation in the same direction. This shows that the centre is capable of responding to a decrease in afferent discharge with the production of a compensatory eye reflex.

The conclusion is therefore justified that a single horizontal semicircular canal in fishes is sufficient to call forth muscular responses to both clockwise and anticlockwise rotation in a horizontal plane. It should be noted that the reflex tests were carried out with exclusion of visual orientation.

A full account of this work will be published in the *Journal of Experimental Biology*.

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March 18.

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[1] Lowenstein, O, and Sand, A., *J. Exp. Biol*, 13, 416 (1936).

Anomalous Expansion of Zinc and Cadmium near the Melting Point

THE expansion of bismuth, as was shown by Roberts[1] decreases rapidly near the melting point. This anomaly coincides with the anomalous decrease of volume of bismuth on melting.

The expansion coefficients of monocrystals of zinc and cadmium have been measured in order to ascertain whether the anomaly found by Roberts for bismuth occurs with these metals also, and whether the sign of the anomaly coincides with that of the normal change of volume in melting.

In directions nearly parallel or perpendicular to the hexagonal axis, the expansion of zinc crystals increases rapidly between c. 415° C. and the melting point (419·5° C.). In the neighbourhood of 418°–419° C. (near the limit set by the plastic deformation under its own weight) values of the expansion coefficients reaching 50–100 × 10^{-5} (Fig. 1*a*) were observed.

The same was observed in the case of cadmium for directions nearly perpendicular to the axis (Fig. 1*b*).

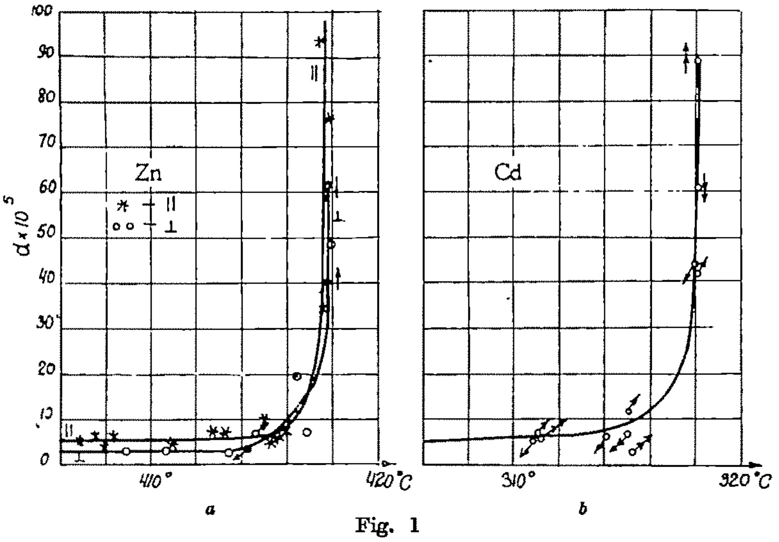

Fig. 1

CHANGE OF COEFFICIENT OF EXPANSION WITH TEMPERATURE FOR ZINC AND CADMIUM. ⇄, FIRST HEATING AND COOLING; ⇉⇇, SECOND HEATING AND COOLING.

It is clear therefore that zinc and cadmium exhibit anomalous expansion near the melting point and that the sign of the anomaly coincides with that of the change of volume in melting.

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[1] Roberts, J. K., *Proc. Roy. Soc.*, A, **106**, 385 (1924).

Induced Radioactivity with Neutrons from Slow Deuterons

IT is of interest, not least from the point of view of possible practical applications, to search for the lower limit of voltages, with which artificial radioactivity can still be produced of intensity sufficient for utilization. We have begun an investigation, in which the induced activity is produced by neutrons, which are produced by slow deuterons. This procedure has the advantage that the small number of neutrons that can be expected will be compensated, at least partly, by the greater efficiency of slow neutrons, due to the slow primary particles.

In our experiments, a beam of positive rays of deuterons was directed on to a mica foil covered with a thin layer of beryllium. The origin of the neutrons is probably the process:

$$^{9}_{4}\mathrm{Be} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{10}_{5}\mathrm{B} + {}^{1}_{0}n\,;$$

but the reaction

$$^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{3}_{2}\mathrm{He} + {}^{1}_{0}n$$

cannot yet be excluded as a possible source of the neutrons. Outside the tube a Geiger-Müller counter of silver was placed at about 10 cm. from the source. It was screened by lead, in order to reduce the number of counts due to the background to 2–3 per minute. The mica foil was irradiated for five minutes with a total current of about 1mA., which was discontinued and the counter set in work. Thus we could measure the activity produced by the neutrons in silver alone.

As regards the half-value periods, the results of our preliminary measurements agree with those of earlier work in other laboratories. We have obtained two active components with periods of 22 ± 3 sec. and 100 ± 15 sec. respectively. The ratio of their intensities is about 1. However, the relatively considerable number of decay electrons is very remarkable. We have obtained, for example, in the first and second minute, 5·1, 1·8 counts as a mean value from 100 measurements, the background counts being deducted. We can state, therefore, that it is indeed not hopeless to search for nuclear reactions of this kind with such a low voltage. By comparison with a preparation of radium-beryllium with known content of radium, we can say that the artificial activity produced by our process is equivalent to that of the unslowed neutrons of such a preparation containing about 6·8 mgm. of radium element. Of course, that does not mean that the number of the neutrons emitted will be the same in both processes; we cannot yet state anything on this point because of the difference of the velocities of the neutrons in the two cases, and we know nothing about the velocities of our neutrons.

The experiments are being continued and will be completed from this point of view.

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R. FÜRTH.
F. OBOŘIL.
K. SITTE.

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German University,
Prague.
March 11.

A Photo-electric Method for the Measurement of the Optical Constants of Metals

THE optical constants of a metal are measured by allowing a beam of parallel light, plane-polarized at an azimuth of 45°, to fall on the plane polished surface of the metallic specimen, and then analysing the reflected elliptically polarized light. From the constants of the ellipse, and the angle of incidence of the light, the optical constants may be calculated.

The methods hitherto adopted for the analysis of the elliptically polarized light fall into three groups:—(i) photographic methods for the ultra-violet; (ii) visual methods for the visible region; (iii) bolometric methods for the infra-red. Of these the most accurate are the visual methods.

In essentials the present method is similar to the visual methods, but since the eye is replaced by a photo-electric cell, the range of application is extended to include the ultra-violet and infra-red portions o the spectrum. The method in principle is as follows The elliptically polarized light is analysed by transmission through a Soleil-Babinet compensator and a Nicol prism. The photo-electric cell in conjunctio with a Lindemann electrometer becomes the objectiv indicator for the determination of the correct setting of compensator and analyser to produce extinctio of the light.

In practice, for a variety of reasons, complete extinction cannot be obtained. There is always a certain amount of background light (of the order of 0·5 per cent of the maximum illumination). Hence instead of adjusting for zero intensity, one adjusts for minimum intensity. This, however, does not reduce the accuracy of the settings, provided the light source is steady. When the light source is unsteady, as for example in a carbon arc, large irregular fluctuations of the electrometer needle are produced. This effect is eliminated by using a compensating beam of light, derived from the same source, and a second photo-electric cell. The accuracy of the results obtainable compares favourably with the accuracy obtainable by visual methods.

Although not expressly designed for the purpose, the same method may be used for determining optical rotatory power.

Full details will be published elsewhere.

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March 17.

Determination of Vitamin C in the Living Organism

WHILE determining the vitamin C content of urine taken from healthy individuals or patients suffering from various diseases by titration with 2-6 dichlorophenolindophenol, we tried to perform this test in the living organism itself. First we injected small quantities of a 1/1,000 normal sterile solution of the dye into the sole of healthy and scorbutic guinea pigs. We observed that decoloration of the dye takes place much more rapidly in healthy animals than in guinea pigs suffering from scurvy. When methyl blue was injected simultaneously, its colour remained unchanged, which shows that decoloration of dichlorophenolindophenol was not due to resorption but to reduction.

Next we tried to show that this reduction is caused by ascorbic acid, and performed similar experiments on human beings. Patients were kept on a vitamin C deficient diet for 10 days and then 1/400 normal dye solution was injected into the forearm. Using a 1·0 ml. tuberculin syringe, it is not difficult to produce a bubble of about 2 mm. diameter. After observing the time of decoloration, various amounts of ascorbic acid were given intravenously. The colour of the newly injected dye disappeared in a much shorter time than before.

Detailed experiments have shown that the time of decoloration depends on the amount of ascorbic acid present in or administered to the organism. We concluded from our numerous experiments that a decoloration time of about 5 minutes indicates *saturation*, that of more than 10 minutes *deficiency* of vitamin C, while decoloration times of 5–10 minutes show *normal* content of vitamin C of the body.

We believe that this simple reaction may prove useful for many purposes.

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Jan. 15.

Churning for Butter

THE familiar process of churning cream to yield butter has led to two different theories of the mechanism involved. The Fischer-Hooker[1] theory is that churning is due to the reversal of an *O/W* emulsion (cream) to a *W/O* emulsion (butter), a view accepted by Palmer[2]. Rahn[3] believes that churning involves æration or frothing with consequent accumulation of milk proteins adsorbed at the newly-created air/liquid interface.

We accept Rahn's theory and hold that emulsion *inversion* is not concerned; rather is it emulsion *breaking*, due to the preference of the proteins for an air/liquid interface rather than a fat/water interface. The subsequent kneading together of butter granules results in an accidental resemblance to a *W/O* system.

If the milk proteins be restrained from accumulating in the froth (where surface denaturation occurs) churning could progress indefinitely without butter granules forming. We tested this idea by adding very surface-active materials to fresh cream of 50 per cent butterfat content (*p*H 7), so that these materials would undergo preferential adsorption in the froth. Saponin and bile salts have proved excellent anti-churning agents. Thus, 1 in 1,000 of saponin in the aqueous phase, added to cream which normally churned in 60 minutes, totally inhibited butter formation for hours. Its effect was still apparent even when the cream contained 50 per cent of sucrose to load the water phase and assist emulsion breaking; without saponin, such cream churned dramatically in 15 minutes. Egg albumen delayed butter formation until surface denaturation of this colloid allowed the accumulation of the milk proteins at the air/liquid interface.

Colloids which are not particularly surface-active have, as anticipated, no influence on the progress of churning; for example, 1 per cent of gum arabic in the cream.

Our complete results are being prepared for publication elsewhere.

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[1] "Fats and Fatty Degeneration", 93 (New York, 1917).

[2] "Colloid Symposium Monograph", 1, 410 (1928).

[3] cf. Rahn and Sharp, "Physik der Milchwirtschaft", 111 (Berlin, 1928).

Reactions Caused by 'Activated' Alumina

WE have observed that passage of a chloroform solution of diacetyltoxicarol through alumina activated for chromatographic adsorption causes 'hydrolysis'; in one experiment, 1·1 gm. of pure toxicarol was isolated from 2 gm. of ester. Of the two acetoxy groups attacked, one was derived from a phenolic, the other from an enolic hydroxyl group; both are very readily hydrolysed by alcoholic alkali. This hydrolysis, which is the more remarkable in that it occurred in a non-polar solvent, was traced to the alkalinity of the alumina used. Commercial 'activated' alumina in water reacts alkaline to phenolphthalein and the alkalinity can be titrated with sulphuric acid; the colour returns if the mixture is kept after neutralization; further quantities of acid are consumed after six and again after eighteen hours; thereafter the supernatant solution remains colourless. The following figures are for 5 gm. of (1) Merck's alumina for adsorption, activated according to Brockmann, (2) B.D.H. aluminium oxide for adsorption purposes, (3) B.D.H. aluminium oxide, calcined, and (4) B.D.H. aluminium oxide (calcined) 'AnalaR', shaken in 50 c.c. of distilled water.

	c c of 0 1 N H_2SO_4 consumed				% Alkalinity calc. as NaOH
	At once	After 6 hr.	After 18 hr.	Total	
1	2·0	1·2	0 8	4·1	0 33
2	3·5	1 1	0 6	5 2	0 41
3	0 3	0 1	0·1	0 5	0 04
4	0·2	0 1	0 1	0·4	0·03

The amounts of adsorbed alkali, as shown in the last column, for the 'activated' aluminas are surprisingly high. The low figures for the ordinary aluminas are a satisfactory 'control'.

Hydrolysis of diacetyltoxicarol is prevented by previously washing the alumina with acetic acid or a solution of phenol in a neutral solvent (we are indebted to Prof. Heilbron for suggesting the use of phenol), but the activity of the adsorbent is largely destroyed by acetic acid and to a less, but still considerable, extent by phenol.

Other reactions of rotenone and its derivatives normally associated with the use of alkali in a hydroxylic solvent can also be effected by passage through activated alumina in chloroform or benzene, and we hope to report these experiments in detail elsewhere. Great caution is advisable when adsorbing alkali-labile compounds. It seems probable that the alkalinity of activated alumina may be responsible for some of the abnormal results recorded by other workers, for example, the isomerization of carotene[1], and the partial inactivation of vitamins A[2] and K[3].

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[1] Gillam, A. E., and El Ridi, M. S., *Biochem. J.*, 30, 1735 (1936).

[2] Castle, D. C., Gillam, E. E., Heilbron, I M, and Thompson, H. W, *Biochem. J.*, 28, 1702 (1934).

[3] Dam, H., and Lewis, L., *Biochem J*, 31, 17 (1937), cf. Dam, H., and Schonheyder, F, *Biochem. J.*, 30, 897 (1936)

Nature of the Linkages in Proteins

THERE is now a considerable amount of agreement that the polypeptides in the protein molecule are held together by cross-linkages[1], but so far crucial experiments, from which the exact nature of these linkages may be deduced, are lacking. The only logical procedure is therefore to consider in turn all possible types of link and to investigate experimentally the deductions to be made from those which pass the qualifying test of being geometrically feasible. Among the links so far proposed are: (*a*) hydrogen bonds[2,3,4], (*b*) cyclol links[4,5,6] and (*c*), as a deduction from (*b*), hydroxyl bonds[4,5].

The hypothesis of hydrogen bonds has recently gained further support from the suggestion, contained in the interesting communication from Dr. Huggins in NATURE of March 25, of synchronized oscillations in hydrogen bridges[7]. The importance of these synchronized oscillations is not confined to proteins but relates to all megamolecules. In connexion with Dr. Huggins's letter, I would direct attention to the diagram given by Jordan Lloyd on p. 267 of her 1932 paper of the structure involving hydrogen bonds associated with . . . HNCOHNCO . . . strings which is now proposed by Dr. Huggins. Further, I may perhaps be permitted to point out that "pictures of this sort" which Dr. Huggins finds "preferable to those proposed by Wrinch", have in fact already been given by Wrinch and Jordan Lloyd[3], and that in any event (as there explained) they are not inconsistent with the cyclol structures which (presumably) Dr. Huggins had in mind. It may well be the case that all three types of link are relevant to the question of the structure of proteins in its various aspects, and possibly others so far unformulated. Thus the prudent course is to seek for support for each and every type of link which is geometrically feasible.

If, however, at this early stage in the history of the protein molecule, it is important to decide between alternatives which are not mutually exclusive, I suggest that it would be of interest to consider how far hydrogen bonds alone can (1) yield structures for protein films and (2) yield structures for the globular proteins which explain the non-random distribution of the molecular weights of proteins established by Svedberg[8] and (3) explain the relation between α- and β-keratin. It appears from a recent series of experiments by Langmuir, Schaefer and Wrinch[9] that the mechanical characteristics of protein films are in good accord with the cyclol hypothesis and its predictions: it is now clear that this hypothesis implies the existence of globular proteins and explains why they fall into discretely arranged molecular weight classes[10]: further, the cyclol link appears to fit elegantly[6] into Astbury's keratin structures. Alternative structures depending upon hydrogen bonds alone would, however, be of great interest.

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March 31.

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[1] Astbury and Woods, NATURE, 127, 663 (1931). Astbury, NATURE, 132, 593 (1933), *Koll Z*, 69, 350 (1934).

[2] Jordan Lloyd, *Biol Rev.*, 7, 254 (1932) and later papers Mirsky and Pauling, *Proc. Nat Acad. Sci.*, 22, 439 (1936)

[3] Wrinch and Jordan Lloyd, NATURE, 138, 758 (1936)

[4] Wrinch, *Proc. Roy Soc.*, A, in the press

[5] Wrinch, NATURE, 137, 411 (1936). 138, 741 (1936).

[6] Astbury, *J. Text. Inst.*, 27, *P* 282 (1936). *Chem. Weekbl*, 33, 778 (1936).

[7] Huggins, NATURE, 139, 550 (1937).

[8] Svedberg *et al.*, a series of papers in *J. Amer. Chem Soc.* since 1929.

[9] *Science*, 85, 76 (1937). See also, NATURE, 139, 516 (1937).

[10] As explained in a communication to the Editor of NATURE dated March 10, 1937.

Isomerism of Derivatives of Cyclohexane

BOTH 4-methyl*cyclo*hexane-1-carboxy-1-succinic acid and 3-methyl*cyclo*hexane-1-carboxy-1-succinic acid, synthesized by condensation of ethyl bromoacetate with the sodio derivatives of the dicyano esters prepared by Higson and Thorpe's method[1], have been isolated in two forms; there being no indication of isomerism connected with multiplanar forms[2]. This method provides a satisfactory synthesis of the tricarballylic acids derived from cyclic ketones, and the low yield of αα-dimethyltricarballylic acid obtained from acetone[3] can be raised to nearly 30 per cent by suitable modification of the method. The conversion of the tricarballylic derivatives into the corresponding aconitic acids is being investigated.

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[1] Higson and Thorpe, *J. Chem. Soc*, 89, 1455 (1906).

[2] Desai, Hunter, Ghulam Khan and Saharia, *J. Chem. Soc.*, 416 (1936); Waheed Bukhsh, Desai, Hunter and Mehdi Hussain, *J. Chem. Soc.*, 1159 (1936); Desai, Farooq and Hunter, *J. Chem. Soc.*, 1162 (1936).

[3] Clemo and Welch, *J. Chem. Soc.*, 2621 (1928).

The Retinal Centre as an Amplifier of Potential Differences

FROM the histological point of view the retina may be regarded as a nervous centre, a piece of the brain, projected on the surface of the body. With other centres it shares the property of responding to stimulation with slow potential changes. Thus, when light falls on the eye, the corneal electrode becomes positive with respect to an electrode behind the eye (vertebrate eye with inverted retina). This change coincides with the appearance of impulses in the optic nerve. Negativity of the corneal electrode coincides with inhibition of the discharge in the nerve[1]. Below we are only interested in the initial positive phase of the retinal response, called the *b*-wave (see Fig. 1), known to be a measure of excitation.

Assume that at regular intervals a *b*-wave is elicited by a constant stimulus, and that on top of this *b*-wave is thrown another stimulus. The latter, the 'test light', exceeds the former 'adapting light' in strength and therefore succeeds in eliciting a second small *b*-wave on the falling part of the *b*-wave, caused by the adapting light (Fig. 1).

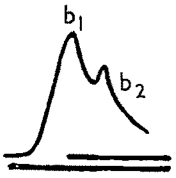

Fig. 1.

RETINAL RESPONSE; b_1 DUE TO 'ADAPTING LIGHT', b_2 TO 'TEST LIGHT'.

As 'test lights' are now chosen two stimuli which taken by themselves differ in size by about 8 per cent. They are then in turn superimposed upon the *b*-wave set up by the regularly recurring 'adapting light'. Do the small *b*-waves to which the test lights now give rise still differ by 8 per cent? An experimental answer is easily obtained. The superimposed *b*-waves are found to differ by, say, 34 per cent, to quote figures actually obtained in an individual experiment. Thus the difference between the test lights has been amplified owing to the fact that the retina has been charged by an earlier stimulus. This 'amplifier principle' has been studied in several ways, mostly with fairly strong stimuli, differently introduced with respect to the various phases of the electro-retinogram.

The fact that amplification may occur in a centre is obviously of general interest for all those who in different fields are trying to understand the working of the central nervous system in terms of simple principles. It illustrates a way of attacking the complicated functions involving differentiation. From the point of view of vision, the amplifier principle gives a clue to an understanding of processes of discrimination such as 'visual acuity', 'brightness discrimination', etc., all of which within limits are favoured by bright stimuli and an illuminated background. Together with many other recent results obtained with the electro-retinogram, it points to the significance as well as to the necessity of considering small eye-movements in connexion with visual discrimination.

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March 4.

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[1] Granit, "Die Elektrophysiologie der Netzhaut und des Sehnerven . . .", *Acta ophth., Kbh.*, Supp. 8 (Levin and Munksgaard, 1936).

Perception of Weight and Elasticity

IN experiments on the perception of elasticity, we have found that individuals equate a pull on an expanding elastic spring with a much *lighter* lifted weight impression. Lifting a weight of 2·50 kilograms (for which the psycho-physical limen is of the order 0·10 kilogram) was matched by one person with a pull as large as 6·50 kilograms (probable error 0·20 kilogram). On the average, from results with some fifty persons, a lift of 2·50 kilograms is matched for weight with a pull on a spring of 4·00 kilograms approximately (probable error 0·25 kilogram). The under-estimation of the spring or elastic pull in terms of weight perception is of the same order irrespective of whether the subject begins with a zero pull in the spring, gradually increasing this until a match with the lifted weight impression is obtained, or whether he begins with a pull of the order 8·00 kilograms, gradually decreasing this until a match is obtained. The effects are just as marked, also, when a pull is used as standard for comparison with a series of lifted weights.

This difference between the effects of a pull and a lift points to phenomenalogical differences in the impressions of weight and elasticity, and has interesting practical bearings on the general psychology of physical training. An account of our experiments will be published, it is hoped, in the *British Journal of Psychology*.

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March 29

Scientific Research in Spain

GRATIFYING evidence that scientific investigation and literary research are by no means at a standstill in Spain has been received by the Society for the Protection of Science and Learning, the permanent successor to the Academic Assistance Council.

With their letter dated February 24, 1937, Prof. Manuel Marquez Rodriguez (dean of the Faculty of Medicine in Madrid), Prof. P. Carrasco (dean of the Faculty of Science in Madrid) and Dr. T. Navarro Tomas (director of the National Library)—all well-known authorities—have sent two copies of recent numbers of the *Anales de Fisica y Quimica*, a copy of *Revista de Filologia Espanola* and a copy of the *Anuario del Observatorio de Madrid* for 1937, which last has recently been referred to in NATURE (April 10, p. 624).

The continuation of such original work as is described in the above publications—and others are to follow—has been made possible by the founding by the Ministry of Education of the *Casa de la Cultura* of Valencia, the objects of which appear to be similar to those of this Society. The *Casa de la*

Cultura houses members of various professions, from whom, the Society is informed, the Ministry has not asked for any declaration or guarantee of a political character. Further, the Ministry has not compelled those, who for special reasons, prefer to remain in Madrid, or to live in other places, to go to Valencia. While teaching has had to be interrupted in the universities, the Ministry has not ceased to pay salaries to professors and others who have remained in the provinces under the authority of the Government. The Ministry is also trying to apportion help to Spanish professors and scholars abroad who have not rebelled against the Government.

Complete detachment from prevailing social and political conditions is usually impossible for the scientific and literary worker and, during the last few years, the work of many well-known scientists and scholars has been adversely affected by conditions against which they have been powerless. A census of outstanding advances in knowledge achieved during this period by those so adversely affected and helped by their colleagues and sympathisers would provide a unique and important historical record.

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Points from Foregoing Letters

PHOTOGRAPHIC records of electrical disturbances occurring during a thundercloud discharge, obtained with a cathode ray oscillograph, are submitted by Dr. F W. Chapman. By means of a device in which the photographic film moves at right angles to the time-base deflection, electrical pulses only a few micro-seconds apart can be resolved. The records show a volley of discharges, presumably to be identified with the 'brush' discharge often observed in an active cloud as a prolonged flicker or flow, followed after a brief quiescent interval by the main lightning discharge. The volley radiates a long series of electromagnetic waves producing interference in radio receivers, while the main discharge consists of series of steps separated by 30-100 micro-seconds, their quasi-period corresponding to a wave-length of 15–30 km.

It is known that the beryllium nucleus, irradiated by γ-rays, emits neutrons, but it has not been decided by physical methods whether the nucleus is thereby transformed into an isotope of beryllium of mass eight, or into two helium atoms. By a micro-chemical method, Prof. F. A. Paneth and Dr. E. Gluckauf have detected, in irradiated beryllium, helium in such quantity that the helium-forming process seems to be the main, if not the only, reaction.

A method for the estimation of enzyme activity by following the change in the density of the medium is described by Dr K. Linderstrøm-Lang. Small drops of the enzymatic reaction mixture, at different stages, are introduced into a vertical glass tube containing kerosene and bromobenzene in suitable proportions to give a practically constant specific gravity gradient, and their density is determined by comparison with similar droplets of known composition which float at given levels, according to their density. Curves are shown giving the change in specific gravity with time and the amount of amino-nitrogen liberated in the case of mixtures containing *dl*-alanylglycine and peptidase.

What appears to be a complete cycle of development of malaria parasites has been observed by Prof K. B. Williamson and M. Zain in controlled experiments with *Culex bitæniorhynchus*, a mosquito hitherto not considered a malaria carrier. The authors suggest that its ability to carry the malaria germs may be related to the fact that it breeds in pure, uncontaminated water.

In East Greenland and northern Spitsbergen the littoral mite *Molgus littoralis* extends its range beyond the shore, probably due to the non-occurrence of big competing mites. In southern Spitsbergen it seems to develop more than one generation in the year. In East Greenland, according to H. Madsen, only one generation is developed, the species wintering in the egg.

In experiments on the semicircular canals of the pike, Dr. O. Lowenstein shows that the sense organ in the ampulla of the horizontal canal has a tonic function, and that a single horizontal canal is capable of evoking muscular responses to both clockwise and anticlockwise rotation of the fish in a horizontal plane.

In an investigation on the lower limit of voltages with which artificial radioactivity can be produced, E. Bertl, Prof. R. Furth, F. Obořil and Dr. K. Sitte have obtained two active components, of period 22 and 100 seconds, by irradiating silver with slow neutrons produced by the action of slow deuterons (positively charged heavy hydrogen nuclei) upon beryllium-coated mica.

The addition of saponin (1 in 1,000) to cream, which usually churns in 60 minutes, delays the formation of butter for several hours, according to Dr. W. Clayton and J. F. Morse. Similar inhibition was observed with egg albumin. The authors accept Rahn's theory that during churning the milk proteins around the fat particles are removed by the aeration and frothing, and this leads to the coalescence of the fat globules.

Drs. R. S. Cahn and R F. Phipers report that commercial 'activated' aluminas contain relatively large amounts of adsorbed alkali and can bring about, in neutral solvents, reactions normally associated with alkaline reagents in hydroxylic solvents. They suggest that the alkalinity may be responsible for abnormal results recorded by other workers.

Commenting on Dr. Huggins's communication on "Synchronized Oscillations in Hydrogen Bridges", Dr. D. M. Wrinch points out that similar speculations have been put forward by Wrinch and Jordan. The author claims that the mechanical characteristics of protein films are in good agreement with her 'cyclol' hypothesis and its predictions.

An experiment is described by Prof. R. Granit showing that the difference in the initial positive electrical response from two test stimuli applied to a retina is increased (from 8 per cent to 34 per cent) when the retina is 'charged' by an earlier stimulus. This may explain why visual acuity, brightness discrimination, etc., are favoured by bright stimuli and an illuminated background.

Research Items

Pithecanthropus—Man or Gibbon ?

THE arguments put forward by Dr. E. Dubois in support of his view that *Pithecanthropus erectus* is to be regarded not as a man, but as a genus allied to the gibbon (see NATURE, Feb. 13, p. 291) have been examined and met by Prof. W. E. Le Gros Clark (*Man*, April 1937). The evidence of the volume of the endocranial cast provides no ground for inferring kinship between two animals because their cerebral development is different Dubois' startling conception that the brain in its phylogenetic development grows discontinuously by doubling its size at each stage rests on quite inadequate observation. The endocranial capacity of *Pithecanthropus* may be assumed to be somewhere between 900 c.c. and 1000 c.c., and of *Sinanthropus* I at 915 c c. Yet Dubois, while insisting that *Pithecanthropus* is gibbon, accepts Peking man as human. *Pithecanthropus* even comes within the range of modern man, of whom examples have been noted with a cranial capacity of about 833 c.c. A number of features in the endocranial cast of *Pithecanthropus* indicate a human status. Such are the convolutional pattern of the frontal lobes, which are more complex than in the apes, and the extremely simple fissuration of the brain, while the 'association areas' must have been incomparably more extensive than in the anthropomorphous apes, and the expansion of these areas can only be related to the development of mental attainments distinctive of the Hominidæ. The characters of the femur, which Dubois takes to indicate the gibbon status of *Pithecanthropus*, are open to serious question. Not only does the palæontological evidence not support his prejudice against the view that the Trinil femur is human because this implies that the frame of man reached its perfection for pedal progression long before his brain attained its present complex structure, but also the arboreal habits believed to be related to other characters of the femur are not proved conclusively. The evidence of the lower jaw fragment from Kedung Brubus is so questionable that it scarcely deserves serious consideration.

Arctic Birds in New Zealand

A SHORT but extremely interesting list of arctic birds which spend the northern winter in New Zealand has been compiled by R. A. Falla, covering fresh records since Oliver's paper in 1930 (*Rec. Auckland Inst. Mus.*, 2, 1 ; 1936). They include fourteen pecies, of which the two most common forms in New Zealand are bar-tailed godwits (*Limosa lapponica aneri*) and knots (*Calidris canutus*). Others are two pecies of skuas, turnstones, Asiatic golden plover, hree species of sandpiper, Asiatic whimbrel, two pecies of phalarope. Considering the small number of expert observers in New Zealand and the wide xpanses which must go unnoticed, the list promises that further work is likely to add many names to this wandering fauna As a rule, the migrants arrive bout October in winter plumage, and set out on the return journey in April, when the adults have completed a pre-nuptial moult. Mr. Falla considers that birds of the year, which have not completed their post-juvenal moult in April, do not migrate, but spend the southern winter in New Zealand. The northern movement of the adults in April, however, bears upon Prof. Rowan's suggestion that increasing daylight is the stimulus which sets the migratory movement in motion, for on the contrary these New Zealand wintering birds undergo the physiological changes associated with migration, and commence migration while the days are shortening.

Studies of Species of *Silene*

E. M. MARSDEN-JONES and W. B. Turrill have continued their investigations on the genetics, life-histories and ecology of *Silene vulgaris* (*S. Cucubalus*) and *S. maritima* in the seventeenth paper of the series "Researches on Silene maritima and S. vulgaris" (*Bull. Misc. Inform., Kew*, 45–53, 1937). In this paper, the genetical relationships of a Welsh mountain plant are discussed on the basis of controlled selfings and crossing with typical *S. maritima* and *S. vulgaris*. The Welsh plant is classified taxonomically as a variety of *S. maritima*, but shows a number of aberrant characters which suggest either previous contamination with *S. vulgaris* or the retention of more ancient phenotypic character combinations than now usually found in coastal populations. Analyses are given of the genetical behaviour of a large number of crosses, and some are compared with results obtained in earlier researches. The importance of this series of papers is that a very full knowledge of two species of plants is being obtained from many points of view : cytological, ecological, genetical, phyto-geographical and taxonomic. When the work that has been planned is completed—and it is well in hand—the real make-up and history of these two species will probably be better known than for any other species of wild plants.

New Species of Algæ

ON the Templeton Crocker Expedition of the California Academy of Sciences 1932, a number of algæ were collected from thirty-two stations, principally among the Galapagos Islands. W. A. Setchell and N. L. Gardner of the University of California are working out this collection. They have published a preliminary account of the new species, varieties and combinations that have been identified up to the present (*Proc. California Acad. Sci.*, 22 ; 1937). The new species already amount to 45 (18 Myxophyceæ, 1 Chlorophyceæ, 3 Melanophyceæ and 23 Rhodophyceæ). Collections along the coast of Lower California are also interesting in extending farther south the known distribution of many Californian species. The authors hope to publish the full account shortly.

Variation of Wind with Height

A DISCUSSION of the variation of wind with height at Wadi Halfa (Sudan), by J. Durward, is the subject of Professional Note No. 72 of the Meteorological Office, Air Ministry. The direct observation of upper winds by pilot balloons is being extended into many parts of the world where the average values of those winds were formerly deduced from cloud movement, or from maps of computed pressure distribution at different heights deduced from observed surface pressure and assumed upper air temperature, and it is interesting to see to what extent observation supports theory. Wadi Halfa lies just inside the tropics, and is several hundred miles from the nearest point on the Red Sea. Were it not for its continental position, the predominance of winds from between north and north-east noted up to a height of about 4,000 feet might be described as appropriate for a place in the north-easterly trade-wind belt of the northern hemisphere, but these winds are better classified with the etesian winds of the Mediterranean and Egypt. At Wadi Halfa the wind from December to February generally backs with increasing height above 4,000 feet and normally blows from about north-west between 10,000 feet and 13,000 feet. In Shaw's "Manual of Meteorology" (2, p. 259 of 1928 edn.) is shown a map of normal pressure at a height of 4,000 metres (13,000 feet) due to Teisserenc de Bort, and on it the isobars run from about west-south-west to east-north-east. If the wind follows the isobars at that level there is therefore an apparent discrepancy of nearly 70° between observation and theory. Observation in this case covers one year only, but that is held to be a long enough period in which to obtain normal winds at Wadi Halfa, where the constancy of the pressure gradient throughout the year is remarkable and the wind is in consequence remarkably steady.

New Method in Geometrical Optics

In a series of memoirs, starting in 1890, A. Gullstrand has made a deep investigation into the properties of optical systems, and in particular has put forward the thesis that no optical instrument can give a point-to-point correspondence between two surfaces, but that there are, on each surface of the object space, two systems of lines that can be represented point by point in the image space. Unfortunately, Gullstrand's methods are very complicated. Boegehold and Herzberger managed to simplify them in a particular case, that of his "fundamental law". Now C. W. Oseen ("Une méthode nouvelle de l'optique géométrique", *Kungl. Svenska Vetenskapsakademiens Handlingar*, Tredje Serien, 15, No. 6; 1936) has given a general method, based upon contact transformations and their invariants. Because the calculations have a character independent of the choice of co-ordinates, all the terms introduced have a geometrical or optical significance. This new method gives a large part of Gullstrand's results, in some cases making them almost obvious, and also gives other results not previously obtained. Oseen comes to the conclusion that Gullstrand's theory of representable lines is not general, and that there really is an optical image corresponding to any surface of the object space. He attributes Gullstrand's failure to reach this conclusion to the illegitimate assumption that the ray always cuts the surface considered at an angle different from zero.

Diameter of Lightning Discharge

Theories of the processes taking place in a lightning discharge channel involve the size of the channel, but the experimental evidence on this point has been confused. B. F. J. Schonland (*Phil. Mag.*, March) has been able to examine a photograph of a lightning flash taken at short range (about 250 metres) which enabled him to make a direct estimate of the diameter of a discharge. Successive strokes of the flash were separated by the wind, and may readily be distinguished on the photograph—there were about ten strokes separated by intervals of about 0·05 sec., so that the whole flash lasted about ½ sec. The negative was sufficiently free from over-exposure and halation to allow a determination of the discharge diameter, the distance of the flash from the camera being known. The values found ranged from 23 cm. for the heavy first strokes to 11 cm. for weak branch strokes. There is a discussion on the question whether these figures represent the actual diameter of the electrical core of the discharge.

Further Atomic Transmutations by Means of γ-Rays

The production of radioactive isotopes by bombarding elements with an intense beam of γ-rays from lithium recently reported in these columns (Nature, 139, 555; 1937) has been further extended (W. Bothe and W. Gentner, *Naturwiss.*, 25, 126, 191; 1937). The isotope of bromine ^{78}Br has been obtained, with a half-life of 3·5 min. Silver gives ^{106}Ag with a half-life of 24 min. Zinc gives a nucleus with a half-life period of 38 min., probably to be identified with ^{63}Zn. Gallium gives two isotopes, ^{70}Ga and ^{68}Ga, with half-life periods of 20 min. and 1 hr., respectively Tantalum gives ^{180}Ta with a half-life of 14 min. In some cases radioactive isotopes were produced which have not yet been identified. Thus molybdenum gives a nucleus of half-life 17 min., and antimony gives one with a half-life of 13 min., which is probably ^{120}Sb. Indium gives either ^{112}In or ^{114}In with a half-life of 1 min., and tellurium either ^{127}Te or ^{129}Te with a half-life of 1 hr.

Lead-Uranium-Thorium Ratio in Uraninite

Recent investigations show that the composition of a single crystal of uraninite may not be uniform throughout the crystal. C. M. Alter and L. A. Yuill (*J. Amer. Chem. Soc.*, 59, 390; 1937) have now examined a single well-developed crystal of uraninite from the Wilberforce locality weighing approximately 42 gm., which was divided into three parts, outer middle and core, by filing each face down an equa amount, the particles of steel being removed magnetically. Determinations of the lead-uranium-thorium ratio of the sections confirmed the variation o composition disclosed in previous work, in which the sections were removed by solution in acid. The ratio Pb/(U + 0·36Th) was 0·1668, 0·1678 and 0·1864 fo the outside, middle and core, respectively. Th higher ratio in the core is unusual, and the ratio are different from those found previously with other crystals. The discrepancy in age using the data for the whole crystal and those for the core amounts to approximately eighty million years, while the discrepancy between the ages calculated for the whole crystal and the outside portion is about forty million years. The age of the mineral, as calculated by formula given in the paper, is 1,100-1,200 millio years, so that the relative error is not so serious although the results emphasize the need for carefu selection of material in order to obtain reliable dat for age calculations. Erroneous results may b obtained by the analysis of a single crystal if th whole crystal is ground and analysed.

Distribution and Characteristics of Early Man

IN celebration of the one hundred and twenty-fifth anniversary of the founding of the Academy of Natural Sciences of Philadelphia, an international symposium on early man was held at the Academy on March 17–20, when a number of representative archæologists from all parts of the world were present. In addition to the introductory address by Dr. John C. Merriam, president of the Carnegie Institution of Washington, and chairman of the committee for the symposium, thirty-two communications were presented, and four round-table discussions on problems of chronology and distribution took place. Broadly, the programme was arranged so that the communications presented on each day dealt with the problems of a continental area: on March 17 communications dealing with Europe or bearing on general problems of correlation with European cultures, on March 18 communications concerned with America, on March 19 matters relating to Asai and the Pacific and general problems arising out of the evidence therefrom, and on the closing day a small group of miscellaneous communications. The proceedings closed with a review of the problem of early man, based on the communications presented at the symposium, by Dr. G. Grant McCurdy.

In the following report mention is made only of the communications of wider general interest.

The proceedings on March 17, following on the introductory address, opened with a communication by Dr. G. H. R. von Koenigswald reviewing man's geological record in Java, and this was followed by a survey of the palæolithic industries of China by Mr. W. C. Pei, which suggested some triking correlations with the palæolithic industries of Europe. The most ancient artefacts of China identified by Abbé Breuil are the Nihowan, a piece of worked stone and some pieces of worked bone, n geological age Upper Pliocene and equivalent to the Villafranchian of Europe. Locality 13 industry, represented by a chert implement of undoubted uman origin, corresponds to the Abbevillian of France and geologically is attributed to an early phase of Lower Pleistocene. Of the four main industries of China, Sinanthropus, which begins the rue industry of China, is also attributed to the Abbevillian and the Lower Pleistocene; the newly iscovered and as yet little studied Locality 15 ndustry of Choukoutien, of the early Middle Pleisocene, corresponds to the Late Lower Palæolithic of Europe; the Ordos industry, contemporary with art of the Chinese loess, belongs to the late Middle Pleistocene; and the Choukoutien Upper Cave ndustry, which is the Upper Palæolithic of China, orresponds to Aurignacian, Solutrean and Magalenian.

Two communications came from Palestine. Miss Dorothy Garrod dealt with "The Near East as a ateway of Prehistoric Human Migrations" and Sir rthur Keith and Mr. Th. McCown, in a joint comunication read by the latter, reported on the early uman skeletal remains from Palestinian caves on ount Carmel. It was pointed out that the human remains from the Levallois-Mousterian layers of hese caves not only provide new additions to the onsiderable list of fossil specimens of man from the middle part of the Stone Age, but they also provide a new perspective concerning Neanderthal man, present a new type of humanity, which is the probable stock ancestral to the inhabitants of Europe in late Palæolithic times, and place in a new orientation the central problem of the evolution of the modern races of man.

The stratigraphic culture sequence in the three Wady Mughara caves overlaps in such a manner that the record carries us from the Acheulean, through the Levallois-Mousterian, to the Aurignacian and culminates in the Natufian, a new epi-palæolithic culture. The human inhabitants of the caves are represented from the Levallois-Mousterian and the Natufian periods.

Three and a half years intensive work on the bones of the Mousterian peoples of Mugharet es-Skhul and el-Tabun has led finally to the conclusion that we here have two distinct types of man, both living in Palestine at about the same time, and before the marked change in the character of the Pleistocene fauna and in the climate which are to be related with the period of the last glaciation in Europe. Mount Carmel man is certainly pre-Wurmian.

The first type is represented by a young adult woman of small stature (1520 mm.) from el-Tabun. The skull is small and low with a heavy frontal torus, the mandible is chinless and the face prognathous. The pelvis, especially the pubic parts, exhibits primitive anthropoid features not seen heretofore in any human race. This is a type similar to, but not identical with, the Western European Neanderthalians; at the same time it bears an unmistakable relationship to the Skhul people.

The other type of Mount Carmel man comes from the Mugharet es-Skhul. The material consists of two tall adult males, 1738 mm. and 1780 mm., that is, nearly or quite six feet. Their lower limb bones in measurement are closest to those of the tall Cromagnon males. Other parts of the skeleton corroborate with varying emphasis. The large well-vaulted skulls exhibit frontal tori with greater or lesser degrees of development, the large palate protrudes, and is completed by a mandible with a clearly defined chin and a modern internal conformation to the symphysis. The teeth do not show the taurodont condition of Neanderthal man, nor indeed do those of the Tabun type. The teeth of a well-preserved child, as well as of other young individuals, show unmistakable traces of a primate ancestry.

In all there are the remains of ten individuals on which conclusions are based. One of the most important points to emerge is their great variability. Their anatomical characters fall into three categories. In the first group, which is small, are the characters like those of the Western European Neanderthals; in the second, slightly larger, are intermediate characters between those of Neanderthal and of Neanthropic man; and the third, which contains by far the greater number, comprises the characters similar to those found in the Upper Palæolithic inhabitants of Europe, leading to the conclusion that there is a genetic relation between the ancient Palestinians and the Cromagnons. In reviewing the evidence as a whole, it may be said that the Skhul people are at least contemporaries, and possibly considerably earlier than the men of La Chapelle, La Ferrassie, of Spy and Neanderthal. They bear the imprint of characters inherited from a type ancestral both to themselves and to the European Neanderthalians. These new fossils show conclusively that the Western European Neanderthals were not ancestral to the modern races of mankind; they clearly demonstrate for the first time that evolution was well advanced in the different groups of *Homo sapiens* in the middle Pleistocene. "Chronologically the Skhul people are too recent and physically they are too distinctive to serve as a form ancestral to *Homo sapiens* in the widest sense of that term. They do provide us with a variety of man who may be considered as the prototype of the earliest modern Europeans".

More immediately based upon the European evidence relating to early man was a communication by Prof. A. W. Brøgger, dealing with the extension in distribution of late Palæolithic man to the extreme north in northernmost Norway. The remainder of the first session was devoted to the application of recent developments in method in European archæology to American conditions.

In the American session on March 18, the number of communications offered was considerable, opening with Dr. A. Hrdlička's discussion of early man in America in the light of the skeletal evidence. Chronological problems were discussed by Mr. Herbert J. Spinden, and Dr. Ernst Antevs dealt with climate and early man. The Folsom problem received attention from Dr. Frank H Roberts and others, and several communications dealt with the question of the evidence of geology and palæontology. Mr. Edwin H. Colbert on the pleistocene mammals of America and their relation to Eurasian forms argued for a considerable interchange in pliocene and pleistocene times, with eventually a much later survival in America of certain typical pleistocene forms, such as mammoth, camel, horse, extinct bison and sloths, into recent times.

On March 19 communications dealing with the prehistory of Asia were taken, opening with a contribution by P. Teilhard de Chardin dealing with the Late Cenozoic relations of North China, Malaysia and Central Europe, in which the entry of *Sinanthropus* into China, probably from the south, was shown to follow an eastern Asiatic uplift which was responsible for changes in earth surface, climate and fauna, and a review of the traces of fossil man in Mongolia by Prof. C. Charles P. Berkey, of Columbia University.

A communication by Prof. V. Gordon Childe, reviewing the evidence relating to the North Eurasian Forest Culture in the Mesolithic and Neolithic phases, drew an interesting parallel between the conditions, which had to be faced by the hunting peoples of northern Europe from Britain to the Urals at about 7000 B.C. with those which had confronted the aboriginals of north America in comparable zones. This forest culture, the Maglemosean, had adapted itself to specialized forms of hunting and fishing, using dog-sleighs (runners found in boreal peat in Finland are the oldest dated evidence for any vehicle for the use of man) conical arrow-heads for killing fur animals, and ice-picks. This East Maglemosean equipment is found right across Central Russia, where, however, it seems to be post-boreal and may mark local survivals of a boreal extension of the Maglemosean. With the more favourable climatic conditions around Denmark of the Littorina transgression, the Ertebølle shell-mound culture is to be regarded as an adaptation of the Maglemose to new conditions, its pottery being due to the foreign influences, which afterwards produced the Nordic neolithic cultures of north Germany, Denmark and southern Sweden. East of the Baltic the environmental change was insignificant, and the old economy persisted. Later in Finland the hunting and fishing economy was transformed by battle-axe folk, who introduced agriculture and stock breeding. The same transformation was effected in central Russia by the Fatyanovo battle-axe folk, yet there pit-comb pottery survived into the Iron Age after 800 B.C. In the Urals late sub-boreal peats have yielded pottery like the Finnish and Central Russian neolithic wares and the aforementioned bone-work of Maglemosean character. Thanks to such survivals, the makers of pit-comb pottery and so also their Maglemosean ancestors can be linked up with the historical Finno-Ugrian peoples.

A more remote problem was considered by Milo S. Hellman and Prof. W. K. Gregory, in examining the evidence of dentition in its bearing on the origin of man in the light of the new anthropoid ape material obtained in the Siwalik Hills, North India, by Dr. de Terra and Mr. G. E. Lewis. The communication was limited to two problems, the origin of the *Dryopithecus* pattern of the lower molar crowns and the known limits of variation of that pattern in fossil and recent anthropoids, and its transformation into the cruciate or four-cusped pattern in the more advanced lower molars of man. Among the conclusions put forward may be mentioned that while the *Dryopithecus* pattern is subject to extreme variation in regard to proportions, it is constant in the fundamental arrangement of the five principal cusps and the several grooves at their base; that of all the variations of the pattern, that of the first lower molar of *Australopithecus* is the closest to the human modification of the *Dryopithecus* pattern, though the tooth itself is far too broad to give rise to that of man; that of the known human first lower molars, that of the palæoanthropic division of man, especially of the Ehringsdorf child and *Sinanthropus*, are the least modified away from the *Dryopithecus* pattern; and finally, contrary to most authors, the opinion is expressed that the older palæoanthropines are at least structurally ancestral on one hand to *Homo neanderthalensis* and on the other to *Homo sapiens*.

In this connexion much interest is attached to certain conclusions at which Dr. H. de Terra has arrived as a result of his investigations in the Siwalik Hills. He states that there is evidence to show that the late tertiary mammals of India migrated to south-east Asia, guided by a shifting of the tropica belt from north to south. It was suggested that such migration should be considered as a major factor in human evolution so far as Asia is concerned. The stone age records of early man in India indicate great expansion of the old palæolithic races from southern India to the Siwalik Hills in the middl pleistocene, shortly after the Himalayan glaciers had retreated from their second major advance. Toward the close of the Ice Age, another group of stone manufacturing people invaded the lower Indus valley settling in a region which recent investigation shows to have also an advanced civilization 5,000 years old Hence the Indus valley shares with other larg drainage areas a long tradition of human pre-history

The Biological Station at Barents Sea

IT will interest British biologists and especially fishery research workers to learn that a big new biological station is being built by the Academy of Sciences of the U.S.S.R. at Murmansk on the Barents Sea. The new biological station is intended for extensive research in morphology, anatomy, embryology, physiology, biochemistry and ecology of sea organisms.

Owing to the penetration of the warm waters of the Atlantic into the Barents Sea, the fauna of the latter is extremely rich and diverse. Of importance is the fact that at Dalnye-Zelenets Bay the water is transparent to a depth of 10 metres, and that large stretches of the sea bottom are visible from the surface. The scientific workers at the station will make a detailed study of the problems of evolutionary physiology, embryology and the relationship of the fauna with changed hydrological conditions effected by the Gulf Stream.

The Murmansk biological station will supply biological material to the various research institutes and higher educational institutions of the U.S.S.R. Superintending the building of the station is a special commission consisting of S. A. Zernov (director of the station), L. A. Orbeli, V. I. Vernadsky and N. M. Knipovich, Prof. K. M. Deryugin of the University of Leningrad, Prof. L. N. Fedorov, director of the All Union Institute of Experimental Medicine, and Prof. E. M. Kreps.

The cost of building the Murmansk Station is estimated at 3½ million roubles, excluding equipment. A scientific library, the zoological, botanical, microbiological and hydrochemical laboratories and the libraries of other departments will be housed in the main building of the station. An aquarium designed for scientific work will be installed on the first floor of this building while several other aquaria, open to the public, will be erected in the basement of the building. Premises containing students' laboratories will be situated near the central building, and will also be equipped with large aquaria. Special interest is attached to an open-air concrete reservoir intended to accommodate large sea animals including seals.

The spawn of crabs will be brought from the Far East for acclimitization and breeding in the Barents Sea. A special vessel, 30 metres long, built for scientific work in the open sea will maintain uninterrupted communications between the station and the city of Murmansk.

At the beginning of this year, the Academy of Sciences of the U.S.S.R. commenced extensive work in the Dalnye-Zelenets Bay, east of the Kola Bay (Teriberka district, situated in the Northern Province) for the construction of this biological station, which will be the finest in the Soviet Union. The Soviet architect N. V. Ryumin and his assistants have designed all the buildings.

Irradiation of Plants with Neon Light

AFTER years of experiments in Holland and elsewhere, an appreciable measure of success has recently been achieved in promoting the development of plants by irradiation with artificial light. J. W. M. Roodenburg and G. Zecher, in a paper in *Philips Technical Review* (Eindhoven) of July last describe recent technical developments, and show that it is now possible for the market gardener and the amateur horticulturist to employ irradiation on a practical scale.

The growth of plants is naturally intimately connected with their photosynthesis. As photosynthesis is most active in red light, it is necessary to use red rays. Twenty years ago neon light was suggested, but this light is not so easy to manipulate as glow lamp light, so further experiments were made with glow lamps. These showed that although the development of leaves was promoted, the general quality of the plants suffered, as the stems and stalks grew too 'leggy'. Experiments have now shown that provided the proper 'dosage' is given, neon light is exceptionally suitable for plant irradiation. The stems become thicker, the roots are stronger and frequently he formation of blooms and fruit is much promoted.

When neon lights were introduced for the irradiaion of plants, they had already been employed for several years as luminous advertisements. For these purposes long glass tubes are used, into the ends of which two iron electrodes are fused. The tubes contain a neon filling at a pressure of approximately 10 mm. They are run at a pressure of 3,000 volts and emit a comparatively small luminous flux per metre of tube-length. For use in damp forcing houses for the irradiation of plants, these tubes would be objectionable owing to the risk of shock; moreover, their low brightness makes it difficult to obtain the best illumination. To get a satisfactory illumination, it was necessary to reduce the pressure to 1 mm. or less. But at this pressure the iron electrodes disintegrated rapidly, so that the life of a tube was only a few hours. A solution was obtained by using hot cathodes similar to those used in gas-discharge tubes for highway lighting. This enables the tubes to be run at low pressures.

The hot cathode tubes are connected directly to 220 volts mains supply, through a series-connected 'choke' coil. A simple device is employed for starting up the tube, since the running voltage is too low to initiate the first electric discharge through the low-pressure neon gas. During the burning of the lamp, the cathode suffers practically no disintegration and the light output remains uniform. After 2,000 hours the cathode begins to be atomized and a black deposit forms on the glass walls. The tube should then be replaced. The tubes are short and mounted in reflectors which considerably increase the efficiency of the irradiation.

Photographs are given which show the effects produced by subjecting flowering plants and strawberry beds to irradiation for periods up to three months at eight hours per night in mid-winter. Compared with plants which have not been treated in this way, the forcing effect is very pronounced.

Power and Light for North Wales

AN interesting article on power and light in North Wales by Brig.-General R. F. Legge, manager of the British Power and Light Corporation, Ltd., appeared in the December issue of *Trade and Engineering*, a monthly review of industrial progress, issued by *The Times*. A subsidiary of this company called the North Wales Power Co., which generates all its electricity from water-power, supplies the north of Wales. The area over which the North Wales Power Company operates covers more than 4,000 square miles. The supply is practically unlimited and the price compares favourably with most other industrial areas in Great Britain.

The full exploitation of this area and to a great extent the well-being of its inhabitants depend largely on sound electrical development. Not only has the North Wales Power Company its own water resources, drawn from its lakes in the Snowdonia mountain ranges, on which it has spent several millions in recent years, but also its transmission system has been linked with that of the Central Electricity Board at Crewe. Hence although at present the hydro-electric system is capable of meeting continuous demands, the whole supply is safeguarded by this link with the national Grid and its controlled steam stations. By agreement with the Central Electricity Board, the output of two of the hydro-electric generating stations of the North Wales Co. is controlled and purchased by the British Power and Light Corporation, from which the North Wales Co. repurchases its requirements. In this way the stations are used by the North Wales Co. for peak load operation and supplement the Board's system by meeting the fluctuating demand at various times of the day.

There are more than 1,000 miles of high-tension distribution lines and 300 miles of low-tension, excluding the systems of eighteen local authorities which are supplied in bulk. The North Wales Power Co. itself distributes to some 300 points within the area, affording supplies to more than 150 townships, to rural villages and to independent farms.

The principal industries in North Wales are the quarrying of slate, granite and limestone, the mining of coal, lead and gold, the manufacture of bricks and tiles, wool textiles, artificial silk and chemicals, and agriculture. According to the annual report of the Secretary of Mines, in 1935 the production of slate in Great Britain was the highest for more than twenty years, and the best slate comes from North Wales. The aggregate power required for working the granite and slate quarries is 20,000 h.p. The L.M.S. Railway at Crewe has a connected load of approximately 16,000 h.p. Extensive developments have taken place in milk food production factories. The local farmers in distant rural districts are availing themselves of the power companies' supply for milking and other farm work. In 1914, the Marconi Telegraph Co. erected at Caernarvon the first long-distance transmitting station to be built in Great Britain. It is still in operation, the North Wales Power Co. supplying it with the necessary current.

The diversity of the loads supplied to the various industries is very beneficial. This is seen by the load factor being about 0·56. During the last three years, purchases per annum have increased from 35 to 106 million units.

University Events

Birmingham.—Mr. A. E. Hills, the donor of the new chemistry block, has made a further benefaction of £25,000, to be used for the provision of post-graduate scholarships open to all students of the University, in any faculty, who have taken a bachelor's degree and shown themselves qualified for post-graduate work. The minimum value of a scholarship is to be £150, but the Council may at its discretion increase the sum. The maximum period of tenure is two years, and the scholarships may be used for study in Leeds or any other place approved by the Council of the University. They will be known as the A. E. Hills post-graduate scholarships.

Dr. R. Peierls, assistant-in-research at the Royal Society Mond Laboratory, Cambridge, has been appointed to the newly instituted chair of applied mathematics as from October 1.

Leeds.—In the recently issued annual report, the significance of the outstanding benefaction of the year, a gift of £50,000 from an old student of the University, Mr. Frank Parkinson, is stressed: The object of the gift is to establish an endowment found for scholarships and it is noteworthy, apart from its magnitude, for the guiding principle prescribed by the donor for the administration of the fund. Education for citizenship is, he holds, a university's highest service to the community. His gift is intended "to fructify in the development of those types of manhood and womanhood which the country needs if it is to hold its place amongst the nations in the strenuous years that lie ahead", and he asks that in selecting beneficiaries the University be mindful of the supreme importance of "keeping the realities of life and the need for breadth of vision in human affairs well before its students".

Among the important developments of the year were the completion of the great new Library, the Brotherton, additions to the staff of the school of medicine and the inauguration of a scheme for closer co-operation with Yorkshire theological colleges. Student enrolments have steadily increased since 1930–31 and in the last session reached the record figure of 2,161 (full-time, 1,663). Nor do there seem to be grounds for fearing that the number is excessive in relation to the opportunities for employment open to graduates. On the contrary, year by year, says the report, we see an increasing reliance upon the value of university education on the part of the public.

Science News a Century Ago

Experiments with the Thermo-Electric Pile

ON April 24, 1837, writing from King's College, London, Wheatstone sent a note to the editor of the *Philosophical Magazine* (May 1837, 414) "On the Thermo-Electric Spark, etc." In this, he directed attention to some experiments recently made in Italy with Nobili's pile, the production of thermo-electric sparks and the effects of thermo-electric currents. The original experiments had been made by Cav. Antivori, director of the Museum at Florence, and Wheatstone had repeated them at King's College, where they were seen by Daniell, Faraday, Henry and Bache, of whom the last two were on a visit to Great Britain from the United States. The thermo-electric pile Wheatstone used had 33 elements of bismuth and antimony formed into a cylindrical bundle ⅘ in. in diameter and 1½ in. in length. The poles of the pile had wires leading to a mercury cup. One face of the pile was heated by a red-hot iron brought within a short distance of it, and the other was kept cool by ice. When contact was broken with the mercury cup, small sparks were observed. Writing of the results, Wheatstone said: "I conclude, therefore, that the experiment of Antivori is a real addition to our knowledge of electrical phenomena . . . it supplies a link that was wanting in the chain of experimental evidence which tends to prove that electricity, from sources however varied, is similar in its nature and effects, a conclusion rendered more than probable by the recent discoveries of Faraday. . . . It is not too much to expect, seeing the effects produced by a pile of such small dimensions, that by proper combinations the effects may be exalted to equal those of an ordinary voltaic pile."

Ornithological Society

THE first general meeting of this Society, which was formed on October 21, 1836, was held on April 26, 1837, at the Thatched House Tavern, St. James Street, with Mr. N. A. Vigors, M.P., in the chair. Since the last meeting, 127 new members had joined the Society, and the Duke of St. Albans, the Earl of Derby and other noblemen had made the Society presents of valuable birds. Several birds belonging to the Society had already been placed in the enclosure in St. James's Park; and the Committee intended to apply to the Government for a plot of ground for the use of the Society, on the plea that the hardy birds would be exhibited in the parks.

Changes in the Ova of Mammals

AT a meeting of the Royal Society on April 27, 1837, Richard Owen communicated a paper by Thomas Wharton Jones entitled "On the First Changes in the Ova of the Mammifera, in consequence of Impregnation . . ." The report of the paper said: "The author having in a former paper described the structure of the unimpregnated ovum of mammiferous animals, now proceeds to investigate the changes which the ovum undergoes in consequence of impregnation. In the rabbit, the first perceptible difference is the addition of a thick gelatinous matter surrounding the parts of which the ovum was composed in its original state, and apparently derived from the ovaries. In the progress of development the vitellary membrane gives way, as happens in the ova of the newt, and of many of the oviparous animals. The gelatinous envelope acquired in the ovary, and which is more especially circumscribed and defined after impregnation, constitutes the only covering of the vascular blastoderma, after the giving way of the vitellary membrane, and afterwards forms the chorion, which in rodent animals, at a further stage of development, presents itself under the form of a thin transparent membrane, very similar to the vitellary membrane of a bird's egg, and situated immediately outside the non-vascular and reflected layer of the umbilical or erythroid vesicle."

Brewster and Forbes

AMONG the letters of J. D. Forbes is one written on April 28, 1837, to Sir David Brewster, a part of which ran: "Your experiments on absorption must be most interesting. I think Wrede, the first pages of whose paper Taylor has lately translated, has done something of the kind you allude to, if I understand it correctly. If I recollect well, he imitates the phenomena of absorption by combinations of thin mica plates, that is by the colours of thin plates.

"I will do my best to capture a Wolf's lens for you, on condition that you will not require an affidavit that I saw the wolf make use of it. To stare a wolf in the face in the Black Forest would be enough to throw any optical philosopher into a fit of reflection."

The Zoological Society

THE anniversary meeting of the Zoological Society was held on April 29, 1837, at the Museum in Leicester Square, the Earl of Derby, president, being in the chair. The receipts for the year had been £19,123 14*s.* 10*d.*, of which £9,463 2*s.* 0*d.* was from admission fees to the garden; the receipts from this source exceeded those of the previous year by £2,000. The giraffes had been a great attraction. The Society had 3,050 members, with 43 candidates, 112 corresponding members, 24 foreign and 10 honorary members. During the year 363,392 persons visited the gardens. The total number of specimens were 1,025, of whom 307 were quadrupeds, 704 birds and 14 reptiles. The number of specimens in the Museum was 6,720, and there had been 3,668 visitors.

Medicine in Italy

THE April issue in 1837 of the quarterly *British and Foreign Medical Review* contains the following account from a correspondent of the state of medicine in Italy at that time.

"From what I have seen of the Italian physicians, I would remark that they display considerable learning and much acquaintance with ancient authors, yet in their practice they do not appear to advance beyond the days of Hippocrates or Galen. Following closely the footsteps of the great Father of Medicine, they closely watch the natural progress of the complaint, but unfortunately they do little either to assist or counteract the operations of Nature. In their practice they seldom employ anything like decision or vigorous measures to cut short disease, and even in the most acute complaints, they depend more on diet and regimen than on the use of medicines. I would not assert that they lose more patients than the English physicians; but I have no hesitation in saying that the bad effect of their mode of treatment is apparent in the immense number of chronic diseases which are continually presenting themselves and which might probably have been prevented from becoming such, had depletion been more freely resorted to in the acute stage of the disease."

Societies and Academies

Dublin

Royal Dublin Society, March 23.

D. A. Webb and W. R. Fearon : Studies on the ultimate composition of biological material. (1) Aims, scope and methods. A spectrographic survey has been made of peat from samples taken at different depths : (*a*) surface, (*b*) five feet down, and (*c*) twenty feet down. The following elements were plentiful in all samples : aluminium, calcium, magnesium, manganese, strontium. The following decreased with depth : lead, phosphorus, silver. The following increased with depth : barium, iron, silicon, zinc. The following were present as micro-constituents and showed no significant variation with depth : copper, molybdenum, potassium, tin. Surveys were made also of related organisms, namely, bakers' and brewers' yeast, and of various regions of a single structure, namely, the outer and inner layers of the testa and the endosperm of the Brazil nut. The data are discussed in connexion with the classification of biological elements into primary, secondary, and micro-constituents, and contaminants.

L. O'Droma and M. Grimes : A study of *Escherichia communior* found as a contaminating organism in 'starter'. A commercial 'starter' for use in cheese-making was found to produce a gassy curd. Manipulation of the mother starter failed to eliminate the gas former. Isolation revealed *Escherichia communior*, a coliform organism which ferments sucrose. Details of the cultural and physiological characters of the organism were given.

Paris

Academy of Sciences (*C.R.*, 204, 829–924; March 15).

Lauge Koch : The question of the Ozakian in Greenland. The arrangement of the strata in northern Greenland is tabulated, in accordance with the author's view. The upper Cambrian is not represented, and the term Ozakian is omitted as being unnecessary.

Maurice Nicloux : The diffusion of ethyl alcohol in marine animals, and the hypothesis of combined water. Experiments bearing on the hypothesis of the existence of a protein-water complex in which the water has lost its usual solvent properties.

Mendel Haimovici : Finsler spaces.

Christian Pauc : Ensemble of finite systems of points of a continuum.

Lubomir Tchakaloff : A problem of Laguerre.

Maurice Potron : Non-negative matrices.

Henri Milloux : The Schottky-Landau theorem and the theory of normal families of functions.

Robert d'Adhémar : The elementary theory of the gyroscopic movement of projectiles. Nature of the approximation. The Magnus effect.

Jean Louis Destouches : The properties of the generalized Lorentz transformation.

Ouang Te-Tchao : The size of smoke particles suspended in the air.

Raymond Chevalier and Mlle. Suzanne Mathieu : The variation of the magnetic susceptibility of a hæmatite powder as a function of the size of the grains. The magnetic susceptibility diminishes regularly as the grain size is reduced. No explanation can be given at present.

Roger Servant : The examination and working of quartz plates cut perpendicularly to optic axis.

Marcel Châtelet : The kinetics of the oxidation of cobalt in ammoniacal solution.

Marcus Brutzcus : Combustion yields of hydrocarbons and energy values of the linkages of their atoms.

Mme. Alma Dobry : The electro-chemical nature of cellulose solutions.

Marcel Servigne : A sensitive method for detecting traces of rare earth elements. The method is based on the production of a photo-luminescence spectrum, and will detect certain rare elements (samarium, dysprosium, europium) in concentrations so low as one part in a million.

Pierre Bonneman : The tetrametaphosphates.

Armand Marie de Ficquelmont : The mechanism of the polymerization of the phosphonitril chlorides, $(Cl_2PN)_x$.

Thadée Urbanski and Marian Slon : The nitration of the paraffin hydrocarbons by means of nitrogen peroxide. With normal paraffins ranging from pentane to nonane, mixtures of mono- and dinitro-derivatives were obtained.

Jacques Parrod : The influence of some compounds on the formation of hydrocyanic acid, by oxidation of lævulose or of alloxan, in a copper-ammonium medium.

Eugène Wegmann : The Precambrian base of southern Greenland.

Louis Eblé : The values of the magnetic elements at the Val-Joyeux (Seine-et-Oise) station on January 1, 1937.

Emile Thellier : The so-called permanent magnetization of basalts. The magnetization of a basalt is altered by the action of even a very small magnetic field. Hence researches on the variations of the terrestrial magnetic field with time based on the study of the magnetic properties of basalts are of doubtful validity.

Robert Lemesle : A new secreting apparatus with tannoids in the genus *Eupomatia*.

Robert Echevin and Arthur Brunel : Nitrogen metabolism in the course of the germination of the lupin, *Lupinus albus*.

Roger Ulrich : Some factors of the premature fall of the fruit in the ivy (*Hedera Helix*).

Robert Quetel : The evolution of various forms of phosphorus in forced lily-of-the-valley.

Roger Gautheret : The action of the root on the survival of isolated cells of the cap of *Lupinus albus*.

Marcel Mascré : Leucænol, a definite principle extracted from the seeds of *Leucæna glauca* (Papilionatæ).

René Souèges : The embryology of the Amarantaceæ. The development of the embryo in *Amarantus retroflexus*.

Marc Simonet : A new case of chromosome division in a hybrid of *Iris pogocyclus*, *I. Ricardii* var. *Leverrier* × *I. Iberica*.

Jules Pavillard : Hybridization (or perhaps mutation) in pelagic diatoms of the genus *Rhizosolenia*.

Maurice Rose and Mlle. M. Hamon : The physico-chemical conditions of bursting and of th dehiscence of the spermatophores of some Cephalopods.

Mlle. Yvette Neefs : Various cases of functiona hermaphrodism in *Strongylocentrotus lividus*.

Wladimir Drabovitch and Pierre Weger : Tw cases of experimental neurosis in the dog.

Paul Chauchard: Chronaximetric analysis of the mechanism of the synergic and antagonistic actions in the field of the autonomous nervous system.

Philippe l'Héritier, Mlle. Yvette Neefs and **Georges Teissier**: Apterism of insects and natural selection.

Maurice Lecamp: The morphological determination of the regeneration of members in the *Phasma*.

Mme. Paulette Chaix: The influence of traces of oxygen on the glycolysis of *Propionibacterium pentosaceum*.

Mme. Andrée Drilhon: The influence of parasitism on the mineral equilibrium of the tissues (sacculine in the crab).

Mlle. Gilberte Mourot: The nature of the excremental compounds resulting from the catabolism of the amino acids.

Iwo Lominski: Is alexin a corpuscular element ?

Georges Blanc and **M. Baltazard**: The influence of fasting on the persistance of the virus of typhus in the flea, *Xenopsylla cheopsis*.

Georges Mouriquand, Henri Tête, Georges Wenger and **Paul Viennois**: Rheumatism with anchylosis in partial C avitaminosis.

Cracow

Polish Academy of Science and Letters, February 8.

S. Mazurkiewicz and **Mlle. H. Szmuszkiewicz**: The zeros of quasi-analytical functions (*B*).

Th. Banachiewicz: The calculations of determinants with the aid of Cracovians (2).

W. Swietosławski and **E. Ramotowski**: Distillation with simultaneous expansion of vapours. Results obtained with an apparatus consisting of four fractionating columns connected by four narrow jets, producing differences of pressure in the four columns. The separation is more efficient with the expansion than without it.

W. Swietosławski and **S. Pieszczek**: The comparative method of determination of the critical temperature of liquids and their mixtures.

K. Dziewonski and **L. Sternbach**: Studies on pyrene.

J. Tur: The extent of the neoplasmogenic action of blastodermic cauterization.

J. Gallera: The teloblast of platyneuric embryos.

Washington, D.C.

National Academy of Sciences (*Proc.*, **23**, 41–131, Feb. 15).

K. W. Cooper: Reproductive behaviour and aploid parthenogenesis in the grass mite, *Pediculopsis raminum* Reut. (Acarina, Tarsonemidæ). After ttachment to the source of food, the hysterosoma of he female swells with fluid to 100–500 times the original body volume of the mite ; eggs form within, nd develop through larval and nymphal stages to dults, when mass birth occurs. Such mass births ntain about 5 per cent of males ; a male is inariably present in every brood. Copulation often ccurs before the mass birth. Virgin females, isolated efore birth, produce only males, which seem to be aploids (chromosome number, 3).

A. V. Manza: The genera of the articulated rallines.

Chester Stock: An Eocene titanothere from San iego County, California, with remarks on the age ' the Poway Conglomerate.

A. G. Steinberg: Relations between chromosome size and effects of inversions on crossing-over in *Drosophila melanogaster*. The effect of an inversion on crossing-over in a non-homologous chromosome is a function of both the inversion itself and of the length of the chromosome affected.

Helen D. King and **W. E. Castle**: Linkage studies of the rat (*Rattus norvegicus*) (2). The occurrence of waltzing in an inbred race of rats at the Wistar Institute is linked with albinism, and its gene is now found to be borne in the same chromosome as the albino gene.

H. H. Laughlin: The coefficient of prediction-accuracy : computation of the portion of individual cases common to both the particular prediction-distribution and to the subsequently determined actual-distribution of the same measured and counted phenomena.

W. J. Crozier: Strength-duration curves and the theory of electrical excitation. Data on the relationship of current strength and time for a fixed magnitude of effect due to repetitive electrical excitation in nerve and muscle, and also data on phenomena of stimulation by light and by sound, can be described by a logarithmic probability integral.

H. Rademacher: A convergent series for the partition function $p(n)$.

J. L. Walsh: Curvature of level curves of Green's function.

A. H. Clifford: Representations induced in an invariant subgroup.

S. Pasternack: The mean value of r^s for Keplerian systems.

Paul S. Epstein: The equation of diffusion. A discussion of two equations for a general theory of diffusion published by Kolmogoroff under the title "The Analytical Theory of Probability" and their relation to other forms of the diffusion equation used in physics.

Th. von Kármán: The statistical theory of turbulence.

F. Zwicky: Intrinsic properties of light and corpuscles from distant sources. The importance is stressed of investigating the change in time of dimensionless ratios of significant physical quantities. Data already available indicate that nebular light and terrestrial light possess intrinsically identical physical properties. Certain recent observations, however, suggest that the velocity of light may depend on its frequency. Similar inquiries should be made with regard to extra-terrestrial corpuscles.

Dorrit Hoffleit: Spectroscopic absolute magnitudes of three hundred and seventy southern stars.

T. E. Sterne and **L. Campbell**: Changes of period in variable stars of long period. A study of the data available for 377 variables by Pearson's χ^2 test indicates that while certain of them have sinuously changing true periods, there is no good evidence for any secular change of period of an evolutionary nature among long-period variables as a whole.

D. E. Adelson and **M. T. Bogert**: The synthesis of gamma-methyl-5,6-cyclopentenoretene, a compound structurally related to 'Diels' hydrocarbon'. It is thought this substance may be of biological interest.

W. D. Harkins: The intermediate nucleus in the disintegrative synthesis of atomic nuclei : disintegration in steps. A discussion of various nuclear reactions based on the view put forward in 1926 that one or more intermediate nuclei are first formed, each of which has an actual life and separate existence.

Forthcoming Events

Tuesday, April 27

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir William Bragg, F.R.S.: "The Crystal and the Engineer" (James Forrest Lecture).

Wednesday, April 28

ROYAL SOCIETY OF ARTS, at 8.15.—Lieut.-Colonel G. P. Pollitt: "Recent Developments in Grass Drying".

Thursday, April 29

BRITISH PSYCHOLOGICAL SOCIETY, at 8.30.—Dr. William Brown: "Hypnosis, Suggestibility and Progressive Relaxation. An Experimental Study".

Friday, April 30

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP), at 6.45—(at the Waldorf Hotel, Aldwych, London, W.C.2).—Annual General Meeting.

Sir Alexander Gibb, F.R.S.: "The Chemical Engineer and Industrial Planning".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ENGINEER AND MANAGER of the Caledonian Canal—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (April 30).

HEAD OF THE BUILDING DEPARTMENT in the East Ham Technical College—The Secretary for Education, Education Office, Town Hall, East Ham, E.6 (May 7).

LECTURER IN MECHANICAL ENGINEERING in the Derby Technical College—The Clerk to the Governors, Derby Technical College, Green Lane, Derby (May 10).

ADDITIONAL ZOOLOGIST on the Scientific Staff of the "Discovery" Committee—The Secretary, "Discovery" Committee, Colonial Office 16 Queen Anne's Chambers, London, S.W.1 (June 1).

GENETICIST for the Rubber Research Scheme, Ceylon—The Chairman, Rubber Research Scheme, Agalawatte, Ceylon (June 30).

ENTOMOLOGIST for the Iraq Government—The Iraq Legation, 22 Queen's Gate, London, S W.7

LECTURER IN PHYSIOLOGY in Loughborough College—The Registrar.

ASSISTANT LECTURER IN ENGINEERING and ASSISTANT LECTURER IN BUILDING in the Swansea Technical College—The Director of Education, Education Offices, The Guildhall, Swansea.

TEACHER OF MINING SUBJECTS in the Whitwood Mining and Technical Institute—The Secretary to the Managers, Education Offices, Castleford, Yorks.

RADIO RESEARCH WORKER for the National Research Council, Ottawa—The Secretary-Treasurer.

Official Publications Received

Great Britain and Ireland

The One Hundred and Third Annual Report of the Royal Cornwall Polytechnic Society. New Series, Vol. 8, Part 3, 1936. Pp. 100+13 plates. (Truro: Netherton and Worth.) 5s. [14

Management Research Groups. The Control of Overheads Prepared by a Research Committee of the Groups under the Chairmanship of F. L. Impey. Second edition. Pp. 36. (London: Management Research Groups.) 5s. [14

Ministry of Health: Advisory Committee on Nutrition. First Report. Pp. 52. (London. H.M. Stationery Office.) 1s. net. [24

Bacon Development Board. Bulletin No. 1: Hygiene in the Bacon Factory. Pp. 32. (London: Bacon Development Board.) 1s [64

Ollsgoil na h-Eireann (The National University of Ireland). Calendar for the Year 1936. Pp. ix+312+580+364. (Dublin: National University of Ireland) [84

The Physics and Chemistry of Paintings: Three Lectures given before the Royal Society of Arts, March 1937. By F Ian G. Rawlins. Pp. 52. (London: Royal Society of Arts.) 2s 6d. [84

Towards a More Beautiful Britain. Pp. 20. (London: Coronation Planting Committee.) [94

Gas Defence from the Point of View of the Chemist By J. Davidson Pratt. Pp. 24. Oxidation-Reduction Potentials and their Applications. By D. S. Glasstone. Pp. 28. (London: Institute of Chemistry.) [94

Other Countries

U.S. Department of the Interior: Office of Education Bulletin, 1936, No. 11: A Guide to Curriculum Adjustment for Mentally Retarded Children. Compiled and edited by Elise H. Martens. Pp. vi+133+13 plates. 20 cents. Bulletin, 1936, No. 14: Poland's Institutions of Higher Education. By Severin K. Turosienski. Pp. 160. 25 cents. Bulletin, 1936, No. 17: William Torrey Harris; the Commemoration of the One Hundredth Anniversary of his Birth, 1835–1935 Edited by Walton C. John. Pp. x+70. 15 cents. (Washington, D.C.: Government Printing Office.) [313

U.S. Department of Agriculture: Bureau of Entomology and Plant Quarantine. Tephrosia as an Insecticide: a Review of the Literature. By R. C. Roark. Pp. 165. (Washington, D.C.: Government Printing Office.) [313

University of California College of Agriculture: Agricultural Experiment Station. Bulletin 602: Solar Energy and its Use for Heating Water in California. By F A Brooks. Pp. 64. (Berkeley, Calif: University of California College of Agriculture.) [14

Carnegie Endowment for International Peace. Annual Report for 1936 of the Division of Intercourse and Education. By Nicholas Murray Butler. Pp. 68+6 plates. (Washington, D.C.: Carnegie Endowment for International Peace) [14

Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending 31st August 1936. Pp iii+234. (Bombay: Indian Central Cotton Committee.) 2 rupees. [303

Trudy Gosudarstvennogo Radievogo Instituta (Travaux de l'Institut d'État de Radium). Tom 3. Pp. 324 (Leningrad: Gosudarstvennogo Radievogo Instituta) 6.50 roubles. [24

Suomen Geodeettisen Laitoksen Julkaisuja: Veröffentlichungen des Finnischen Geodätischen Institutes. No. 23: Relative Bestimmungen der Schwerkraft in Finnland in den Jahren 1931, 1933 und 1935. Von R A. Hirvonen. Pp. 151. (Helsinki.) [54

U S Department of Agriculture. Circular No 423: The House Rat. By James Silver. Pp. 19. (Washington, D.C.: Government Printing Office) 5 cents. [54

U.S. Department of the Interior: Office of Education. Vocational Education Bulletin No. 185 (Trade and Industrial Series No. 53): Aviation in the Public Schools By Robert W Hambrook Pp. vi+78. (Washington, D C.: Government Printing Office.) 15 cents. [54

Cornell University: Agricultural Experiment Station. Bulletin 655: Transportation of Milk and Cream to the New York Market. By H. R. Varney. Pp. 79 Bulletin 661: Rural Youth; Activities, Interests and Problems. 2: Unmarried Young Men and Women, 15 to 29 Years of Age. By W. A Anderson. Pp. 36. Bulletin 662. Soil and Plant Response to certain Methods of Potato Cultivation. By George C. Moore. Pp 48. Bulletin 663: Influence of Storage Temperature and Humidity on Seed Values of Potatoes. By Ora Smith Pp. 31. Bulletin 664: Effect of Soil Reaction on Growth, Yield and Market Quality of Potatoes. By Ora Smith. Pp. 21. Memoir 194 Lysimeter Experiments, 4: Records for Tanks 17 to 20 during the Years 1922 to 1933, and for Tanks 13 to 16 during the Years 1913 tc 1928. By T. L. Lyon and J A Bizzell. Pp 59 Memoir 196: Physiological Studies on Rhizobium Species By D. G. Clark. Pp. 30 (Ithaca N.Y: Cornell University.) [5

Carnegie Institution of Washington. Annual Report of the Directo of the Department of Terrestrial Magnetism. (Reprinted from Yea Book No. 35, for the Year 1935–36) Pp ii+231–280. (Washington D.C.: Carnegie Institution.) [5

Olösta Gåtor och aktuella Problem Sjuttiosex Uttalanden i Svensk Dagbladets Enquête om Naturforskningens nuvarande Uppgifter oc framtida mål. Pp. 302+24 plates. (Stockholm: Wahlström an Widstrand.) 6.75 kr. [5

Annual Report of the Public Health Commissioner with the Government of India for 1934. Vol 1, with Appendices. Pp ix+358+1 plates. (Delhi: Manager of Publications.) 6.2 rupees; 10s. [7

Report of the Aeronautical Research Institute, Tôkyô Imperi University. No. 146: The Interference Effect of the Surface of th Sea on the Lift of a Seaplane. By Susumu Tomotika and Isao Ima Pp. 69–128. (Tôkyô: Kôgyô Tosho Kabushiki Taisha.) 55 sen. [9

U.S. Department of the Interior: Office of Education. Bulleti 1935, No. 2: Statistical Summary of Education, 1933–34 Prepare by Emery M. Foster Pp. 14. (Washington, D.C.: Governme Printing Office.) 5 cents. [9

Indian Forest Records (New Series). Vol 2, No 12: On the Biolog of the Bostrychidæ (Coleopt.) By C. F C. Beeson and B. M. Bhatı Pp. ii+223–323+3 plates. (Delhi: Manager of Publications.) 3 rupees; 5s 6d. [1

An Essay on the Uses of the Coconut Palm, together with an Illu trated Guide to Coconuts. By W. V. D. Pieris Pp. ii+12+50 plate (Lunuwila: Coconut Research Scheme.) 1.50 rupees; 2s 6d. [12

Bulletins of Indian Industrial Research. No. 7 The Utilisatio of Nepheline Syenite Rock as a partial substitute for Soda Ash the Glass Industry of India. By Dr V S Dubey and P. N. Agrawal Pp. iii+19 (Delhi. Manager of Publications) 6 annas; 8d. [1

Catalogues, etc.

Protamine Insulin (with Zinc) Suspension—Boots, in the treatme of Diabetes Mellitus. Pp 16. (Nottingham: Boots Pure Drug Co Ltd.)

Anemometers. (Catalogue No. 609.) Pp. 24. (London: C. Casella and Co, Ltd)

A Catalogue of Books and Manuscripts to commemorate the Nin tieth Anniversary of the Firm of Bernard Quaritch, 1847–1937. (N 532.) Pp 176. A List of Selected New and Recent Publications. (N 12.) Pp. 16. (London: Bernard Quaritch, Ltd.)

Electric Laboratory Furnaces and Electrically Heated Laborato Apparatus (List No. 75 J.) Pp 52. (London A. Gallenkamp a Co, Ltd.)

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The Imperial Forestry Institute, Oxford

THE future policy of the Imperial Forestry Institute, Oxford, is set out in its twelfth annual report—the first issued since the new scheme of management was introduced. Briefly, it is proposed "to develop the Institute as a centre for the study of world forestry in relation to Empire forest problems and as a forum for the interchange of professional knowledge amongst foresters from all parts of the Empire, rather than as a place of instruction *ex cathedra*". Every opportunity is to be taken of maintaining a closer liaison with the services concerned. It is hoped that ultimately it may be possible for forest officers from different parts of the Empire to be seconded to the Institute for the purpose of giving instruction.

In the meantime, it is proposed to make the fullest use of the fund of knowledge and experience brought to the Institute by the constant stream of forest officers and research personnel who visit it for refresher courses or other purposes, by drawing upon it systematically and placing the results on record. The staff of the Institute will not only act as *rapporteurs* of experience brought to the Institute, but also study and analyse the various techniques of utilization, sylviculture, land conservation and improvement, and their reasons for success or failure, in the light of the fundamental sciences applicable to them. They will carry out research, especially team research, by which plant physiology, soil science, ecology, systematic botany and other sciences may be applied to the solution of complex problems. It is considered axiomatic that the teaching given should be based on research carried out by the staff.

In order that the staff may be better fitted to carry out the role assigned to them, it is essential that they should have some first-hand knowledge of forest conditions in the Empire at large, and opportunities of establishing contact with other workers overseas. It is hoped that it will be feasible, ultimately, to arrange for members of the staff to make tours of some length, during which the duties of the member of the staff on tour will be carried out by a *locum tenens* from some other part of the Empire. Meanwhile, as a beginning, financial provision has been made for one of the senior members of the staff to undertake such a tour.

The fullest development of the Institute as a centre for the diffusion of knowledge by personal contact, implies not only the interchange of knowledge between the permanent staff and visiting officers of experience, but also between the students themselves. One important suggestion from this point of view has been put forward to the Colonial Office, namely, that the year's course at the Institute taken by probationers before taking up their posts in the services to which they are appointed, should be postponed until they have completed an apprentice tour of, say, two years. Their experience, though limited, would enable them to appreciate more fully the problems they have to face than can be expected from any student without experience of tropical conditions. They would be in a position to concentrate on these problems, compare notes with their fellow students from other territories, and refer difficulties to the Institute's staff and to more experienced officers undergoing refresher courses.

Whilst the dissemination of knowledge by personal contact will form such an important feature of the activities of the Institute, it will also, so far as its financial resources permit, act as a clearing house for information on world forestry available in documentary form. As a beginning, the practice of scanning all incoming forestry literature and indexing important contributions has been resumed in a modified form, involving the use of the 'Flury' international decimal classification and the issue, to the services, in multigraphed form, of a *Current Monthly Report*. There is some hope that an Imperial Forestry Bureau may be set up under the Imperial Agricultural Bureau scheme, and attached to the Institute.

With regard to the subjects to be included in the curriculum of the Institute, it is intended to provide more teaching of economics, as the basis of forest utilization and management, and of ecology, plant physiology and soil science as fundamental to the study of sylviculture, not only on the productive side, but also in the widening field of the protective and reclamatory influences of vegetation. The main object, on the teaching side, is to make the initial training and refresher courses more useful to serving forest officers.

Points in the report which may raise questions in the minds of scientific foresters, are the tendencies to emphasize economics as against sylviculture, and to minimize the importance of the study of European forestry as part of the training of a forest officer. It is proposed to hold the study tour of the present year in Finland, on the ground that the highly specialized forms of forestry of Germany, France and Switzerland, seen in the usual study tours, have little application to average conditions overseas. Though, in a literal sense, this contention is true, the forestry of these countries provides the finest examples available of the adjustment of forestry practice to local conditions, and the field in which the ecological, economic and sociological foundations of forestry have been most fully worked out. Students in British forestry schools probably receive sufficient grounding in European forestry, but those officers whose training has been outside Europe should be given an opportunity of making a first-hand acquaintance with the finest examples. Finland is an excellent field for the special study of the economics of exploitation in conditions which are analogous to those of parts of the Empire in some respects, but even more remote in others (climate, number of species, etc.).

The practice of arranging special tours for individuals wishing to study particular aspects of forestry is an important feature of the Institute's work, and it is recognized that it is desirable to extend them into the nearer tropics and even the United States of America on occasion. The advisability of making the Scandinavian countries the venue of ordinary instructional tours is more doubtful.

The policy outlined in the report should commend itself to the forest services of the British Empire, and it is to be hoped that the financial and other support, necessary to implement it fully, will be forthcoming.

Application of Medical Science in Tropical Countries

A Doctor's Odyssey:
Adventures in Forty-five Countries. By Dr. Victor Heiser. Pp. 547. (London: Jonathan Cape, Ltd., 1936.) 15*s*. net.

ABOUT few books can it be said that they have the combined qualities of being interesting, elevating and amusing; but such a claim can certainly be made in the case of Dr. Victor Heiser's book. Dr. Heiser has passed a wonderful life, first in developing the public health service in the Philippines at the time when the United States of America took over these islands, and, at a later date, as one of the executive officers of the Rockefeller Foundation, whose mission it was to organize measures for the suppression of tropical disease, and especially of hookworm infestation, in many parts of the world.

There are probably not many people who realize the extent to which preventible disease develops in tropical countries—plague, smallpox, malaria, typhoid and typhus fevers, hookworm disease, and many other disorders. On arriving at the Philippines, Dr. Heiser says, "I set myself the goal of trying to save 50,000 lives a year." Such a statement may seem grotesque to the average reader, but there is no doubt at all that the Health Board more than succeeded in this object. Millions of people die of these diseases, and those who survive are usually crippled in one way or another for life, in spite of the fact that the knowledge for suppressing most of them is available. In India alone there are said to be 100 million people suffering from malaria. What are we to think of this state of affairs? If human life and health are sacred and precious, why is no united effort made to eliminate or at least to control these death-bringing diseases ? Why are such efforts left in the hands of a few people who, however successful, may have their work hindered, or even stopped, at any moment by the whim of the politician or political administrator ? A good instance of this kind of interference in public health administration is given by Dr. Heiser when he deals with the period of Governor Harrison's presidency over the destinies of the Philippines. Harrison believed that the natives of a country ought to control their own legislation and administration, even in the case of malaria and plague prevention. It can be readily imagined what these primitive people thought of sanitation and clean houses ; and only after the death-rate had again mounted to enormous figures was it decided that a proper standard of health was incompatible with home rule founded on ignorance, superstition and vested interests. The American medical men again got their chance with the arrival of a new governor.

The kernel of the matter is that eighty per cent or more of all social and political problems of tropical countries are essentially biological in nature. When politicians and administrative officers recognize this fact and encourage the medical scientist and biologist to the utmost, many difficulties of administration will disappear, and the standard of health and mental development in these countries will be completely revolutionized.

But it is not only politicians who will profit by reading this book. It might be of some advantage to that large number of people, even educated people, whose idea of modern science centres around aeroplanes, high explosives, poison gas, and the metaphysical interpretations of mathematico-physics sponsored by our modern scientific Schoolmen. It is representatives of this group who state so frequently from the pulpit and through the medium of the British Broadcasting Corporation on Sunday evenings that "modern science has failed".

It will be evident that Dr. Heiser not only had his chances but also that he seized them with both hands. In the Philippines, at least, he seems to have met with almost unreasonable success in most things he attempted, apart from the Governor Harrison episode referred to above. This success was, according to his own account, often due not so much to his own skill as to the fact that most people who stood in his way seemed to be not only slightly weak-minded but completely complacent. In my experience, obstruction and complacency in public life do not generally go together, but Dr. Heiser wins through most of his difficulties and pleases everybody, including the reader of his adventures.

Dr. Heiser is a man to whom things 'happen', as I suppose they happen to most of us at times ; but he also has the faculty of remembering the incidents, and sufficient humour to appreciate them. About whom but Dr. Heiser could the following incident revolve ? He had a quarantine officer called Dr. Turnipseed, and it was the duty of this Dr. Turnipseed to board a ship one morning for quarantine purposes. He knocked on the captain's cabin door and said, "I am Dr. Turnipseed," to which the answer was, "Well, you have nothing on me, I am Captain Garlic."

The book is full of amusing incidents and suggestions. For example, at one time Dr. Heiser was travelling in a ship which was infested with cockroaches. These cockroaches used to run over the feet of passengers when they were asleep, so that if they had corns these were neatly removed by the cockroaches, who gnawed down until they reached a sensitive spot on the foot, when they would be automatically shaken off by the disturbed patient. What chiropodist could compete with this perfect and costless procedure ?

But, however light the tone adopted by Dr. Heiser in describing his life's work, it must be realized that he is really dealing with the fundamental problem of extending modern knowledge to combating disease and death. The fact that he has written in this most acceptable form must not be regarded as evidence of the lack of seriousness of purpose in his endeavours. The general reader will enjoy reading this book greatly, but for those with an intimate knowledge of tropical medicine the fun will not be so unadulterated. The expert will often be made to jump by the cleverly concealed but obvious egotism of the author and by his wrong appraisal of the relative importance of some medical discoveries. Will, for example, Dr. Heiser kindly remember in discussing beriberi in any future edition, that Eijkman is a figure reverenced by all with real knowledge of nutritional disease ? Still, it is improbable that a book of such excellence could have been written by anyone who had not the failings as well as the good qualities of Dr. Heiser.

Now that Dr. Heiser has retired from the tropics and returned home, the Government of the United States ought to put him in charge of a campaign to attack the dreadful situation of venereal disease in that country. If it is true, as stated by those with intimate knowledge, that there are 681,000 new cases of syphilis annually in the United States, it is high time that somebody with Dr. Heiser's qualities for successful administration in preventive medicine should tackle this scourge of public health. E. MELLANBY.

The Tsetse Fly Problem

The Tsetse Flies of East Africa:
a First Study of their Ecology, with a View to their Control. By C. F. M. Swynnerton. (Transactions of the Royal Entomological Society of London, Vol. 84.) Pp. xxxvi + 579 + 22 plates + 7 maps. (London: Royal Entomological Society, 1936.) £5 10*s*. 0*d*.

THE greater part of tropical Africa is covered by the range of one or more of the twenty-one species of tsetse fly (*Glossina*) indigenous to that continent. In much of this vast territory it is not possible to keep cattle owing to the ravages of nagana disease, while the human population is being decimated by sleeping sickness. It is well known that the trypanosomes responsible for these diseases are carried by one or other of the species of *Glossina*. The future prosperity of great tracts of the African continent depend, therefore, on discovering means by which such areas can be inhabited by man and his domestic animals free from risks of infection by these diseases.

Mr. C. F. M. Swynnerton, director of tsetse research in the Tanganyika Territory, has now provided the most comprehensive detailed compendium on the problem that has yet appeared. Published by the Royal Entomological Society with the aid of a monetary grant from the Tanganyika Government, it runs to nearly six hundred pages, with a table of contents alone extending to thirty-six pages. It will be understood, therefore, that it is far too detailed and lengthy for anything more than a very general notice in these columns.

In Tanganyika, two-thirds of the Territory is under infestation by tsetse; and over the remaining one-third, infestation is rapidly spreading. Mr. Swynnerton's problem is how best to rid the land of the scourge of *Glossina* by a reasonable expenditure of money and labour. His equipment for this campaign has amounted to £15,000 per annum, with a European staff of three entomologists, a zoologist, botanists, field officers, etc., together with an office staff of Asiatic clerks. His method of attack is to concentrate on intensive research in co-operation with experimental reclamation of defined areas. The striking success that his methods have already produced is the best argument that his schemes deserve the fullest support from all concerned with the welfare and administration of a great Territory. His policy is to study the ecological requirements of each species of tsetse with the view of depriving it of the minimum necessary for its existence. It appears that each of the eight species of *Glossina* present in Tanganyika needs a concurrence of different vegetational types. If, therefore, any essential type is modified or destroyed, to a required degree, the tsetse is no longer a menace in a given area.

Mr. Swynnerton's bulky volume is a great storehouse of tsetse ecology treated from every point of view. Each species of the fly presents its own series of problems while sub-problems seem to be innumerable. *Glossina morsitans*, for example, affects seven different types of country, each of which requires individual consideration. The term environment includes not only vegetation but also nearly the whole of the vertebrate fauna of a given area. Domestic animals, man and his operations and practices, soil conditions, climate and its smaller units, native settlement, besides matters of medical and veterinary concern, are also comprised within the comprehensive term environment.

Mr. Swynnerton lays down the axiom that effective attack on the fly in the bush offers the only full solution. In the first instance, after the making of a thorough preliminary study, it is necessary to form barriers for enclosing great tsetse-infested areas of bush. Once these barriers have been established, the destruction of the tsetse in the main bush has to be taken in hand. Complete clearing is objectionable not only on grounds of expense but also on account of the erosion which results. Discriminative clearing is therefore to be aimed at. As regards barriers, it is considered that cleared zones two miles wide will be permanent. Barriers formed by certain types of thickets also prevent the crossing of the fly, evergreen thickets being effective in narrow width. Barriers of deciduous thickets are also advocated, but they need to be of considerable width. Apart from the application of the foregoing measures, direct attack on flies by trapping and other means is only likely to be effective in limited areas. An intensive field study of each species of tsetse is stressed, and this needs to be followed by laboratory analysis of the factors involved. Good progress has already been made in this field with the aid of a number of workers.

The connexion between different kinds of tsetse and the wild game, and other fauna, is a great problem in itself. Mr. Swynnerton points out that the only form of game destruction, likely to prove of benefit at all, is highly organized hunting directed by Europeans—otherwise it is useless or directly harmful. Organized game hunting, however, is only feasible in types of more open wooding but not in dense thicket. It also involves great expense which is liable to grow into an indefinite commitment.

Once areas are cleared and reclaimed, problems of native settlement then arise. All means, also, have to be employed to prevent re-growth of vegetation. Co-operation of the natives themselves is essential, and in this respect Mr. Swynnerton's personality has already worked with great success among the peoples of Tanganyika.

Our congratulations go to Mr. Swynnerton. By his boundless energy and enthusiasm, the way is now pointed towards the solution of a great problem in this Territory. His encyclopædic document will prove a boon, as a storehouse of information, that will also guide and stimulate workers in other parts of the continent of Africa menaced by the tsetse.

A Programme for the Social Sciences

The Science of Social Adjustment
By Sir Josiah Stamp. Pp. vii+174. (London: Macmillan and Co., Ltd., 1937.) 7*s*. 6*d*. net.

IT needs no more than the painful experience of the Special Areas or a study of the social and industrial surveys of South Wales and Merseyside, with which the University of Liverpool and University College, Cardiff, have recently been associated, to demonstrate how sadly we need to develop a science of social adjustment. If under this new title Sir Josiah Stamp had merely given us his earlier valuable addresses on the calculus of plenty and the impact of science upon society, we might have welcomed this book for its further stimulus to much overdue action in this field. He has, however, done more. The theme of his recent presidential address to the British Association has been expanded by rearrangement and additions, and with the revised lectures on eugenic influences in economics and on the calculus of plenty, we are given three successive chapters in which his argument is continuously developed until he comes to consider in the final chapter some projects for research.

Wherever and whenever new science touches society, it creates a disturbance which has hitherto been mostly accepted as inevitable, but is often a high price for progress. The study and control of this impact constitute the science of social adjustment, and Sir Josiah's insistence that this is no new problem but one that has been with us in lesser degree for centuries does not encourage continued neglect, but calls more imperatively to action. Indeed, Prof. A. N. Whitehead's assertion that we are living in the first period of human history for which we can no longer assume that each generation will live substantially amid the conditions governing the lives of its fathers, and transmit those conditions to the succeeding generations, is emphatically endorsed.

For all this, we have no adequate technique of change, and treat life as mainly static with occasional and exceptional periods of change, instead of regarding it as continuously changing with occasional and abnormal periods of rest, and we have to secure all the changes of social outlook implied by that reversal of view. Even if we have come to accept change as normal and not the exceptional, we are still faced with the fact that it is almost impossible to predict what social life would be under a very different regime. The decay of social cohesion caused by industrial growth, the increased severity of industrial depressions could scarcely have been predicted in any detail. With T. N. Whitehead in his "Leadership in a Free Society", Sir Josiah reminds us that foresight at long range is not possible when dealing with anything so complex as a modern society.

Sir Josiah, however, does not leave us with a purely negative diagnosis; though he makes no proposals for action, he puts forward theories of proposals which are the working hypothesis as a basis for research and fact-finding. Essentially his book is a challenge to thought, and whereas Whitehead has primarily thrown down a challenge to leaders in industry to accept the responsibility of supplying social leadership to repair the disintegration which industry is working in society, and to see industry as essentially a part of society, Sir Josiah's challenge is rather to academic thought. He warns us indeed that economic life must pay a heavy price, in this generation, for the ultimate gains of science, unless all classes become economically and socially minded, and large infusions of social direction and internationalism are carefully introduced. The emphasis above all, however, is on the quality of thought. "A great draft on the highest mental ability for such social studies is essential." Courses in social science should be as difficult and call for as much thought and scholarship as any of the natural sciences. They are in many senses more exacting in thought processes because they cannot employ the same concrete methods available in the physical sciences.

This emphasis on the need for sustained economic analysis by more first-class minds does not mean government by scientific technique or any other transferred technique, appropriate as these may be to the physical task of production. When the requisite facts have been assembled and analysed, the leadership required must take account also of social wisdom and allow for the slow and halting development of interlocking human relations. Even in this era of change, the motives ensuring predictable and organized activities are the social sentiments surrounding accustomed routines.

It is, however, in presenting a programme for research that this book has the widest claims on the interest of scientific workers. Throughout the book and not only in his final chapter, Sir Josiah gives us examples of lacunæ in existing knowledge which adequate research in eugenics and economics could fill, and in the absence of which a wise direction of national affairs is scarcely possible. He reiterates proposals for research into population changes and distribution, recommending the establishment of a Royal Commission to examine and report upon the probable consequences of the decline in population and change in age groups, and to recommend upon the measures required. He urges a new view of census responsibilities, a census every five years with allied studies of unemployment and of educational adjustments of major significance.

A further proposal is the development of a practice, by the responsible body in each branch of science, of reviewing periodically the immediate *hinterland* of its subject, setting out for each period the chief discoveries, their application, effect on employment and location of industry and the like. He adds another voice to the many who in the last ten or fifteen years have questioned the fundamental suitability of the present patent system to industrial conditions to-day. He suggests very tentatively the possible advantage of confining all patent protection to a six-year period, and urges strongly the need for careful research into the record of recent invention and into the existence of economic and human waste and disturbance in the direction and stability of industry. Scientific research of a close inductive type is required to determine how far the penetration of inventive ideas is fortuitous and dependant on reaching the right man and the right purse at the right time.

Obsolescence provides yet another subject for research which should be approached from the social point of view, and over the last twenty years might provide a model picture and give the basis for a proper treatment. The investigation of taxation adjustments, the co-ordinated study of human heredity and the selective direction of financial support in research are other matters drawing strong support from Sir Josiah, who pointedly directs attention to the disparity between research resources both in men and finance, in the economic or social fields and those available for the physical sciences. University scholarships in the social sciences are negligible in number compared with those given in classics and humanities, and while not suggesting that any of the social sciences should be made school subjects, he pleads for further scholarships in such sciences or a redistribution of funds which will encourage the supply of competent research workers in these fields. Sir Josiah also urges pertinently that to determine, for example, whether a considerable element of under-employment is or is not actually and preventably inherent in the present industrial and economic system is a first-class issue much transcending in importance any current problem in physics or engineering. The resolute and vigorous analysis of the "Douglas Credit" diagnosis of deficient purchasing power, of J. A. Hobson's theories of under-consumption dependant upon maldistribution of income, and of J. M. Keynes' equation between saving and investment and of his analysis of the "propensity to consume" and the issues raised by them, are other examples cited as deserving the attention of a considerable number of thinkers of the front rank. Finally, he raises the question of the various forces which decrease the mobility of personnel in industry, and allied problems—the need for research on the psychological reaction to unemployment relief in relation to the incentive for seeking work, to change of occupation and readiness to train for such changes or to accept a change of neighbourhood—and the social consequences of our facilities for technical education, and its relation to industrial and social activity.

To those who believe that the problems of to-day can only be dealt with by a radical transformation of the nature of society, even if revolutionary, Sir Josiah Stamp's programme for study and development of a science and technique of social adjustment may be of little interest. To those, however, who believe in the possibility of a step-by-step advance, in the development of a mental attitude or discipline competent to guide society through habitual change in an orderly manner, in man's capacity if wisely guided to develop once more the powers required for mastering his environment, it is a challenge both to thought and action. It should win the sympathy and support of even the most ardent protagonist of the physical sciences, to make his own contribution to the great redistribution of our scientific resources and research effort involved when we seriously undertake the programme of social adjustment.

R. BRIGHTMAN.

A Manual of Pharmacology

By the late Dr. Walter E. Dixon. Revised by W. A. M. Smart. Eighth edition. Pp. viii+483. (London: Edward Arnold and Co., 1936.) 18*s.* net.

W. E. DIXON'S well-known text-book has long enjoyed a wide popularity. It is almost the only text-book of pharmacology in the English language of suitable length for those students who regard pharmacology merely as one of the obstacles on the road to a medical qualification. It has always contained a spice of unorthodox and entertaining information which has delighted its readers, and sometimes puzzled their instructors. The seventh edition appeared in 1929, and is now out of date. The eighth edition, prepared by Dr. W. A. M. Smart, represents a drastic revision. The number of figures has been reduced from 97 to 79, but the figure which appears to portray inhibitory nerves to voluntary muscle has been retained.

A large number of chemical formulæ have been inserted, so that it is now possible to find the structure of nearly all drugs of importance. These formulæ are useful for reference, but the detailed chemical structure of most of these substances throws little light on their action, and a knowledge of these details is really only of value to those engaged in research. The bulk of the book has been reduced by the use of a thinner and better paper, but the number of pages is about the same. The general arrangement has not been altered, and the allocation of space to different sections is about the same as before. The chapter dealing with vitamins, hormones, vaccines and sera occupies only fourteen pages. This section might well have been expanded.

It cannot be said that this new edition represents a reliable guide to all the drugs in common use today. There is no mention of the agranulocytosis caused by pyrazolon derivatives or of the action of plasmoquine on the sexual forms of the plasmodium, or of coramine, or dinitrophenol. Salyrgan and mersalyl appear as two different substances. The section dealing with the chemical structure of the cardiac glycosides contains no reference to the cyclopentenophenanthrene skeleton. On the other hand, the book is still the most attractive of its kind. The use of different types for subheadings makes reference easy, and the introduction of a number of prescriptions will probably be a popular feature.

A Modern Biology

By Ernest J. Holmes and Dr. R. Darnley Gibbs. Pp. xvi+272. (Cambridge: At the University Press, 1937.) 3*s.* 6*d.*

THE introduction of biology into the school curriculum and the School Certificate examination syllabus has resulted in the production of many text-books, several of which tend to regard biology as a mixture of botany and zoology. To many biologists, the division of the subject is regrettable, and the question has been raised whether it is possible to teach biology to a pupil of school certificate stage. It is much easier for a young pupil to grasp concrete facts about specific plants and animals than to grasp generalizations, but if biology is really to be appreciated then these generalizations must be grasped.

This book is a praiseworthy effort to establish biology on its own feet instead of on botanical and zoological crutches. The subject matter is treated biologically throughout, and in no place is there an obvious separation made into plant and animal work. The result is a very readable book on which it should be possible to base a good course in biology. The authors indicate in their introduction that the book is intended to succeed a course in nature study, in which it is assumed that many structural features of plants and animals will have been studied. On this foundation the authors have built a course, the theme of which is function rather than structure.

The book is well produced, well printed, and beautifully illustrated. At the end of each chapter are suggestions for practical work based on the subject matter of the chapter. The treatment of the subject matter is modern and refreshing, and should be read and carefully examined by every teacher of school biology.

The Hair in Health and Disease:

a New Explanation of Diseases of the Hair, Scalp and Skin and of "Barbers' Diseases" in Particular. By Edward Lawrence. Pp. xvi+181. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 5*s.* net.

THE author of this book is a barber, and he feels that barbers have been badly treated. They have been punished for being dirty and spreading infectious diseases. Stirred by a strong sense of injustice, he says that 'barbers' rash' is not due to germs, and that diseases in general are not due to micro-organisms but to heredity. He adds that medical men, who have testified against barbers, may themselves be responsible for conveying the infection of puerperal fever. He counters dogmatic statements with the lie direct. The relative importance of the different possible factors in the causation of such diseases is not in fact known with certainty. Scientific workers in general are more open-minded than the author supposes, but they are not likely to be convinced by rhetoric.

Statistical Methods for Research Workers

By Prof. R. A. Fisher. (Biological Monographs and Manuals.) Sixth edition, revised and enlarged. Pp. xiv+339. (Edinburgh and London: Oliver and Boyd, 1936.) 15*s.* net.

THIS book has done more than any other to popularize the use of modern statistical methods. Thousands of workers have been taught to use statistical machinery without the burdensome necessity of knowing exactly how it works. Six editions have appeared in twelve years, and the number of pages has been steadily increasing. To facilitate reference the numbering of the sections has been kept constant. It would be convenient if the numbers of the sections could be printed at the top of each page. The book maintains its place as the standard work on its subject for the ordinary scientific worker.

Water-Power Developments in the United States

By Dr. Brysson Cunningham

I

THE United States Geological Survey, among its other activities, renders an important service to hydrological science by collecting and publishing information on the amounts of developed and potential water-power throughout the world, the returns of the former and the estimates of the latter, of course, requiring periodical revision as the development of water-power proceeds. From the latest statement issued by the Survey, it is to be gathered that the total amount of horse-power actually harnessed at the end of 1934 was 55 millions, as compared with 46 millions in 1930, 33 millions in 1926, 29 millions in 1923, and 23 millions in 1920—an increase of nearly 140 per cent in fourteen years.

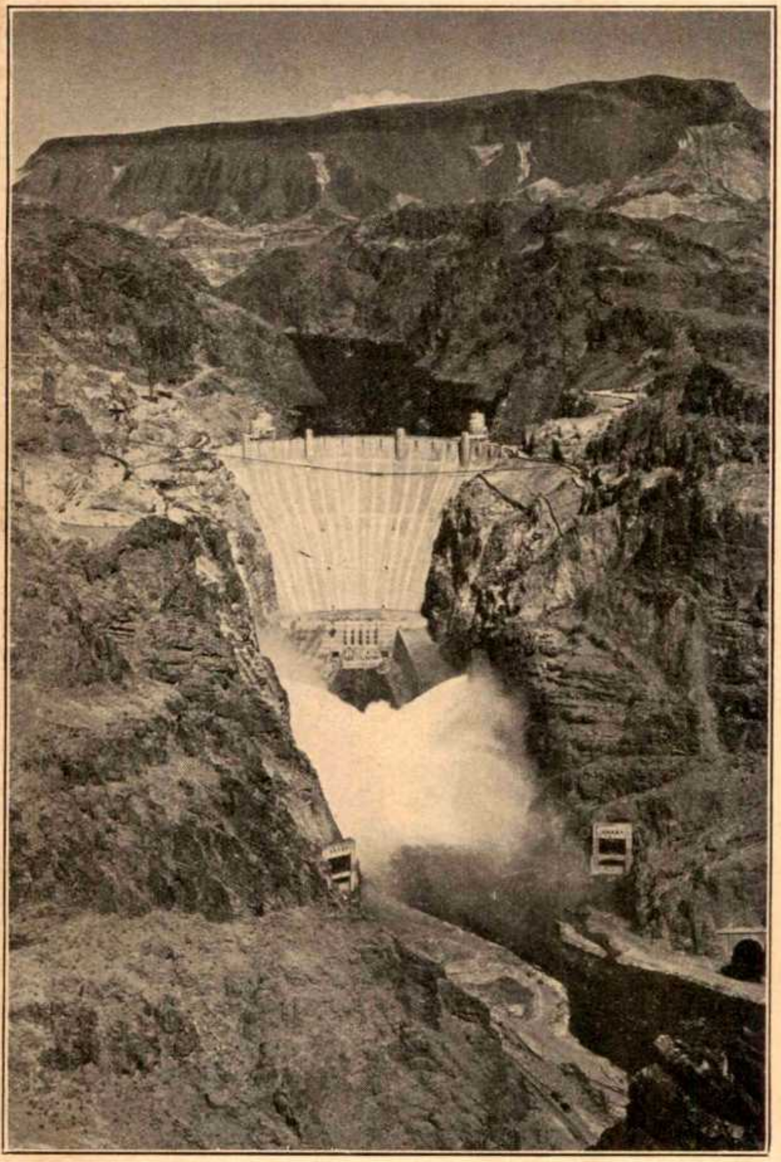

Fig. 1.
VIEW OF DOWNSTREAM FACE OF BOULDER DAM; IN THE DISTANCE IS FORTIFICATION MOUNTAIN.

As regards the potential developments, estimated on the basis of ordinary minimum flow and an efficiency of 70 per cent in installation, the following brief summary of continental aggregates is of interest: Europe, 58 million horse-power; Asia, 80 millions; Africa, 190 millions, of which no less than 125 millions is located in the basin of the Congo and adjacent territory; Oceanica, 17 millions; and America, 127 millions, of which 73 millions is in the northern hemisphere, and 54 millions in the southern.

Developed horse-power at the present time is spread over the world in the following approximate amounts: Europe, 24,300,000; Asia, 4,900,000; Africa, 115,000; Oceanica, 550,000; North America, 24,400,000, and South America, 1,000,000. In comparing these figures with those for potential exploitation, allowance must be made for the fact that the former are based on the actual capacity of the machinery installed, which averages from two to three times the potential power at low flow at the same sites.

A notable fact from the statistics is that Europe has practically caught up with North America in the capacity of actual installations. As against this must be set the fact that the unit magnitudes of certain installations in hand in the United States far exceed those of any other installation under construction in the world. Four outstanding examples may be mentioned: the Boulder Dam, on the Colorado River on the joint boundary of the States of Nevada and Arizona; the Norris Dam, on the Clinch River in North-Eastern Tennessee; the Bonneville Dam, on the Columbia River, at Bonneville, Oregon, and the Grand Coulee Dam, also in the Columbia Basin, but in the State of Washington. These undertakings are of such striking magnitude as to claim some detailed notice. The following descriptions are compiled from information kindly supplied by the authorities concerned.

THE BOULDER DAM

The Boulder Dam, perhaps the most notable of the four, has already received a brief preliminary notice in this journal (NATURE, Feb. 9, 1935) just before its completion in May 1935*. It is by far the highest dam in the world, with a height of 726 ft. above bedrock foundation, as compared with 450 ft., the height of the Chambon Dam in France, which at present ranks second in altitude. The crest length is 1,282 ft., and the structure enables the water surface of the Colorado River to be raised 584 ft. It is located on the Arizona-Nevada State boundary line, in upper Black Canyon on the Colorado River, about 30 miles south-east of Las Vegas, Nev., and 80 miles north of Needles, Calif. The natural geological formation of the site is andesite breccia, hard and very durable.

The dam, the downstream face of which, as it appears from a mountain top on the Nevada side of the Black Canyon, is shown in full extent in Fig. 1, is of the arch-gravity type, and contains 3,255,000 cubic yards of concrete, weighing somewhat less than seven million tons. The artificial reservoir formed by the dam has a capacity of 30½ million acre feet: it is 115 miles long, with a superficial area of 146,500 acres, or 229 square miles, and the filling with water is taking a period of about three years to complete. The view (Fig. 1) shows twelve discharge outlets fully open, resulting in two great cascades with a fall 13 ft. more than the Niagara Falls.

The upstream face elevation above the level of an intermediate impounding stage in Lake Mead

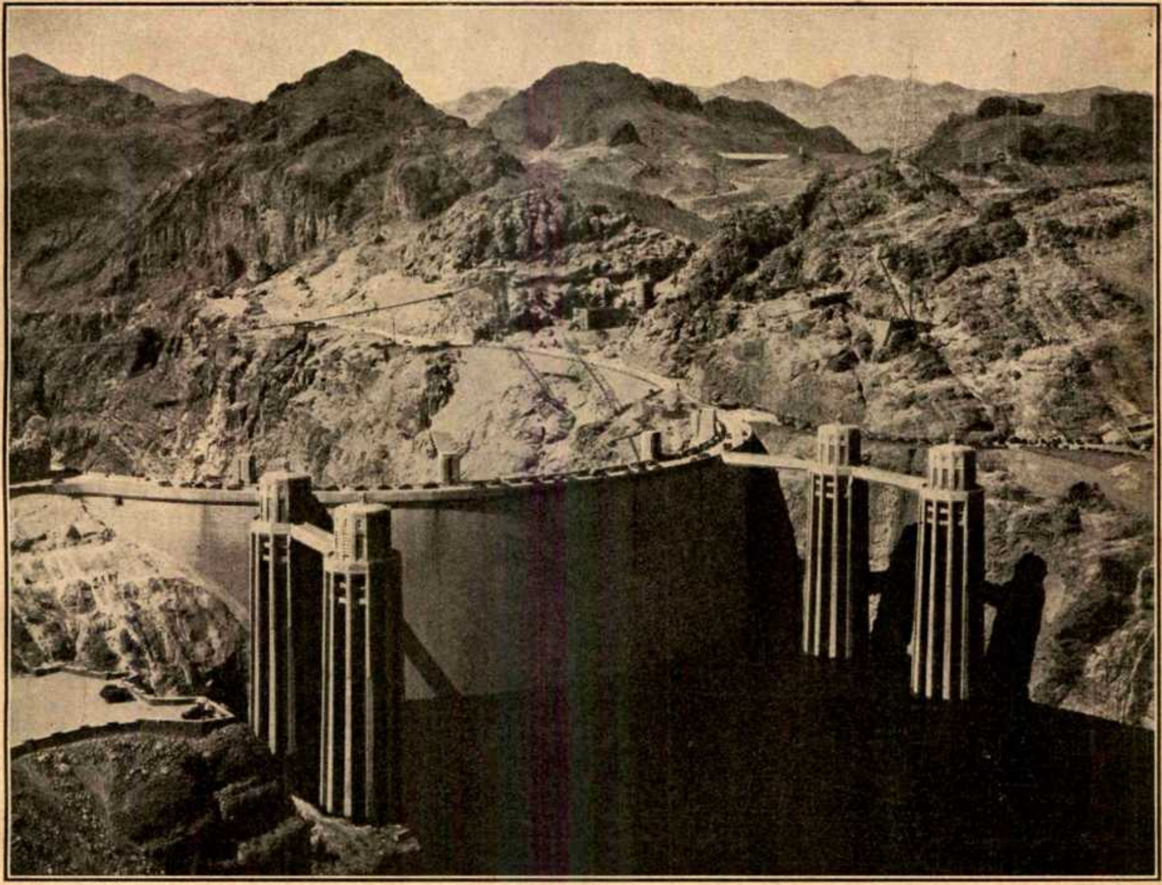

Fig. 2.
VIEW OF UPSTREAM FACE OF BOULDER DAM, SHOWING IMPOUNDED LAKE MEAD.

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* It also formed the subject of a lecture delivered to the Institution of Civil Engineers on April 15 (*vide* NATURE, April 24, p. 706).

with a depth of more than 330 ft., is shown in Fig. 2. Motor-cars can be seen parked in the four-lane roadway across the dam. As will be seen, there are four reinforced-concrete towers located adjacent to the dam, two on each side of the river, and about 165 ft. apart in a direction parallel to the stream. The towers are 375 ft. in height, and average 75 ft. in diameter, decreasing from 82 ft. at the base to 63 ft. at the summit. Each tower controls a quarter of the water supply to the power plant turbines, to which they are connected by 30-ft. diameter plate-steel pipes installed in 37-ft. and 50-ft. diameter concrete-lined tunnels. Each tower has two cylindrical gate valves, 32 ft. in diameter and 10 ft. high, one near the bottom, and the other about mid-height.

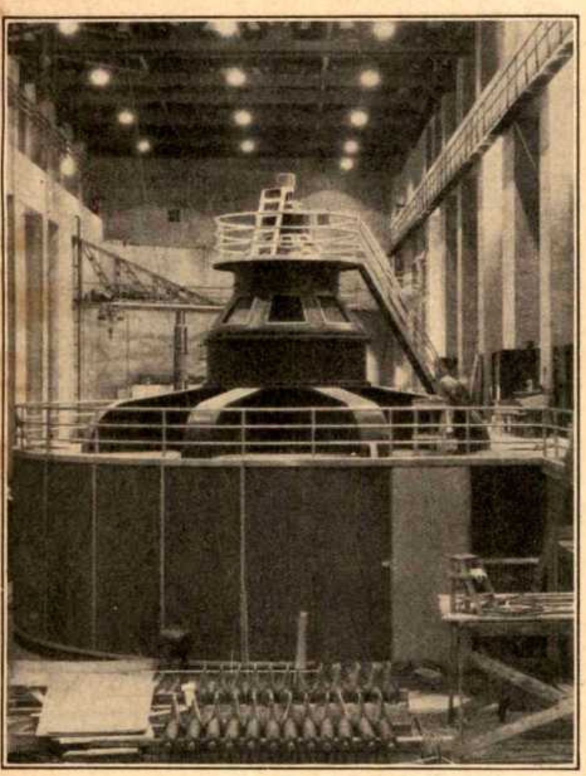

Fig. 3.

82,500 KILOVOLT-AMPERE GENERATOR IN BOULDER DAM POWER HOUSE.

Power development is contemplated to the extent of 1,835,000 rated horse-power. For comparison, it may be mentioned that the total horse-power at Niagara (United States) is 452,500, and at Dnieprostroy (U.S.S.R.) 750,000. A view of the power house is given in Fig. 1 above, and a view of the interior, showing one of the gigantic generators (capacity 82,500 kilovolt amperes) in operation since October 1936, is given in Fig. 3. Four 115,000 horse-power turbines are being installed at the outset, together with a fifth of 55,000 horse-power. The main plant units are unexcelled in magnitude in the world: they have a capacity nearly twice as great as any previously constructed—the nearest approaching them being the 83,000 h.p. turbines and the 76,500 kilovolt ampere generators at Dnieprostroy. The Boulder installation will be complete with fifteen large, and two smaller units about 1940, when about 663,000 horse-power will be continuously available, based on 83 per cent plant efficiency and 10 per cent maximum shortage.

The flow of the Lower Colorado River is an important feature of the project. The greatest measured discharge has been 240,000 cusecs (cubic feet per second) at Yuma, Arizona, but an abnormal flood is believed to have reached 300,000 cusecs for a short period in 1884. At the other end of the scale, the discharge has fallen to 66 cusecs, also measured at Yuma. At the site of the dam, the average discharge is 21,000 cusecs with an average annual run-off of 15,069,000 acre feet.

In addition to power generation, the water from the impounded area is to be used for irrigation purposes. Below the Boulder Canyon reservoir there are some 1,900,000 acres of irrigable land in the States of Arizona, California and Nevada, of which hitherto only 660,000 acres have been under irrigation. There is, therefore, abundant scope for further extensions of supplies of water for irrigation purposes.

Another feature of the project which should not be overlooked is the "All American" Canal, so called because it lies entirely in the United States, while the present Imperial Main Canal is largely in Mexico. The new canal will lead from the Colorado River to the Imperial and Coachella Valleys. The intake is at the Imperial diversion dam, at a site about 15 miles north-east of Yuma, Arizona. The length will be 80 miles to the Imperial Valley, and that of the main canal to the Coachella Valley, 130 miles. A maximum diversion of 15,000 cusecs of water is planned. The canal widths are 232 ft. at the surface and 160 ft. at the bottom, with 20·6 ft. depth. There are only two larger canals in the United States, both ship canals.

The Boulder Canyon Act authorized expenditure up to 165 million dollars (33 million pounds) on the project, of which 70 million dollars is the estimated cost of the dam and reservoir, 38 millions the cost of power development, and a similar sum the cost of the "All American" canal. Up to 1936 about 110 million dollars had been expended.

The photographs illustrating this article have been courteously supplied by the Bureau of Reclamation, Department of the Interior, Washington, D.C., U.S.A., as also, in conjunction with the U.S. Geological Survey, the information on which the article is based.

The Geological History of the Maidenhair Tree and its Allies

By Sir Albert Seward, F.R.S.

IT is probably true to say that *Ginkgo biloba*, the maidenhair tree, is the most interesting and impressive link with the past in the plant kingdom. Does it still exist as a wild tree? Most botanists would probably answer that far-travelled plant collectors in China have never seen a maidenhair tree growing under conditions in which man was not involved. It would, however, be rash definitely to assert that the question is settled. In 1933, a Chinese botanist, W. C. Cheng[1], after recording the occurrence of *Ginkgo* in certain localities in the Chekiang province, added: "This tree is very common in Tienmu-Shan, growing in association with coniferous and broad-leaved trees. It seems to grow spontaneously in that region." The word "seems" implies a lack of conviction. It may still be true to say that *Ginkgo* would have ceased to exist centuries ago had not man adopted it as an object of religious veneration and carefully tended it in the groves of temples and other favoured places.

This sacred tree is an isolated and primitive type; the solitary living representative of a comparatively large family distinguished by certain important peculiarities from other families of naked-seeded plants. About forty years ago, *Ginkgo* was removed from its former association with the yew among the Conifers and placed in a separate family, the Ginkgoaceæ, and even in a group of its own, the Ginkgoales. Ginkgoalean trees were formerly almost cosmopolitan; and there were many genera.

My present purpose is neither to follow through the ages the gradual rise into prominence of the Ginkgoales, nor to attempt a description of the wanderings of the several genera over the world's surface; it is simply to direct attention to some recent work which has greatly extended our knowledge of ginkgoalean trees in Arctic floras separated in time from the present by at least one hundred million years and more. It has long been known that *Ginkgo* and other members of the family were common trees in arctic lands, and flourished so far north as 80° N. lat. Professor Nathorst of Stockholm, writing in 1911, spoke of fossil leaves of a *Ginkgo* covering the surface of Lower Cretaceous shale in Spitsbergen as completely as the leaves cover the soil beneath a living *Gingko* tree in autumn.

The first contribution to be briefly considered is by Dr. Rudolf Florin of Stockholm, the author of a well-illustrated paper entitled "Die fossilen Ginkgophyten von Franz-Joseph-Land nebst Erörterungen über vermeintliche Cordaitales Mesozoischen Alters"[2]. Some of Dr. Florin's conclusions, which are of minor importance and do not affect the soundness of the work as a whole, may be questioned; but all botanists who regard the past history of recent genera as worthy of attention will heartily welcome this very valuable contribution from a leading expert in a special branch of palæobotanical research.

We are concerned only with the Ginkgoales. Improvement in methods of examining fossil leaves microscopically has greatly facilitated the discovery of more trustworthy evidence of natural affinity. It is seldom possible to cut microtome sections of petrified leaves or other plant remains, but Dr. Florin has succeeded in doing this with some of the Franz-Josef Land material after treatment with hydrofluoric acid. Petrified plants are relatively rare, and most fossil leaves occur as thin carbonized films on the surface of shale and sandstone. By the employment of a suitable technique, Florin and other palæobotanists have made substantial additions to a more exact knowledge of the histological structure of epidermal layers, which throws welcome light on relationship to recent plants.

Dr. Florin's paper is mainly devoted to an intensive and comparative study of ginkgoalean leaves from rocks of Lower Cretaceous age, approximately contemporaneous with the Wealden beds of south-eastern England. In 1880, Mr. Leigh Smith collected a few fossil plants in Franz-Josef Land: a larger collection was brought to England in 1896 in the steamship *Windward* chartered by the Jackson-Harmsworth Expedition. The plants were partially described in 1897 by Messrs. E. T. Newton and J. J. H. Teall: specimens collected by Dr. Nansen were described by Prof. Nathorst, and others by Graf zu Solms-Laubach. These descriptions have now been revised and greatly supplemented by Florin. The best material was found on the southern coast of the archipelago, where horizontal layers of basaltic lava, thickly covered with ice, overlie a few hundred feet of sedimentary rocks. These early Cretaceous plants afford a striking contrast to the few flowering plants, barely thirty in number, which are now able to withstand the long arctic night. There were trees in those days, and a flora clearly demanding much more genial climatic conditions.

The genus *Ginkgo* was represented by two, possibly more, species: *Ginkgo polaris*, originally described by Nathorst, with small semicircular leaves about 3·5 cm. broad and 2·5 cm. long, more or less deeply dissected into linear or wedge-shaped segments comparable on a smaller scale to the lobed leaves of the maidenhair tree borne on young shoots and seedlings. In venation and in the minute structure of the stomata and other epidermal cells, the arctic leaves closely resemble those of *Ginkgo biloba*. Another closely allied species is *G. coriacea* Florin. Some seeds from the same beds revealed epidermal characters similar to those of the leaves. The most important part of Florin's paper is the description of other genera of the *Ginkgo* family differing from the maidenhair tree in bearing long and narrow leaves in tufts on very short, deciduous branches surrounded at the base by a few persistent bud-scales (Fig. 1). These deciduous leafy shoots may be compared superficially with the so-called dwarf shoots or foliage-spurs of pines with two, three or five needles: in the ginkgoalean trees the leaves were usually broader and flatter, and more of them on each dwarf shoot.

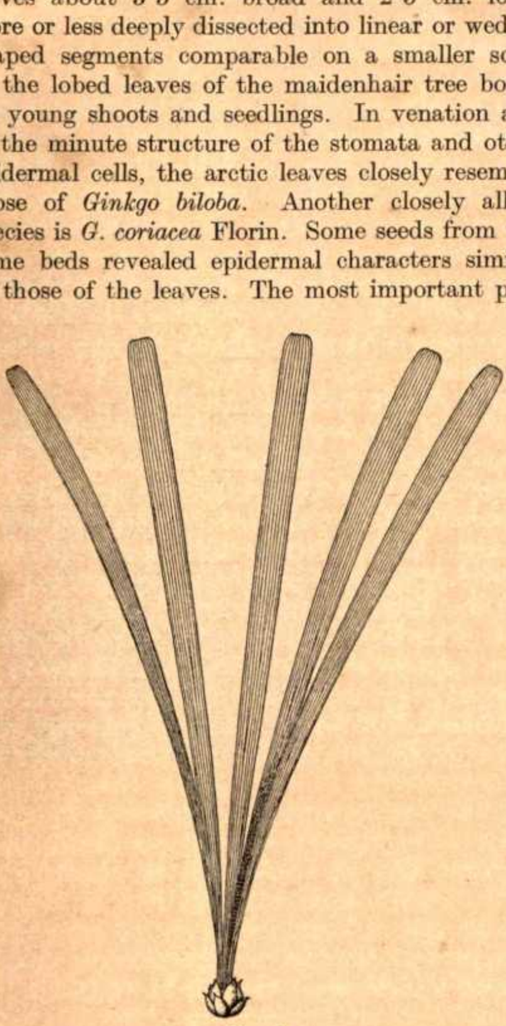

Fig. 1.

Windwardia Crookallii Florin. Reconstruction of a single dwarf shoot. ¾ nat. size. After R. Florin.

For the last sixty years, the name *Phœnicopsis* has been widely adopted for specimens of flat, linear, multi-veined leaves borne on very short shoots, or preserved singly. The generic name denotes a certain external form and venation, not a particular anatomical structure. Florin has now been able to assign certain distinctive types of leaves having the external form of species of *Phœnicopsis* to genera founded on anatomical character. One of these genera is *Stephenophyllum*, called after Cape Stephen on the south coast of Franz-Josef Land, where the best material was found. Seven leaves are borne on a diminutive axis surrounded by small, persistent bud-scales: such a shoot is comparable to the short branches of *Ginkgo biloba*, but differs in being much shorter and deciduous. *Stephenophyllum* is assigned to the *Ginkgo* family on the ground of similarity in certain important anatomical characters of diagnostic value. Another genus is *Culgoweria*, named after Culgower in Sutherland, a locality from which some linear leaves of the same form were originally described as a species of *Phœnicopsis*. This genus closely resembles *Stephenophyllum* in habit, but is distinguished by anatomical characters. A third genus, *Windwardia* (Fig. 1), differs from the other two in the absence of secretory ducts and in certain anatomical features. There are five leaves on each dwarf shoot. Among other new genera are *Sphenobaiera* and *Arctobaiera*, represented by leaves having the external form of the old genus *Baiera*, a name used for deeply dissected leaves, in some instances resembling the foliage of *Ginkgo* in outline, but with narrower lobes and without a leaf-stalk. In *Arctobaiera* the leaves were borne in tufts; some of them are divided in the distal portion into two narrow lobes. The genus *Sphenobaiera*, founded on a piece of leaf with tissues excellently preserved, differs in the greater degree of lobing and in anatomical characters. Another genus represented in the arctic flora is *Czekanowskia*, a world-wide type, characterized by still narrower leaves once or twice deeply forked, borne in bunches on a dwarf shoot.

The important point is that Florin has demonstrated by his skilful handling of the material that the ginkgoalean group was represented by at least six genera in the Wealden flora of Franz-Josef Land. As Dr. Florin says, the genera "show clear affinities to *Ginkgo*, whereas they exhibit such great morphological and anatomical differences in comparison with other recent and fossil gymnosperm groups that no near relationship with them can be assumed".

Additional evidence of the former abundance and variety of trees of the *Ginkgo* family in arctic floras has been furnished by Prof. T. M. Harris of Reading in a series of remarkable papers, published in the *Meddelelser om Grønland* during the last ten years, on the Rhætic flora of Scoresby Sound on the east coast of Greenland (lat. 70° 25′ N.). This exceptionally rich flora affords a most impressive example of the problem of climatic conditions raised by arctic fossil plants. Prof. Harris has been able to distinguish many species of *Ginkgo* (or *Ginkgoites*) by an examination of the epidermal structure of the leaves. He has also described species of *Czekanowskia, Baiera, Phœnicopsis,* and *Torellia,* a ginkgoalean genus previously recorded from Grinnell Land, still farther north; together with a new generic type which he has named *Hartzia.*

It is noteworthy that several species of these different members of the Ginkgoales recorded from Mesozoic floras north of the Arctic Circle are either identical with or closely allied to species previously described from Europe and the Far East.

The genera already mentioned do not exhaust the list of ginkgoalean trees discovered in Mesozoic floras of the world: we are concerned only with arctic forms.

The two photographs, Fig. 2 (*a*) and (*b*), for which I am indebted to Dr. Florin, illustrate the striking similarity in the stomatal apparatus of a fossil leaf and a leaf of the existing species. In both preparations of the epidermal film there is the same general arrangement of subsidiary cells encircling the stomatal pore. The thick black bands mark the position of strongly cuticularized cell walls. Fig. 2 (*a*) shows the epidermal structure of a leaf of *Ginkgo adiantoides* from Upper Tertiary beds (Pliocene) near Frankfort-on-Main: Fig. 2 (*b*) is from a leaf of *Ginkgo biloba*. The Frankfort leaves and others recorded from Pliocene beds in the Rhone Valley prove the existence of *Ginkgo* in Europe so late as the latter part of the Tertiary period shortly before the beginning of the Great Ice Age. We know that *Ginkgo* was a member of an early Tertiary (Eocene) flora on the basaltic plateau of which the Island of Mull is a detached fragment. The *Ginkgo* leaves from Mull in the Starkie Gardner collection in the British Museum (Natural History) are exceptionally beautiful examples of fossil foliage.

We cannot say with certainty when the *Ginkgo* family first appeared in the vegetation of the world; there is, however, some evidence of its existence as early as the Permian period. We know that it had reached an advanced stage of development before the end of the Triassic period in both the northern and the southern hemisphere. The family continued to occupy a prominent position almost throughout the world in the Jurassic and in the early part of the Cretaceous period. The genus *Ginkgo* persisted as a widely distributed tree well into the Tertiary era.

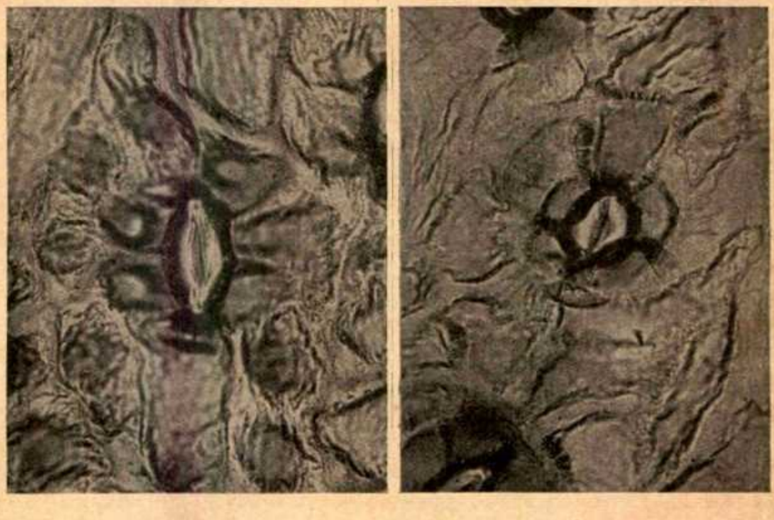
(*a*) (*b*)

Fig. 2.

STOMA AND ADJACENT CELLS ON THE LOWER SURFACE OF A LEAF OF (*a*) *Ginkgo adiantoides* (UNGER) HEER; (*b*) *Ginkgo biloba* L. × 400. AFTER R. FLORIN.

This brief account may serve to give point to Darwin's description of the maidenhair tree as "a living fossil", and especially to emphasize the fact that this sacred tree is the solitary living representative of a large company of genera which played a conspicuous part in the vegetation of the world through successive geological periods.

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[1] *Contrib. Biol. Lab. Sci. Soc. China*, **8**, No. 3, 3 (1933).

[2] *Palaeontographica*, **81** and **82**, Abt. *B.* (1936).

The Nottingham Meeting of the British Association

THE preliminary programme of the British Association meeting at Nottingham has been issued, and is obtainable from the offices of the Association at Burlington House, London, and at Commerce Chambers, Elite Building, Nottingham. The meeting will be held on September 1–8, and Sir Edward Poulton will be the president.

This will be the third time the Association has met in Nottingham. In 1866, the versatile Queen's Counsel and fellow of the Royal Society, William

R. Grove, presided over a meeting there, and in 1893 the president was Burdon Sanderson. On the first occasion, it was necessary to use 'the theatre' for the major meetings; on the second, the Albert Hall was available, and here again, next September, the presidential address will be given. In it, Sir Edward Poulton will review the history of evolutionary thought, as recorded in the meetings of the Association, a subject of very wide general interest, peculiarly appropriate to the Association which maintains Darwin's home as a national memorial, and fortunately chosen by one whose personal relations with the Association have been so intimate, over so long a period, as the president's.

For the rest, practically the whole of the meeting will find a new and very attractive venue in the University College. The old building in the centre of the city was in use in 1893, but now a fine new college occupies a beautiful and even inspiring site three miles from the centre, and here, or in the immediate vicinity, all the sections will meet, the reception room will be established, and many of the visiting members will be housed in the excellent hostels. Lest any who live or will be staying in the heart of the city should fear that the distance of the College will be a drawback, it should be stated that ample means of conveyance will be arranged, and that the city authorities are making generous provision for the free transport of visiting members. The convenience of concentrating so much of the business at a single centre is manifest.

The first evening discourse will be given by Dr. R. E. Slade on the suggestive subject of grass and the national food supply, and the second—arranged too late to be included in the preliminary programme—by Prof. J. Gray, who will deal with the movements of fish. The provision of lectures to the public, which the Association always undertakes if asked to do so, has found a wide welcome, for such lectures have been asked for, and will be given, in Nottingham itself (by Prof. H. Hartridge, on illusions of colour) and in Derby, Lincoln, Long Eaton, Mansfield, and Newark.

The sections already announce a number of principal items in their programmes, of both general and special interest. The full list is too long to detail, but reference may be made to the unusual feature of six sections (Geography, Geology, Zoology, Botany, Agriculture, and Economics) contributing to an evening discussion on planning the land of Britain. An extensive series of excursions and visits is planned. Nottingham itself is a centre of unusually varied scientific interest, in respect of its manifold industrial and historical features, and it commands a district, from Derbyshire on one hand to Lincolnshire on the other, possessing a scenic and economic variety remarkable even in England. A civic reception will be given in Nottingham Castle, and a garden party at the University College.

Occasion is taken to announce in this preliminary programme certain matters not relating to the annual meeting, among them the new activity of the Association in arranging the Alexander Pedler and Norman Lockyer lectures, taken over from the British Science Guild since that institution was incorporated into the Association. The Pedler lecture will be given by Prof. Allan Ferguson in Leicester, in co-operation with the University College in that city, on Monday, May 3, at 8 p.m. The Norman Lockyer lecture will be given in the Goldsmiths' Hall, Foster Lane, London, by kind permission of the Goldsmiths' Company, on Wednesday, November 24, by Dr. R. E. Mortimer Wheeler.

Obituary Notices

Prof. D. A. Low

To Prof. David Allan Low, emeritus professor of engineering, East London College, University of London, who died on March 24, a host of distinguished engineers, and architects and chemists scattered throughout the Empire are a living memorial. Few men in fact have had greater influence on the technical education of Great Britain by his lectures and by his text-books. Probably the most successful writer of engineering text-books who ever lived, his influence has extended to every university and technical college throughout the English-speaking world.

Prof. Low was extraordinarily patient, rarely angered, amazingly thorough, great beyond words in his efforts to help his friends, a man to whom a man could anchor his affections and loyalty, a man whom it was a privilege to serve, a great engineer. He never said a word against anyone. Perhaps his greatest characteristics were his extraordinary thoroughness and imperturbability. Was not the great success of his students in after-life are flection of these characteristics?

On his seventieth birthday, a banquet and presentation was held in his honour by a large number of old students, and on February 9 last—his eightieth birthday—some of his intimates dined together at the "Cheshire Cheese". It was one of those simple, informal, unforgettable occasions, with everyone in perfect harmony inspired by an abiding affection.

The quality of those men and the affectionate intimate speeches were an ample testimonial of the worth of "Daddy Low".

Prof. Low's early general education was received at the High School and West End Academy, Dundee. During apprenticeship, he attended evening classes for science and technical subjects and afterwards studied at Owens College, Manchester, and the University of Glasgow. Altogether he spent seven years in engineering workshops and drawing offices before taking up a lectureship in engineering at Allan Glen's Institution, Glasgow. He was headmaster of the Day Technical School for Boys at the People's Palace, London, a school which set a high standard to technical education never surpassed. For twenty-six years he was professor of engineering in East London College, University of London.

Many very successful text-books stand to Prof. Low's credit, dealing with machine drawing and design, practical geometry and graphics, engines and other engineering topics. Most of these books, which are singularly free from mistakes, have seen many reprints. His "Heat Engines" took about five years to write. He loved his book writing and was never satisfied until he had everything as perfect as he could make it. As the result of this meticulous care, most of his books are as good to-day as when they were written.

For many years, Prof. Low was greatly interested in the theatre and opera, went to many 'first nights' and particularly to his favourite place of entertainment, the "Old Vic". He was very fond of travel, went to Canada and the United States four or five times, the last time being in 1932 with the Institution of Mechanical Engineers, of which he was one of the oldest members. Since his retirement he made eight or nine trips in the Mediterranean with his wife, and did a good deal of motoring with two devoted daughters.

On his last day, Prof. Low smoked two cigars—his great luxury, the gift of his old students—went to bed in the library where his books were written. At 11.30 p.m. he was sleeping peacefully, at 12.30 a.m. he had ceased to sleep. To Mrs. Low and her family his old students unite in deepest sympathy. They will never cease to hold him in grateful memory and abiding affection. He will ever remain an inspiring example to British engineers.

Mr. Adolf Gallenkamp

ADOLF GALLENKAMP, whose death at the age of eighty-eight years occurred on February 26, founded the firm which bears his name about fifty years ago. He was a shrewd observer, and foresaw that a wider recognition of science in academic and industrial circles in Great Britain was inevitable. In conformity with this view, he devoted the early part of his business career to the provision of apparatus for schools, of a better and more varied type than that previously in use. The success achieved in this direction led him to extend his work to higher educational institutions, and he found a special field in the technical colleges and polytechnics which were being established in different parts of the country. Later, he extended his activities to the special requirements of industrial laboratories and the medical and other professions, and always strove to provide the latest and best types of apparatus.

Mr. Gallenkamp frequently visited laboratories in other countries in search of new ideas, and always welcomed suggestions from those who had dealings with him. He was a diligent reader of scientific publications, from which he frequently extracted information which enabled him to improve on many of the instruments then in use. His time was so completely occupied in his business that he was unable to take an active part in the work of scientific bodies in London, and few to whom the name of his firm was well known were personally acquainted with this genial and gifted man, whose face bore a striking resemblance to that of Victor Hugo. He gathered round him a staff of competent men who shared his enthusiasms, and had the satisfaction of seeing his business grow from a very humble beginning to one with a world-wide connexion.

All scientific men recognize the debt they owe to those who provide the instruments upon which the quality and quantity of their work so largely depend, and amongst the many who have contributed in this way to the advancement of science, the name of Adolf Gallenkamp will be honoured by all those who knew or had dealings with him. C. R. D.

WE regret to announce the following deaths:

Dr. Katharine J. Bush, formerly of the Zoological Department of the Peabody Museum, Yale, known for her work on annelids, molluscs, and other marine invertebrates, on January 19, aged eighty-one years.

Prof. H. Bechhold, director of the Institute for Research in Colloid Chemistry at Frankfort-on-Main, known for his work on colloids in biology, on February 18.

Mr. J. W. Capstick, fellow of Trinity College, Cambridge, on April 27, aged seventy-eight years.

Dr. A. H. Church, F.R.S., formerly University lecturer in botany, Oxford, on April 24, aged seventy-two years.

Dr. Milton J. Greenman, director of the Wistar Institute of Anatomy, Philadelphia, an authority on the nervous system, on April 7, aged seventy years.

Major J. Herschel Hardcastle, an authority on small arm ballistics, on April 21, aged sixty-six years.

Dr. T. G. Macaulay Hine, O.B.E., known for his work on pathology, especially cerebrospinal fever, on April 25, aged sixty-six years.

Prof. Enrique Paschen, formerly director of the Vaccination Institute of Hamburg, an authority on smallpox and vaccination, aged seventy-five years.

Prof. Julius O. Stieglitz, professor of chemistry in the University of Chicago, known for his work in organic chemistry, on January 10, aged sixty-nine years.

Prof. W. M. Wheeler, professor of entomology in Harvard University, on April 19, aged seventy-two years.

News and Views

Prof. T. G. B. Osborn

THE Sherardian chair of botany in the University of Oxford has been filled by the appointment of Prof. T. G. B. Osborn, at present professor of botany in the University of Sydney. Prof. Osborn graduated in 1908 in the University of Manchester with first-class honours. His exceptional abilities were recognized by his immediate appointment to a lectureship in economic botany in Manchester which he held until 1912, when he was elected professor of botany, vegetable pathology and parasitology in the University of Adelaide. The excellence of his teaching and the energy with which he threw himself into his academic work is attested by the fact that when he left Adelaide in 1927, large and commodious laboratories had been built as well as an experimental greenhouse. While in Adelaide, Osborn acted as consulting botanist to the Government of South Australia and in furtherance of the pastoral interests of the country he established a field laboratory at Koonamore, some two hundred miles north of Adelaide, where he and his assistants could study the vegetation of an arid region and make useful suggestions to the grazing interests. Certain pastoralists interested in this ecological work which Prof. Osborn was carrying on presented an area of 1,200 acres to the University to extend these investigations.

IN 1927, Prof. Osborn was appointed to the vacant professorship in Sydney, and here, too, the number of the botanical students soon increased and necessitated laboratory and greenhouse extension. In addition to his academic work, Osborn was asked by the Commonwealth Council for Scientific and Industrial Research to review the botanical work in progress in the various universities and other research institutes in Australia, and in 1927 he was appointed adviser to the Council and was offered the directorship of the Division of Plant Industry; but he preferred to continue to devote himself to teaching and research. As an investigator, Osborn, in spite of his heavy teaching and administrative work, has been continuously active. His earlier published researches dealt with mycology and morphology, but since he has been in Australia he has devoted himself largely to ecological work. Not only has he made valuable contributions to the ecology of the arid regions of South Australia, but also more recently he has devoted some attention to forest problems in New South Wales, and journeys in Australia and elsewhere have given him a wide outlook on ecological problems. Since the Biology Board at Oxford has indicated that an ecologist would be most suitable for the Sherardian chair, the selection of Prof. Osborn would seem a most suitable one.

Dr. John Louis Tiarks, F.R.S. (1789-1837)

THE report of the council of the Royal Astronomical Society read at the eighteenth annual general meeting contained an appreciation of the services rendered by Dr. John Louis Tiarks, who died on May 1, 1837, at Jever, Germany, his native town. Born in May, 1789, Tiarks had been educated at the University of Göttingen and in 1810 came to England, and was given a post in the library of Sir Joseph Banks. His knowledge of mathematics and astronomy led to his being appointed British astronomer to the commission appointed under the Treaty of Ghent of 1814 to settle the American Boundary Line, the United States at the same time appointing Ferdinand Rudolph Hassler (1770–1843) as their representative. The survey of contested points was carried out, but certain matters were referred to the King of the Netherlands for decision. His views, however, did not prove acceptable to the United States, and even in 1838 an extent of 10,000 square miles remained disputed territory. On his return to England, Tiarks was entrusted by the Admiralty with several important scientific missions. In 1822 he determined the position of Funchal by means of fifteen chronometers sent from Greenwich to Madeira. He afterwards made observations at Dover, Falmouth and Portsmouth, bringing to light errors in the trigonometrical survey. In 1825 he made other observations in the North Sea in H.M. Steam Vessel *Comet*, on which occasion Sir Humphry Davy accompanied him in order to make observations on the compass. He left Great Britain in March 1835, and in the spring of 1836 was struck down by paralysis from which he never recovered.

Regulations for German Scholars Travelling Abroad

THE following is a translation of an extract from a decree of the German Minister of Education entitled "Foreign Travel by University Teachers and Students" and dated December 24, 1936, recently received at NATURE office: "It has frequently been observed of late that Germans and especially professors and students, when travelling abroad for cultural or scientific purposes, have failed to establish contact with their local national official representatives. Such contact is specially important in countries where Jews occupy a predominant influence in cultural affairs, and where emigrants seek to press into the foreground in questions concerning German cultural life. In these countries it is particularly necessary that German national guests, local or official, shall be informed of these local relationships by the official national representatives abroad. I therefore order that all under control of my Ministry who travel abroad for study, research or lectures, or for congresses or similar purposes, shall on their arrival in a foreign country forthwith get into contact with the competent local representative of Germany, with the Foreign Organization of the Nazi Party and with the branch office of the German Academic Exchange Service, whenever possible. If this be not done, a short report of the reasons must be furnished to me. I take this opportunity to point out that previous decrees concerning foreign journeys are still not always obeyed by all concerned. For example, news of a proposed journey abroad by persons under control of my Office often reaches me first through the German Centre for Congresses. This results in delay, and the person involved not only risks refusal of the necessary foreign exchange, but is also acting in defiance of my orders. I therefore hereby order all controlled by my Office to obey in every detail the Decree on Foreign Travel, and to lay before me, through the official channels, any applications for permission to travel abroad."

German Refugees at the University of Istanbul

MANY former members of staffs of German universities and other institutes have, as is now well known, either been forced to leave or have voluntarily vacated their posts, for political, racial and other reasons. Some have obtained analogous posts in the universities of countries outside Germany, and we have recently received a list of those who are now working at the University of Istanbul. Among these are Prof. H. Winsterstein (physiology), Prof. M. Brauner (botany), Prof. M. Dember (physicist), Prof. M. von Mieses (mathematics), and nearly thirty others, most of whom have been appointed to chairs in the University of Istanbul. Prof. M. Freundlich, who is at present professor of astronomy, leaves at the end of the academic year for the University of Prague, and Prof. F. Dessauer, professor of rontgenology, is going to the University of Fribourg, Switzerland.

Broadcasting and the Coronation

CORONATION day, May 12, is likely to mark an interesting and notable event in the history of radio communication, for it will witness the most complicated outside broadcasts yet undertaken by the British Broadcasting Corporation. The arrangements for the sound programme were explained in the issue of the *Radio Times* of April 23, while some details of the means to be adopted for televising the Coronation procession were given in *World Radio* of the same date. On the sound side, apart from the arrangements necessary for the home and Empire programmes, the B.B.C. is providing facilities for about a dozen foreign observers to broadcast commentaries in their own languages direct to their own countries. Two separate control rooms will be established, one at Westminster Abbey for the British programmes and the other at the Middlesex Guildhall for the foreign commentaries. In addition to supplying all the B.B.C. transmitters, the 'home' programme will be distributed to loudspeakers within the Abbey and to others on some of the stands along the route followed by the procession. By this means, a large number of the public will be enabled to follow the progress of the procession and to hear the service in the Abbey. At the foreign control room, provision is being made for ten separate commentaries in different languages to be fed by land-line to the International Trunk Exchange of the British Post Office, whence the programmes will be distributed to the countries concerned. Some 472 miles of special wiring are involved in the whole installation, which is being carried out by the General Post Office in co-operation with the B.B.C. Engineering Division. This one outside broadcast will involve the use of fifty-eight microphones, and, not least among the technical difficulties, is the necessity of rendering the installation of these as inconspicuous as possible, particularly inside the Abbey.

ON the television side, May 12 will go down in history as the first day on which the direct television of a remotely controlled outside programme has been attempted from the London ultra-short-wave station. For this purpose, the Post Office has installed a special co-axial cable, connecting the Alexandra Palace transmitter with Broadcasting House and the observation point at Hyde Park Corner. In addition, and as a stand-by service, the B.B.C. will use a van equipped with an ultra-short-wave transmitter for feeding the programme to Alexandra Palace. The observation point at Apsley Gate, Hyde Park Corner, was selected on account of its having a combination of several advantages. The afternoon sun had to be behind the 'cameras' and preferably on the objects to be televised; on account of the small receiver screen, the site must allow close-up views on a level with the windows of the royal coach; at the same time, the site must permit an extensive view of the procession as a whole; finally, and not least important, the apparatus must be remote from the huge crowd of the general public. At this site, three 'cameras' will be used for converting the visible scene into the high-frequency electrical currents to be passed along the cable: one of these 'cameras' will be near the main arch at a height of five feet above the pavement; the second will be about ten feet above ground-level and will be used for viewing the crowd and the approach of the procession to within a few yards; the third will be on the other side of the arch and used for following the procession as it disappears towards Constitution Hill. A separate circuit with microphone will be used for providing the sound commentary to this programme. Much of the apparatus to be used on this occasion will be new and untried except on an experimental basis, while very special conditions will prevail on Coronation day itself. The occasion will, however, most decidedly mark the beginning of a new era in television.

British-American Understanding

SIR FREDERICK WHYTE presided over a discussion, held on March 4 under the auspices of the English-Speaking Union, on "The Contribution of British Schools, Universities and other Educational Bodies to British-American Understanding". The discussion was opened by Mr. J. Wickham Murray, who outlined some of the work of the Union in developing contacts between Britain and America. He specially stressed schemes such as the Page Scholarships scheme for men and women teachers, reciprocal scholarships under American direction, exchange of school boys and school masters and mistresses, and assistance given to visitors in both countries. He indicated, however, that the Union desires now to widen its work and to face the greater responsibilities which the present state of the world suggests it should undertake. To that end it has formed a Research and Discussion Committee, which is seeking the advice and guidance of experts in such fields as foreign affairs, economics, the Press of both countries, and general relationships such as would arise as a result of neutrality legislation and American grievances against British policy. Already meetings of experts in these matters have been held, and, at every meeting, the importance of closer attention to matters of education has been stressed.

MR. WICKHAM MURRAY added that, in thinking it important for British students at school and university to get an accurate picture of English-speaking countries, the Union believes that because of similarities in our joint democratic institutions, experiments in those countries might be of greater relevance to Britain than experiments in such very different countries as Soviet Russia, Italy or Germany. In asking the meeting to consider what might be done to improve the contribution of British educational bodies so far as an understanding of problems in English-speaking countries is concerned, he raised the question of possible changes in examination syllabuses, special facilities for providing books on American and Dominion history and affairs, the increase of scholarships and fellowships, and the introduction of special courses on the subject into curricula.

MR. H. G. WELLS, president-elect of Section L (Education) of the British Association, who contributed to the discussion, thought there will be no peace in the world until education has been recast into a common basis of understanding throughout the world. He had little confidence in what has been called 'scientific' American, British, or other history. There is but one history—the history of mankind. The world is involved in great issues of human ecology and of economics, but little of these things is taught. He said that we shall have to realize—and it will be a wrench—that much of the history at present taught is stale, unprofitable and out of date. British people are curious about America. They devour American publications; they patronize American films; they are learning to think and speak American; but they are not interested in the history of the Constitution or local points of pre-Civil War days. The public is willing to react against limited histories and get into general understandings, but the schools hold up this natural development towards the human understanding of the world.

The National Maritime Museum

THE National Maritime Museum, opened by H.M. the King on April 27, is a notable addition to the public galleries of Great Britain. Housed in a building with historic associations from which can be seen on one side Greenwich Park and the Royal Observatory and on the other the Royal Naval College and the Thames, the Museum will make an appeal to all who take an interest in the history of naval affairs, the growth of the British Empire and the lives of great British seamen of the sixteenth, seventeenth and eighteenth century. It has come into existence through the enthusiasm of the members of the Nautical Research Society, the munificence of Sir James Caird and finally the passing of the National Maritime Museum Act of 1934. The buildings it occupies include the Queen's House finished three hundred years ago, and the wings erected during the nineteenth century when the place was used for the Greenwich Hospital School, now removed to Holbrook, Suffolk. After restoration by the Office of Works, both the Queen's House and the other buildings have been turned into galleries, which now contain the most magnificent series of sea pictures in existence. In addition to the portraits, seascapes, and battle scenes, the great Macpherson collection of prints, drawings, etc., there are beautiful models of ships of the various periods, collections of navigational instruments and a spacious library. No attempt so far has been made to illustrate the great revolution in maritime affairs during the nineteenth century or the historic events of more recent times, but these no doubt will be taken into consideration in due course. The thanks of the whole community, no less than those of students of maritime affairs and of marine art, are due to Sir James Caird, who has made the nation his debtor by the support he has given to the formation of the museum.

The Newcomen Society

ON April 21, simultaneous meetings of the Newcomen Society took place in London and New York, when two papers were read. The first of these was by Dr. A. Raistrick, and was entitled "The Steam Engine on Tyne Side, 1715–1778" and the second was by Prof. J. W. Roe on "Interchangeable Manufacture". Dr. Raistrick's paper was based on the records preserved by the North of England Institute of Mining Engineers, Newcastle-upon-Tyne; these records consisting largely of "View books" compiled by the colliery 'viewers', the forerunners of the present-day mining engineers. The reports of the 'viewers' contain much information as to the flooding in the mines and the cost of the engines and the pumping. By means of the various papers, Dr. Raistrick has been able to trace the erection of no fewer than 104 'fire engines' built between 1733 and 1778, before the improved engines of Boulton and Watt came on the scene. A rough figure for the first cost of an engine with a 33 in. cylinder was about £1,200 and the annual cost of working it £400. Though 13 engines were built between 1715 and 1733, all of the Newcomen type, it has been impossible to trace any connexion with them of Newcomen or of the "Proprietors of the Invention for Raising Water by Fire" who had exploited the engine. The paper was accompanied by a valuable map of the coal field showing the sites of the engines. In Prof. Roe's paper it was shown that interchangeable manufacture had begun with firearms early in the nineteenth century and had afterwards spread to clocks, watches, sewing machines, bicycles and motor-cars. Of all the products of modern industry, the motor-car has pushed interchangeable manufacture furthest, and to the benefit of the widest public.

Low Temperature Carbonization Plant

THE recent opening by the Duke of Kent of a new plant erected near Chesterfield by Messrs. Low Temperature Carbonisation Ltd. has once again directed public attention to the commercial possibilities of carbonizing coal at comparatively low temperatures (about 600° C.). This method of treating coal has as its main product a smokeless fuel which can readily be burned in any open grate, and in consequence is a valuable contribution towards a solution of the important problem of reducing atmospheric pollution. In addition, the process yields as by-product a tar from part of which a fuel suitable for use in Diesel engines can be prepared and a motor spirit of high antiknock value. The tar is also amenable to treatment by hydrogenation for the production of further motor spirit if desired. In view of a possible national emergency, there is a tendency, particularly among those not acquainted with all the relevant details, to stress the value of low temperature carbonization as a source of home-produced motor spirit. It is, therefore, well to bear in mind that although any method of producing oil or spirit from coal is of national importance, the spirit is in this case only a by-product, and that even if all the tar were hydrogenated to produce additional motor spirit, the total yield would be extremely small when compared with the quantity now imported.

Centenary of the University of Athens

THE University of Athens is the richer to-day by the congratulations of the world of learning on its centenary. Elaborate celebrations have marked this event, which was enhanced by the active participation of H.M. the King of Greece, members of the Government, of the Church and of the Services, the French Minister of National Education, and 150 delegates representing eighty foreign universities. Eloquent addresses, official receptions, musical festivals and classical performances added to the splendour of the occasion. During the past hundred years, the University of Athens has grown from a small establishment with fourteen students, to a mighty seat of learning with nearly ten thousand students of both sexes, an imposing list of professors, and manifold extensions, laboratories and institutes as additions to the original faculties. Parallel with the development, learning has found in Athens the old spirit which made the town famous throughout the classical and Byzantine periods. To-day, science and letters are steadily pursued by a band of investigators who have made substantial contributions to knowledge. To give just one example, mathematicians are familiar with the names of Hatzidakis, Zervos, Sakellariou and Eginitis. Even the history of science is represented by Prof. Stephanidis, who has many important monographs to his credit. If the English language and literature were not hitherto adequately represented, the omission has been made good by the creation of a Byron chair, which was announced as a gift of Great Britain to the most ancient seat of learning of Western civilization.

Witchcraft in Bechuanaland

WIDESPREAD interest has been aroused by the trial for witchcraft of Bagakgametsi, the former wife of Tshekedi, son of Khama, and regent chief of the Bamangwato tribe. This chief, it will be remembered, earned notoriety a little while ago for inflicting punishment on a white man, as it was held, illegally, and was deprived of his chieftainship in consequence. In February 1936 he married his cousin, Bagakgametsi, but secured a divorce from her on March 7 of this year. She is now twenty-seven years old, and was described by Sergeant Lewis, the prosecutor in the present case at Serowe, as "an educated woman". With her were accused two men, who are described as witch-doctors. The offence alleged was "practising witchcraft calculated to injure the Queen-Mother, Semane"; but it was asserted in evidence, as reported, that Bagakgametsi herself was in fear, or stated that she was in fear of witchcraft by the Queen Mother, and consulted her two co-defendants to verify her suspicion and secure protection. One witch doctor in giving evidence in defence stated that he blew on a horn and threw the bones—the usual divinatory procedure in such cases—and said, "If Semane is bewitching Bagakgametsi she should die from blood". He added that Semane would die within two months. The other witch doctor said that the woman came to him for medicine and said she was afraid that Semane, who was jealous of her, would kill her. On the other hand, it was alleged by the prosecution that Bagakgametsi had asked one of the men for a poison root to get rid of the Queen Mother so that she alone should share Tshekedi's power. The verdict was "guilty", and a fine of £50, or twelve months imprisonment was imposed. The case is interesting as illustrating the strong hold of a belief in witchcraft on this people, even among the more enlightened, as well as the illogical working of the attempt to suppress the belief, which concentrates on the witch doctor, who though in many instances undoubtedly fraudulent, is at least working against an anti-social force which in such circumstances as these goes free. The British code, however, does not recognize witchcraft as such.

Synthesis of Large Molecules

AT the Friday evening discourse at the Royal Institution on April 23, Prof. H. Mark discussed "The

Synthesis of Large Molecules". In Nature, all organized objects consist of large molecules. The great importance of the natural highly polymerized substances has led to the conclusion that very valuable mechanical and physiological behaviour is associated with these macro-molecules. Therefore the industries concerned with synthetic rubber, artificial silk and synthetic resins have worked out a number of synthetic high polymers, which are, in fact, of great use in making insulators, fibres and solid materials of high resistance and valuable properties. It appears that the kinetics of polymerization reactions is very complicated, but one can already distinguish three main processes which play an important role in every polymerization reaction. First a nucleus of high reactivity must be built. This can be done by a thermal collision of high energy, or photochemically, or by means of a catalytic agent. The production of these nuclei requires a high activation energy, and is therefore rather slow. The nuclei react quickly with the molecules of the monomeric substance and grow with rather high velocity stepwise to a chain. The activation energy of the growing reaction is low (about 5,000 cal./mol.) and therefore the probability of the growth is large. The chains would grow infinitely if there were not break-up reactions of different kinds. There is the possibility that the growing of the chains may be ended by lack of monomeric substance; it is possible that the decreasing steric factor of the association reaction may diminish the velocity of chain growth to a very low rate, and one must consider that different side-reactions may break up the chains suddenly. In the case of styrene, we have succeeded in distinguishing these three different stages and developing a reaction mechanism which seems to be in fair agreement with the experimental data.

Recent Acquisitions at the Natural History Museum

AMONG recent additions to the Zoological Department at the British Museum (Natural History) is a specimen of the pigmy scalytail of West Africa received from the Basle Museum. The Department has also acquired a large number of small mammals and birds from Yugoslavia collected by Mr. V. Martino. This collection, comprising a number of new forms, is of considerable scientific importance and will help to fill one of the chief gaps in the study collections of mammals and birds. An important purchase for the Department of Entomology is the remainder of the Fruhstorfer collection of butterflies. 13,799 specimens, comprising the Lycænidæ and Hesperiidæ, were purchased by the Trustees in 1933, and a small section of the collection (the oriental Nymphalidæ) have in the interval been sold to the Paris Museum. The balance now acquired consists of 48,677 specimens, of which about 3,000 are the actual specimens upon which the original descriptions of the species were based. The Mineral Department has been given by Mr. J. D. Hague a specimen of native gold in beautiful bright crystals, from the North Star mine, California. Mr. Felix F. Wilson has presented a small collection of gold which has been picked up from burns at Leadhills, in Lanarkshire, by the late Mr. Thomas Newbiggin, who was for many years engaged in mining there. A magnificent, clear blue, step-cut, flawless blue topaz, 614 carats in weight, from Brazil has been bought. Owing to the easy cleavage of this mineral, it is seldom that a coloured stone of this size is so free from flaws.

Fourth International Grassland Congress

THE fourth International Grassland Congress is to be held in Great Britain on July 8–23 under the presidency of Prof. R. G. Stapledon. The paper-reading sessions will be held in Aberystwyth on July 14–18. Before and after these sessions, delegates will be shown the leading types of grassland in Great Britain, in a tour from Oxford to Aberystwyth and from Aberystwyth to Edinburgh. Fifteen plenary papers are to be presented to the Congress by delegates from Great Britain, Sweden, Germany, Italy, Finland, United States, Canada, Australia, New Zealand and South Africa. The remaining papers will be read to sectional meetings of the Congress, which will deal with the following aspects of the grassland problem: (1) grassland ecology, (2) seeds mixtures, (3) plant breeding and seed production, (4) fertilizers, (5) nutritive value and fodder conservation, and (6) pastures. Full details regarding plans for this Congress and a list of all papers to be presented are obtainable from the Joint Secretaries, Fourth International Grassland Congress, Aberystwyth. Particular attention is directed to the closing dates for receipt of applications (May 15 and June 19, according to the option selected).

The Parliamentary Science Committee

THE latest addition to the constituent bodies of the Parliamentary Science Committee is the British Institute of Radiology. For some time past the Committee has been engaged in investigating how the Patent Office Library could be brought up to date in such a manner as to serve the interests and convenience of the public who make use of that Library. The British Science Guild undertook a similar inquiry some years ago, and the Parliamentary Science Committee made its report the starting point for the investigation. A report has been completed, and the Parliamentary Science Committee has been in communication with the Chartered Institute of Patent Agents. Dr. Leslie Burgin, M.P. (Parliamentary Secretary of the Board of Trade), has now consented to receive a deputation from the Parliamentary Science Committee on the subject on May 3. The deputation will be introduced by Sir Arnold Wilson, the chairman of the Committee, and it will include two or three members of parliament who are also members of the Committee.

The Mellon Institute

THE new building of the Mellon Institute, Pittsburgh, will be dedicated on May 5–9. At the formal dedication of the building in the afternoon of May 6 in Carnegie Music Hall, with Dr. Weidlein presiding, addresses will be given by three Nobel prizemen, namely, Dr. Irving Langmuir (chemistry), Dr. H. C. Urey (physical chemistry), and Dr. W. P. Murphy (medicine). Brief addresses will also be given by Andrew W. Mellon and Richard K. Mellon, representing the founders. A symposium on "Recent Progress in Science" will be held on May 7. Speakers will include Dr. G. O. Curme, jun., Dr. F. B. Jewett, Sir Frederick Banting and Dr. W. W. G. Maclachlan. The new building, which has taken six years to complete, is to be dedicated to science and humanity in honour of Andrew W. and Richard B. Mellon, founders of the institution, who in 1911 gave support to the research fellowship system advanced by the late Robert Kennedy Duncan by establishing a specific department at the University of Pittsburgh, and in 1913 placed the system on a permanent basis with the organization of Mellon Institute.

Discharged Soldier Settlers in New Zealand

ACCORDING to the report of the New Zealand Department of Lands and Survey on Discharged Soldiers Settlement for the year ended March 31, 1936, a further twelve applications for land were received during the year, seven of which were granted, making a total of 4,093 allotments, covering 1,440,818 acres in the twenty-one years the Act has been in force. A grand total of 1,452,829 acres has been proclaimed for this purpose since the inception of the scheme. Loans authorized during the year numbered 719, involving an amount of £66,517. Reports from the District Commissioners of Crown Lands indicated that the soldier settlers, most of whom are engaged in dairy farming or sheep farming, have had a better year, although those engaged in orchards again had a poor season owing to inclement weather.

Rockefeller Foundation China Programme

THE Chinese Mass Education Movement, the Colleges of Public Affairs and Natural Sciences at Yenching University and the Institute of Economics of Nankai University received aid from the Rockefeller Foundation during 1935. In the part of the China programme centring round Nanking in south China, support was extended to the national health administration; to the Commission on Medical Education, and to three institutes interested in agricultural development; to the University of Nanking for its departments of agricultural economics and science; the National Central University for work in animal husbandry and veterinary preventive medicine; and the National Agricultural Research Bureau for insect control work. Local fellowships in China granted by the Foundation numbered 140.

Maintenance of Isothermal Chambers

AT the Institution of Electrical Engineers, Savoy Place, W.C.2, on May 5 at 6 p.m., Mr. L. B. Turner, a well-known radio-physicist of Cambridge, will present a paper describing a method he has devised of keeping a mains-operated isothermal chamber at a temperature constant to one thousandth of a degree centigrade. Although designed for a specific engineering application, it is likely to prove of interest to biological research workers and they are invited to attend the meeting. Biologists are specially interested in the maintenance of extremely constant temperatures; for minute changes of heat production in living tissue, detected by thermocouple, have been used as an index of vital process; and these changes can be measured only when the body under examination is protected from temperature fluctuation imposed from outside.

Conference on Large High Tension Systems

THE International Conference on Large Electric High Tension Systems will be held in Paris on June 24–July 3. It was established in 1921 with the sole object of studying the problems connected with the high-tension transmission of power. The organization and interpretation facilities will enable anyone speaking English to profit fully by the work of the Congress. An attractive programme of visits and excursions has been arranged and special terms are offered by many of the hotels and railways to registered members of the Congress. Further details may be obtained from the Secretariat, Avenue Marceau, 54, Paris, or the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Travelling Fellowships in Medicine

THE Medical Research Council invites applications for six Rockefeller medical fellowships for the academic year 1937–38. They are intended for British graduates who have had some training in research work in clinical medicine or surgery, or in some other branch of medical science, and who are likely to profit by a period of work at a centre in the United States or elsewhere abroad, before taking up positions for higher teaching or research in the United Kingdom. The Council also invites applications for four Dorothy Temple Cross research fellowships in tuberculosis. The object of these fellowships is to give special opportunities for study or research to suitably qualified British subjects of either sex "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms". Further information and forms of application, returnable not later than June 1, are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

Royal Aeronautical Society Awards

ON April 26, Mr. H. E. Wimperis delivered his presidential address to the Royal Aeronautical Society on the subject of the natural limits to human flight, and the following medals and awards were presented: Society's Gold Medal to the late Señor J. de la Cierva, for his work on the development of the autogiro; Society's Silver Medal to F. W. Meredith, for his work on the automatic pilot; Society's Silver Medal to P. A. Cooke, for his work on the automatic pilot; British Gold Medal for Aeronautics to A. Gouge, for his achievement in the development of flying boats; Simms Gold Medal to Dr. H. J. Gough, for his paper "New Light on the Strength of Materials afforded by Modern Physics"; Simms Gold Medal to W. A. Wood, for his paper on "New Light on the Strength of Materials afforded by Modern Physics"; Taylor Gold Medal to Dr. G. P. Douglas, for his paper on "Cooling Problems with particular Reference to the work of the 24 ft. R.A.E. Tunnel"; Edward Busk Memorial Prize to Mr. G. H. Dowty, for his paper on "Retractable Undercarriages"; Pilcher Memorial Prize to H. Leaderman, for his paper on "The Fundamentals of Boundary Layer Theory with Some Applications to Aircraft".

Current Sunspots

AFTER some weeks of only moderate solar activity compared with the great activity shown from about last November until January, the recent appearance of an extensive active area of the sun may be noted. There are three chief groups of spots, one of them showing a rapid development from April 19, when the total area was only about 50 millionths of the sun's hemisphere, to April 22 when the area had increased to 1,750 millionths. Particulars of the groups of spots are as follows:

Date on Disk	Central Meridian Passage	Maximum Latitude	Maximum Area
April 15–28	April 22·4	10° S.	650
„ 16–29	„ 23·2	25° N.	900
„ 18–30	„ 24·6	19° N.	1750

Bright hydrogen eruptions were observed in association with the largest group on April 21 between 11^h and 12^h and 15^h–16^h U.T., whilst a series of small but very bright eruptions occurred on April 23. Another bright eruption, more extensive than any of these, was observed at Greenwich on April 25 between $8\frac{1}{2}^h$ and $11\frac{1}{2}^h$. Two magnetic storms were recorded at Greenwich beginning on April 24 at 12^h 0^m and on April 25 at 15^h 45^m. For the first storm, the ranges in declination, horizontal force and vertical force were 46′, 275γ and 145γ respectively, and for the second (up to April 26 10^h) 30′, 310γ and 105γ respectively. The second of these storms would seem to be related to the display of aurora reported by Mr. E. L. Hawke in *The Times* of April 27 as seen on April 25 from the Chiltern Hills.

The Night Sky in May

DURING the month, the duration of night decreases in the latitude of London by nearly 1¼ hours. The moon is new on May 10 at $13·3^h$ and full on May 25 at $7·6^h$, when a penumbral eclipse takes place. The greatest altitude of the moon at meridian passage (61·2°) is on May 12, and the least altitude, 15·9°, on May 26. Venus is a morning star rising just over an hour before the sun; on and about May 24 the planet is at its greatest brilliancy (magnitude −4·2). Conjunction with the moon occurs on May 8 at 15^h. On May 11 at 11^h, Mercury is in inferior conjunction with the sun, and a partial transit (invisible from Great Britain) of the sun's disk occurs the same day between $8\frac{1}{4}^h$ and $9\frac{1}{2}^h$. The planet Mars is conspicuous low down in the night sky and souths about midnight in the middle of the month. On May 19, Mars is in opposition, and nearest to the earth on May 28, when the apparent diameter of the planet is 18½″. On May 24 at 18^h, there is a conjunction with the moon, Mars being 0·6° northwards. Jupiter is a morning star of about mag. −2·0 in Sagittarius. Saturn rises in the dawn and can only be located with difficulty. About May 5, the maximum of the η Aquarid meteors occurs, the radiant being at R.A. 22^h 32^m: Dec. −2°, and on May 24 that of the Herculids, the radiant of which is at R.A. 16^h 36^m and Dec. +30°. Approximate positions for Comet Whipple (1937*b*) are given by Moller's ephemeris in I.A.U. Circular No. 653, as follows:

Date	R.A.	Dec
May 3	14^h $21·9^m$	+60° 28′
„ 7	22·7	60 18
„ 11	23·7	59 58
„ 15	25·0	59 29
„ 19	26·5	58 49

All times in this note are in U.T.; add 1^h to convert to Summer Time.

Announcements

THE proceeds of the Daniel Pidgeon Fund for 1937 of the Geological Society of London have been awarded in equal proportions to Dr. G. F. Claringbull, who proposes to investigate the geology and petrology of the Ross of Mull granite, and Mr. F. W. Cope, who proposes to map the central region of the Derbyshire dome, and to correlate the Lower Carboniferous rocks of the area with those of North Wales, Westmorland, and the type section of the Avonian.

PROF. GEORGE R. MURRAY, emeritus professor of medicine in the University of Manchester, has been made a member of a Departmental Committee appointed by the Home Secretary to consider the question of compensation for card-room and other workers in the cotton industry disabled by respiratory diseases.

DR. JOHN B. GRANT, of the Rockefeller Foundation, was recently decorated by the National Government of China on the occasion of the New Year with the Fifth Order of Beautiful Jade for his meritorious services in China. This order was awarded especially for his pioneering and developing public health work and in promoting medical education in China.

A ROYAL Rumanian Society of Genetics and Eugenics has recently been founded at Bukarest under the presidency of Prof. G. Marinesco.

WE have received from the Association of British Chemical Manufacturers, 166 Piccadilly, London, W.1, a copy of the second edition of the "Index to Acts of Parliament and Statutory Rules and Orders affecting the Chemical Industry", which comprises supplements bringing the work up to date to December 31, 1936. Copies may be obtained from the Association at the price of 2*s*. 6*d*. post paid, remittance accompanying the order.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 762.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Some New Characteristic Properties of Certain Industrial Dusts

WITH the assistance and encouragement of the Institution of Mining and Metallurgy and the Medical Research Council, we have continued an investigation, initiated four years ago under the auspices of the Institute of Chemistry, upon the chemical nature of dusts causing silicosis. Using the salicylic acid dust filters described in a recent communication[1], we have now obtained, probably for the first time, analysable samples of mine dust as breathed by the miner. The dust was produced by wet drilling and blasting of granite in a Cornish mine. On beginning the analyses of these samples, we immediately found that the loss on ignition, determined on the material dried at 105° C., was between 8·0 and 9·0 per cent, whereas the corresponding figure for the powdered granite rock was 0·6 per cent. Further analyses showed that the high loss on ignition was probably due to hydration of the dust, since it increased progressively from 3·7 to 5·7 and 8·5 per cent in samples taken at 10 ft., 20 ft. and 40 ft. from the working face.

On discussing these observations with our collaborators, Dr. Brammall and Mr. Leech, it was apparent that their recent work[2] on the reactivity of minerals to water and the way in which water may enter the crystal lattice was highly significant in elation to our problem. It suggested, *inter alia*, that such hydration as we had found should release alkalis from the crystal lattice, and on examining the alcoholic extracts obtained in separating the dusts from the salicylic acid filter beds, we found evidence of the presence of alkali in quantities oughly proportional to the degree of hydration of the parent dust.

Following up this result, our colleagues have made he very interesting observations recorded in another etter (p. 754), and we have made some preliminary xperiments upon the nature of the aqueous extracts of various dusts which are known to cause silicosis, ncluding typical pottery dusts and the dusts produced by crushing or disintegrating calcined flint, asbestos and felspar. Though we propose later in typical cases o make a gravimetric examination of the aqueous extracts of mineral dusts, we have for the present elied on the well-known silico-molybdate colorimetric est for silica, and the 'soluble' silica here referred o is that so indicated.

In every case so far examined we find that the ust, on extraction with water, yields both alkali nd 'soluble' silica, and that the amount of the latter reatly exceeds the normal solubility of quartz. The solubility' is a complex phenomenon and will require careful study as it depends not only on temperature ut also on time, on particle size and on the quantity dust submitted to the action of the solvent, and is largely affected by the presence of adsorbed films. Felspar dust produced by grinding the mineral under benzene and drying at 110° C. is unaffected by water, and even resists the prolonged action of steam at 110° C.; but it yields alkali readily on treatment with 95 per cent alcohol. The obvious inference, that felspar dust can hold very firmly a protective adsorbed film of benzene, suggests a possible means whereby dangerous dusts might be rendered innocuous.

Our experiments also indicate that the solubility of siliceous dusts may be profoundly affected by the presence of extraneous substances. For example, the apparent 'solubility' of finely divided silica (quartz) is greatly reduced (even to one tenth of the usual figure) by simple admixture with an equal weight of finely divided sugar charcoal, anthracite or bituminous coal. Further knowledge on this point may evidently serve to explain the remarkable differences, hitherto inexplicable, observed in the incidence of silicosis in different mining areas. On the other hand, the presence of sugar charcoal has little or no effect upon the quantity of soluble silica yielded under given conditions by asbestos, though it materially reduces the quantity of alkali liberated. Thus it is possible that the 'soluble' silica liberated from quartz by water is different in nature from the 'soluble' silica similarly liberated from asbestos, the former being presumably of greater molecular complexity.

The relationship of the alkali liberated from a dangerous dust to the simultaneous release of soluble silica is as yet obscure. The facts so far elicited are as follows: (1) the presence of sodium carbonate in water materially increases the yield of soluble silica by quartz dust; (2) extraction of asbestos dust with very dilute acid (sufficient only to neutralize the bulk of the liberated alkali) does not diminish the yield of soluble silica therefrom; (3) the presence of calcium hydroxide (but not calcium carbonate) in small proportion substantially inhibits the release of soluble silica from both quartz and asbestos. The evidence on this last point seems quite clear: the yield of soluble silica from 200 mgm. of a certain asbestos dust under standard conditions was reduced in presence of an equal weight of calcium hydroxide from 5·8 mgm. to 0·06 mgm., that is, to about one hundredth of the original value. Here again, evidently, is a very unexpected result which may quite possibly point to a means of making dangerous dusts safe. It is probably useless to supply lime dust, which would become largely carbonated before reaching the lung surface, but admixture of a dust such as that of fresh cement, capable of yielding caustic lime on hydrolysis, might well serve to mitigate the effects of dangerous dusts.

While much work remains to be done in following up these preliminary experiments, it seems already to be clearly established that *freshly fractured* surfaces of silica and some mineral silicates are in a highly reactive state and readily yield both alkali and 'soluble' silica on contact with water, and that for the finest particles, of the order of 5–1 μ and less, in freshly formed mineral dusts this reaction to water, though superficial, is quantitatively important. Thus, chemical changes in minerals which normally are extremely slow may, in the case of very fine dusts, proceed very rapidly to a substantial extent. It follows that, in many cases, quite apart from any effect of sedimentation, dust solids by the time they reach the lung surface, are quite different chemically and mineralogically from the mass which has given rise to them.

As most medical opinion rejects the idea of mechanical damage as the cause of silicosis, it seems probable that the changes observed in the tissues must be attributed to the chemical effect of the dust particles, that is, to the chemical effect of the soluble substances they yield up to the tissues. Therefore there seems reason to hope that the further study of the solubility of dusts, both dangerous and non-dangerous, which is being actively carried on in these laboratories, may throw useful light upon the causation of silicosis and allied diseases such as asbestosis, and may possibly suggest methods of minimizing their incidence.

On several occasions we have found that fine dusts which have become aggregated by settlement or have been for some time exposed to air appear to be much less reactive than when freshly formed. This observation may explain the failure of attempts in the past to induce silicosis in animals by exposing them to artificially raised siliceous dust clouds. In the light of present knowledge, it might be anticipated that such 'dead' dusts would be relatively innocuous. When the present investigations have developed further, it may well be worth while to institute fresh animal experiments on the effects of dust inhalation; but if these are to be significant, it must first be clearly established that the dusts used are really dangerous, that is, that their chemical properties are similar to those of dusts which are known certainly to cause silicosis.

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P. F. Holt.
J. W. Matthews.
P. M. Sanderson.
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London, S.W.7.
March 30.

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[1] Matthews, J. W., Holt, P. F., Sanderson, P. M., and Briscoe, H. V. A., "Porous Solid Filters for Sampling Industrial Dusts", *Bull. Inst. Mining and Metal.*, No. 386 (Nov. 1936).

[2] Brammall, A., Leech, J. G. C., and Bannister, F. A., Mineralogical Society, Jan. 28, 1937; Abstr. *Geol. Mag.*, 74 (March 1937).

Hydrolysis of Rock-forming Minerals

As members of a small team organized by Prof. H. V. A. Briscoe to study, geochemically, the hydrolytic effects of humidity on mine dusts ($< 1\ \mu$), we have recently investigated the conditions under which various mineral silicates are degraded by simple aqueous extraction towards layer-lattice end-products belonging to the sericite, chlorite and clay types, and have examined the sols obtained.

The alkalinity imparted, instantly, to cold water by powdered soda-glass is a commonplace fact—readily demonstrable by using water containing an indicator such as phenolphthalein. Tamm[1] has recently shown that finely powdered orthoclase, muscovite, stilbite and wollastonite are very hygroscopic and are partially dissociated in water, which then gives an alkaline reaction. Incidentally, he suggested that the end-product of leached orthoclase dust is related to muscovite. The behaviour of beryl, calcite, orthoclase, albite and wollastonite was studied by Stevens[2] on similar lines. Thugutt's work on the hydrolysis of leucite and labradorite[3] involved the use of closed tubes at high temperatures, 182°–238°.

We find that, by moistening dust-fine mineral particles with cold water, a similar reaction, variable as regards intensity, is readily obtainable with most of the common rock-forming minerals: for example, biotites and other basic micas; hornblendes and other amphiboles (including asbestos); wollastonite, diopside, hypersthene, augite, aegirite and other pyroxenes; olivine, apatite, sphene and some varieties of tourmaline; grossularite, melanite and some varieties of almandite; members of the chlorite and epidote groups; calcite, aragonite, magnesite, dolomite; brucite and chondrodite; all feldspars, notably the more calcic plagioclases.

Sericite, hydromuscovite and true muscovite are among the less readily reactive species. Some chlorites and 'sericites' isolated from slates are essentially inert, though there is evidence that a clay species akin to pyrophyllite is admixed with the 'sericite' in some of these cases. The behaviour of common clays under the same experimental conditions is somewhat erratic, and often in strong contrast with their individual responsiveness to base-exchange conditions.

Sericite, hydromuscovite[4], muscovite and the basic micas yield up an appreciable amount of their alumina, etc., on treatment with weak solutions ($< N/5$) of salines such as salt and potassium chloride, extraction being accelerated by heat. Paver and Marshall[5] noted this reaction, and its rapidity, in the case of certain clays. Seven basic micas treated by us yielded hydroxides of aluminium and ferric and ferrous iron (with some magnesia), which were readily removed from the mineral particles by very dilute ($< N/40$) hydrochloric acid and precipitated from the filtrate by ammonia. The residues in the two cases tested had the properties of a true mica grading towards 'bleached biotite'.

Tamm[1] noted that orthoclase dust produced by grinding under benzene was neutral towards water. We confirm this finding, and extend its application to mineral dusts in general if they are produced by grinding under either benzene, or bromoform, or methylene iodide, which appear to endow the particles with a protective film. This neutrality t water is partly overcome by further attrition, and may be entirely cancelled by the use of aqueous alcohol.

The comparative ease with which dust-fine miner particles are partially dissociated and leached of som portion of their bases by cold water alone shows the 'mineral solubility' can be a misleading term[6]. Th facts merit adequate consideration in relation to th genetic history and petrology of sedimentary rocks they bear directly on (*a*) the geochemistry of weathe ing processes; (*b*) the extent to which mineral chang is dependent on the grade size of the detrital particl and on the solutes present in surface and unde ground waters; (*c*) the metastability of sedimente mineral particles under environmental conditio liable to oscillate between aggradation and degradation; and (*d*) the extent to which original mineral composition (and parental sources) can be inferred from the actual mineral assemblage in any particular case.

A. BRAMMALL.
J. G. C. LEECH.

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Imperial College of Science and Technology,
London, S.W.7.
March 17.

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[1] *Arkiv Kemi, Min. Geol.*, **11**, No. 14 (1934); *Min. Abstracts* (March 1935).

[2] Prof. Paper U.S. Geol. Surv., No. 185-A (1934).

[3] *Arch. Min. Soc. Sci., Varsovie*, 11 (1935); *Min. Abstracts* (March 1936).

[4] Brammall, A., Leech, J. G. C., and Bannister, F. A., Mineralogical Society, Jan. 28, 1937; *Abstr. Geol. Mag.*, **74** (March 1937); *Science Progress*, **31**, No. 124 (April 1937).

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Active Absorption of Anions in the Animal Kingdom

IN recent papers (1933–37), Lundegårdh[1] has demonstrated in the roots of plants a mechanism for absorbing and concentrating salts out of very dilute solutions. This mechanism utilizes energy derived from the oxidation of sugar and acts by transport of anions (in Lundegårdh's experiments, NO_3^- and Cl^-) from the outside medium through the active cells to the inside. It is a specially important point that the energy used up is proportional to the anion exchange, while cations cause no increase in respiration. In carbonate solutions no active transport can take place and the exchanges of cations are slight only.

I submit that a mechanism closely resembling Lundegårdh's is of widespread occurrence and of great biological significance in the animal kingdom.

H. Koch (1934)[2] discussed the occurrence in a number of freshwater arthropods of certain groups of cells which take up silver nitrate from very dilute solutions and become deeply stained when the silver chloride formed is afterwards reduced under the influence of light. He suggested that these special cells normally act by actively absorbing salts which go to maintain the osmotic concentration of the organism. Working in my laboratory, he was able to prove the correctness of this suggestion.

I studied[3] simultaneously the active absorption of salts by frogs. Frogs which have been deprived of a certain amount of salt will take up actively Cl^- ions from solutions down to 10^{-5} molar or less, either with Na^+, (K^+) or in exchange against HCO_3^-. While in plant roots the process is apparently going on indiscriminately all the time, in the frog's skin it is definitely regulated. It takes place only when the salt content of the body has been depleted, and when potassium chloride only is available it soon stops. Calcium is scarcely taken up at all, but from calcium chloride there is a quantitative exchange of Cl^- ions against HCO_3^-. Br^- is absorbed just as rapidly as Cl^-, and I find now that the nitrate ion also is absorbed from a *n*/1,000 solution. In an experiment with sodium chloride plus nitrate, each 0·002 molar, the initial uptake of Cl^- was thrice as rapid as that of NO_3^-. Iodine penetrates only slowly and probably by diffusion.

Corresponding mechanisms exist in a large number of freshwater animals where they seem to be located in the gills. I have found them in several fishes, crustaceans, gastropods and mussels.

In the eel in sea water, a mechanism for excreting Cl^- through certain cells in the gills was demonstrated by Keys (1931)[4], and it is significant that this mechanism cannot act in the opposite direction when the eel is living in fresh-water.

Ingraham and Visscher (1936)[5] describe a mechanism, which is probably similar, for the absorption of Cl^- from the intestine, and I venture the prediction that the Cl^- absorption taking place in the kidney tubule is also similar in nature. It is well known that bromide is not distinguished from chloride by the kidneys.

A. KROGH.

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April 12.

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A Lead Extrusion Phenomenon

IT has been known for the past two decades that in the extrusion of lead cable sheaths and pipe on the hydraulic press, the presence of oxides may result in the existence of irregularities in the structure which are brought to light by suitably etching a polished section. In this case, the feature originates in the oxidation of a surface of the metal exposed at an earlier stage in the process, and the layer of oxide, formed at right angles to the direction of flow, may be folded over, and appear afterwards as a radial line of weakness in the finished pipe. An important distinguishing feature in this type of irregularity is the fact that the crystal structures on the two sides of the feature are quite separate and distinct; there is no growing of the crystals across the line of oxide (see Fig. 1).

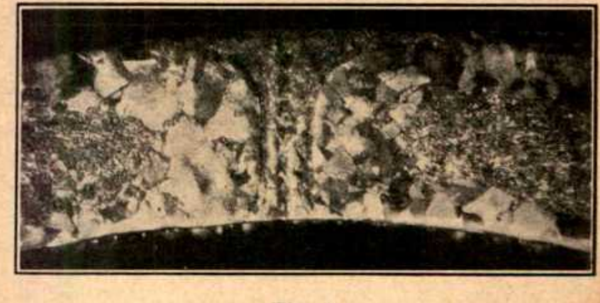

Fig. 1.

WELL-KNOWN INCIPIENT FISSURE DUE TO OXIDE LAYERING. CRYSTAL SYSTEMS DISTINCT ON TWO SIDES.

In the production of pipe and cable sheath by the continuous lead extrusion machine, the formation of oxide layers has been avoided by the exclusion of air from the device. Notwithstanding the complete absence of oxidation, however, it has been found possible, by the use of bridge supports dividing the flow of lead on its passage to the forming die, to produce radial lines in the etched section of the finished pipe showing that an impression has been left on the structure of the lead. In this case, although the crystals grow continuously across the line, it seems to be quite clearly established that the splitting of the lead stream by a steel part before final amalgamation results in a modification of the structure which may be brought to light by subsequent deep etching.

The former well-known defect consisted of a 'mush' of small non-crystalline particles, dross, etc., and was frequently backed up on each side by sandwiches of crystals and mush, evidently on their way to form the defect. In that case, however, the crystal structure was definitely broken at the boundary line, whereas with this new phenomenon, all my observations indicate that the line brought out by deep etching is not a boundary between two separate crystal systems, but actually passes through the crystals themselves and, moreover, passes continuously from one crystal to the next.

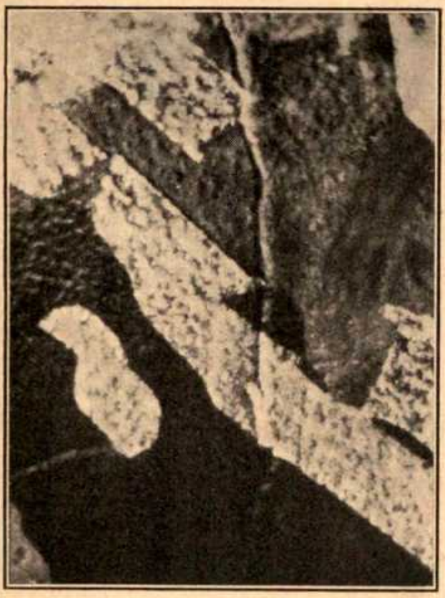

Fig. 2.

LINE IN STRUCTURE, BROUGHT OUT BY DEEP ETCHING, WHERE METAL HAS FLOWED OVER A DIVIDING MEMBER AND JOINED UP AGAIN. ONE HOMOGENEOUS CRYSTAL SYSTEM.

The distinction is shown in the two photomicrographs (Figs. 1 and 2). There are one or two possible explanations of the phenomenon of Fig. 2. Although oxide is excluded from the machine in which this structure has been produced, it may easily happen that a small quantity of oxide disseminated throughout the mass of lead, probably in solution, could be segregated at the dividing barrier and produce the effect, at the same time being so small in quantity as to permit the free recrystallization of the metal as in Fig. 2, after the divided stream has joined up again beyond the barrier. A second possible explanation is that in rolling and rubbing over the dividing steel surface, a segregation of the very small quantities of impurities always found in lead may take place, and that the 'line', therefore, indicates a difference in alloy which, while very slight and insufficient to interfere in any way with the formation of the crystals, is still sufficient to cause differential solubility through electrolytic local action and the bringing to light of the feature through the local depression. As would be expected from the integrity of the crystal system, the existence of the feature does not reduce the bursting strength of the pipe and, while suitable modifications of the machine have been made to obviate the effect, its appearance would not seem to share the disadvantages of the former type of split lead due to oxide inclusions.

P. DUNSHEATH.

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March 23.

A Method of Measuring the Magnetic Moment of Free Neutrons

F. BLOCH[1] has recently pointed out the possibility of producing partly 'polarized' neutron beams, that is, beams which contain more neutrons of one direction of spin than of the other. The method consists in passing a beam of slow neutrons through a plate of magnetized iron, the 'polarizer'; the polarization of the beam can be demonstrated by passing it through another iron plate, the 'analyser': a change in the intensity of the beam would be expected, according to Bloch, on reversing the magnetization of the analyser. Such a change has in fact been observed by Hoffman, Livingston, and Bethe[2].

The magnitude of the polarization effect was shown[2] to be in agreement with the value $\mu_n = 2$ N.M. (1 N.M. = 1 nuclear magneton = 1/1840 Bohr magneton) for the magnetic moment of the neutron deduced from the moments of the proton (2·5–2·9 N.M.[3,4]) and the deuteron (0·8 N.M.[5,4]). This calculation is based on a careful study of the density distribution in the iron of those electrons which produce ferromagnetism.

We would like to point out a direct method of measuring μ_n which also permits a determination of its sign (that is, its direction relative to the direction of spin). Our method makes use of the Bloch effect for obtaining polarized neutron beams, but does not necessitate the application of the theory of ferromagnetism.

The method consists in studying the depolarizing effect of a magnetic field through which the neutrons pass on their way from the polarizer to the analyser. If this field, H, is perpendicular to the polarizing (and the analysing) field the neutrons start to precess with an angular velocity $\omega = 4\pi\mu_n H/h$ (h = Planck's constant). On leaving the field the neutrons have turned through an angle $\varphi = 4\pi\mu_n Ha/hv$ (a = length of field, v = neutron velocity), and consequently the polarization effect (the change in beam intensity when the analysing field is reversed) is diminished by a factor cos φ. Thus the study of the dependance of the polarization effect on H permits a determination of μ_n. Taking $v = 2 \times 10^5$ cm./sec., $a = 3\cdot5$ cm., $\mu_n = 2$ N.M., we find that a field of about 4 gauss should turn the neutrons through 90° and thereby make the polarization effect disappear.

We have made some preliminary experiments t demonstrate the existence of this depolarization effect (Qualitative evidence has been obtained by Powers Beyer, and Dunning[6].) Our arrangement was similar t that of Hoffman, Livingston, and Bethe[2]. As polarize and analyser we have used flat iron rings which wer wound throughout their length in order to minimiz any external field action of the magnetizing current Still, it was soon found best to switch off the magnetizing current during the measurements and to wor with the permanent field only. A long solenoid wa placed between the iron rings in order to produce the depolarizing field H.

With $H=0$, the polarization effect was found to be $(0{\cdot}65 \pm 0{\cdot}28)$ per cent of the total count (of which about one half was due to thermal neutrons). With $H=4$ gauss, the polarization effect was negative, but at the limit of error $(-0{\cdot}36 \pm 0{\cdot}31)$ per cent. At $H=2$ gauss an intermediate value of $(+0{\cdot}29 \pm 0{\cdot}36)$ per cent was obtained. These results are in qualitative agreement with the assumption $\mu_n = 2$ N.M. The errors given are mean square errors; similar figures were obtained on computing the errors in the traditional way from the fluctuations of the single results. Altogether, 1·2 million counts have been made.

A new and improved apparatus is being prepared in order to determine the amount and the sign of μ_n; the sign can be found by placing polarizer and analyser at an angle and by studying the direction of precession depending on the direction of the magnetic field.

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H. VON HALBAN, JUN.
JØRGEN KOCH.

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Theoretical Physics,
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April 7.

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[2] Hoffman, Livingston, Bethe, *Phys. Rev.*, **51**, 214 (1937).

[3] Estermann, Stern, *Z. Phys.*, **85**, 17 (1933).

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Radioactive Neon

IN a previous note[1] it has been reported that the radioactive helium formed by bombarding fine-grained beryllium hydroxide with neutrons can be transferred by a stream of gas through a tube from the place of activation around a neutron source to a Geiger counter placed at some distance.

By bombarding sodium or magnesium with fast neutrons, a radioactive substance of 40 sec. half-value period is produced[2], which is generally assumed to be $^{23}_{10}$Ne. So far as I am aware, no chemical proof has been obtained. It therefore seemed of interest to attempt to use the above method to decide whether the active substance in question is a gas. Magnesium hydroxide was precipitated together with ferric hydroxide in various proportions by the method of O. Hahn[3] in order to give it a high emanating power. The dried precipitates were bombarded with neutrons from a beryllium-radon source of 200 millicuries, and air from an aspirator was passed at a suitable rate through the samples and then through a glass tube to the thin-walled jacket around the counter. No definite effect was found; it follows from the relative yields by bombardment of beryllium and magnesium with neutrons, that if radioactive neon is given off by the bombardment of magnesium, one would expect only a very weak effect (just detectable) by this method. This is mainly due to the small relative abundance of $^{26}_{12}$Mg.

In the case of sodium, the effect to be expected is much larger if the radioactive neon can be removed from the crystals of the sodium compound during an interval comparable to 40 sec. Commercial sodium stearate[4] proved suitable, and an unambiguous effect was found. In Fig. 1, the number of counts per minute is plotted against the rate of the air stream in cubic centimetres per second. From the volumes of the activation chamber, the connecting tube and the jacket around the counter, one can calculate the shape of the curve to be expected when the radioactive gas has a given half-value period T. The curve drawn in the figure corresponds to $T = 40$ sec. The experimental points are not in disagreement with this, although a slightly smaller value of T (35–40 sec.) would fit a little better. With sodium butyrate, a similar effect was obtained.

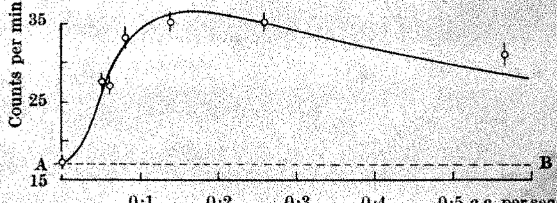

Fig. 1.

RELATION OF NUMBER OF COUNTS TO RATE AT WHICH THE AIR STREAM PASSED TO THE COUNTER. AB REPRESENTS THE γ-RAY EFFECT.

The effect here described may be of interest for the study of the emanating power of sodium compounds.

T. BJERGE.

Institute of Theoretical Physics,
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March 19.

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[1] NATURE, **138**, 400 (1936).

[2] Fermi, Amaldi, D'Agostino, Rasetti and Segré, *Proc. Roy. Soc.*, A **146**, 483 (1934).

[3] Hahn, O., *Naturwiss.*, **17**, 295 (1929).

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The Cosmological Constants

PROF. P. A. M. DIRAC's recent letter in NATURE[1] encourages me to direct attention to certain 'coincidences' which I had noticed some years ago, but which I have been hesitating to publish from the conviction that purely 'dimensional arguments' will not lead one very far.

If we consider the natural constants h (Planck's constant), c (velocity of light), H (mass of the proton), G (the constant of gravitation), we can form the following combination M_α which is of the dimension of mass:

$$M_\alpha = \left(\frac{hc}{G}\right)^\alpha \frac{1}{H^{2\alpha-1}}, \qquad (1)$$

where α is an arbitrary numerical constant. Now a particular case of the above occurs in the theory of stellar interiors, namely, when $\alpha = 3/2$. Then

$$M_{3/2} = \left(\frac{hc}{G}\right)^{3/2} \frac{1}{H^2} \doteqdot 5{\cdot}76 \times 10^{34} \text{ gm.}, \qquad (2)$$

which is about thirty times the mass of the sun. Now, the apparent success of steady state considerations in 'explaining' the observed order of stellar masses can be traced to the circumstance that the above combination (2) of the natural constants gives a mass of the correct order. It may be noticed that apart from numerical constants, (2) is the same as the upper limit to the mass of completely degenerate (degenerate in the sense of the Fermi-Dirac statistics) configurations[2]. The occurrence of (2) in stellar structure equations need not cause any surprise, since one can easily convince oneself by considering two homologous stellar configurations that if a formula for mass exists, it must contain the mean molecular weight μH with an inverse power 2, and this would, according to (1), fix the value of the exponent α as 3/2.

It is of interest to see what (1) leads to for other values of α. If $\alpha = 2$, then

$$M_2 = \left(\frac{hc}{G}\right)^2 \frac{1}{H^3} \doteqdot 9\cdot5 \times 10^{20} \text{ mass of sun} \qquad (3)$$

If we divide M_2 by H, then we get for the corresponding 'number of protons or/and neutrons',

$$N = \left(\frac{hc}{G}\right)^2 \frac{1}{H^4} \doteqdot 1\cdot1 \times 10^{78}, \qquad (4)$$

which is of the right order as the 'number of particles in the universe'. We may notice that if $G \sim t^{-1}$ (t is Milne's cosmological time), then $N \sim t^2$, which agrees with Dirac's speculation.

It may be further pointed out that if $\alpha = 1\frac{3}{4}$, then

$$M_{1\frac{3}{4}} = 1\cdot7 \times 10^{11} \text{ mass of sun}, \qquad (5)$$

which is of the same order as the mass of our Milky Way system. If we 'identify' $M_{1\frac{3}{4}}$ as representing the mass of a galaxy (external or otherwise), then we should have, according to Dirac's ideas, that the 'number of particles in the galaxy' should vary as $t^{1\cdot75}$ Similarly, the number of particles in a star should vary as $t^{1\cdot5}$.

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[1] NATURE, **139**, 323 (Feb. 20, 1937).

[2] Chandrasekhar, S., *Mon. Not. Roy. Ast. Soc.*, **91**, 456 (1931).

Sources of Inaccuracies in Spectrographic Research

IT may be of interest to point out that there is considerable evidence entirely confirmatory of Mr. D. A. Webb's observation[1] that very intense spectra due to element A, present in minute concentration in electrodes B, can be brought out by addition of C.

Development of spectra in discharges is in the main due to one of two causes, namely, direct collisional excitation as a kinetic effect, or receipt of energy from another excited body, that is, a collision of the second kind. Other processes such as chemiluminescence, recombination reactions, etc., are generally of much smaller account.

As regards the first of these, it seems permissible, in view of the very wide variations in electrical factors such as electron speeds, etc., to suppose that in spite of considerable differences in excitation functions and excitation potentials, among both the various elements and their different spectral series, the genesis of excited states will be so much a matter of probability that the ratio of the intensity integrals of spectra due to A and to B, may be taken as a fair measure of their relative concentrations.

Excitation according to the second of these causes may lead to very different results. The probability that transfer of energy will follow the contact of excited and unexcited bodies, is here governed by two principles. From energy considerations alone (Franck's 'resonance rule'), it is expressed by a somewhat complex function which in practice means that the chance of such excitation increases very much as the discrepancy $\triangle E$ between the energy of the donor, and that of the nearest excitable level of the acceptor, decreases. In the mercury-sensitized fluorescence of sodium, for example, the line $\lambda = 4423$ A. is extremely intense, since it proceeds from a level lying within 0·02 v. of the mercury 2^3P_1 state, other lines (for example, 6 D, 8 S) being only one eighth to one quarter as bright, although $\triangle E$ is here[2] only about 0·15 v.

Excitation is also markedly favoured, given good energy resonance, if the process can take place without change in the overall multiplicity, S, of the system (Wigner's rule). To this is due the thirtyfold enhanced probability of:

$$\mathrm{Kr}(2^3P_2) + \mathrm{Hg}(1^1S_0) \rightarrow \mathrm{Kr}(1^1S_0) + \mathrm{Hg}(5^3D_n) + 0\cdot038 \text{ v.}$$

as compared with:

$$\mathrm{Kr}(2^3P_2) + \mathrm{Hg}(1^1S_0) \rightarrow \mathrm{Kr}(1^1S_0) + \mathrm{Hg}(5^1D_2) + 0\cdot033 \text{ v.}$$

In the first reaction, where the mercury triplets are excited, S remains constant at unity, whereas in the second case, where the singlets appear, S has fallen to zero[3]. It would appear not improbable that there may be yet a third factory, depending upon the *type* of level being excited, but the evidence here is as yet very slender[4]. So many cases are known, however, where the first principles are valid[5], that it will be clear that considerable caution must be adopted, in spectographic analysis, as regards metrical interpretation of the results. Mr. Webb's communication is a welcome and timely reminder to this effect.

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Royal Institution,
W.1.
March 30.

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[1] Webb, NATURE, **139**, 248 (1937).

[2] Beutler and Josephy, *Z. Phys.*, **53**, 747 (1929).

[3] Beutler and Eisenschimmell, *Z. phys. Chem.*, B, **10**, 89 (1929).

[4] Manley and Duffendack, *Phys. Rev.*, **47**, 56 (1935).

[5] Willey, Monograph on "Collisions of the Second Kind" (in the press).

Germination of Oospores of Onion Mildew, *Peronospora Schleideniana* W. G. Sm.

IN a previous letter[1], the germination of the oospores of the downy mildew of onions, *Peronospora schleideniana* W. G. Sm., was briefly discussed. Commenting on this letter, Miss Blackwell[2] remarked on the general difficulty experienced in germinating such fungal spores, and points out that time is a factor as well as maturation.

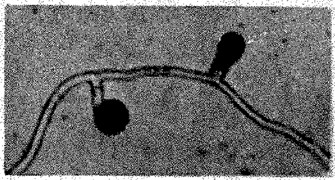
Since then, Wolf and his associates[3], working on somewhat similar lines to mine, have recorded the germination of oospores of the downy mildew of tobacco. They state that less than a dozen oospores germinated out of several thousands tested, and growth of the germ-tubes was very limited. In view of our general lack of knowledge concerning the behaviour of such oospores, the following additional information regarding those of the downy mildew of onions may be of interest to other workers.

One per cent of the oospores germinated at the end of four years, but it was evident that the remainder had not lost their vitality, since:

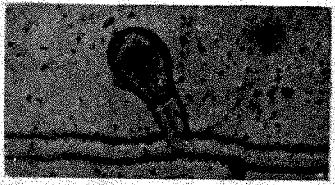
(*a*) The changes occurring in the oospores indicated that they were not dead.

(b) A slight increase in germination occurred after four years, though two per cent was the highest obtained in water.

(c) Eventually it was found that on adding potassium permanganate solution (0·01–0·02 per cent) to water containing the oospores, the latter being 5–6 years old and weathered out-of-doors, 60–85 per cent germination occurred inside forty-eight hours at 15°–20° C., 0·05–1 per cent occurring in controls. The oospores were placed in water on microscope slides, sufficient of the permanganate solution added to give a definite pink colour to the water, and cover slips applied. The reagent did not appear to act directly on the oospores, as scarcely any germination took place when they were mounted perfectly clean. If, however, plenty of organic remains were present, germination occurred.



(a) × 200



(b) × 400

Fig. 1.

Peronospora Schleideniana.

The germ-tube produces a hypha which grows to a length of 2–8 mm., with more or less subsidiary branching, when longitudinal growth apparently ceases. After this, at any time in 3–10 days, a second type of branch arises usually on the main hypha. These branches are very short, and may be either scattered along the hypha or adjacent to each other, when they are often on alternate sides, as shown in Fig. 1 (a). These short branches are terminated by a single cell (Fig. 1 b), the latter varying in size. Three to nine of these bodies may occur on a hypha produced by a single oospore, so that we have here a limited saprophytic existence of the fungus in water. Some oospores germinate without forming any of these bodies; the significance of this is not yet known.

The treatment of eighteen-months old oospores with the permanganate solution gave no result. This confirms Miss Blackwell's observation that the time factor as well as maturation is necessary for the germination of these fungal spores.

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Drumcondra,
Dublin.

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[1] NATURE, 135, 306 (Feb. 23, 1935).

[2] NATURE, 135, 546 (April 6, 1935).

[3] *Phytopath.*, 26, 760–770 (1936).

The Technique of Plastic Reconstruction

PLASTIC reconstruction is desirable in almost any structural embryological investigation. At the best of times it is a laborious process, yet I feel that the difficulty of obtaining or preparing suitable plates may often be a determining factor in preventing the still more frequent use of this method. In a department where there is a constant demand for plates, such difficulty will not arise as the necessary apparatus will be permanently set up and a trained technician will be available, but when the demand is sporadic difficulties may occur.

It is in the hope that some of these difficulties may be lessened and that further stimulus to the use of plastic reconstruction may be given, that I am writing this letter.

Plates may be made of wax[1] or other suitable material. The chief advantage of wax is that it allows plates of any predetermined thickness to be made. The plates are usually rolled on a lithographic stone[2] or on a cast-iron plate[3,4]. The former is cumbrous and very liable to crack, the latter is incorporated in a special apparatus; neither is readily transported and set up wherever happens to be immediately convenient.

Some time ago, I tried a sheet of plate-glass (24 in. × 15 in. × ½ in.) as a substitute for the lithographic stone, and I have been using the method since with considerable satisfaction. The glass is placed on any suitable end-supports, so that it rests about 4–6 in. clear of the bench. After levelling, it is gradually heated by waving a gas poker underneath the free surface between the supports. (The 'poker' is easily made by sealing the end of a piece of brass tubing and punching a series of suitably spaced holes in it.) When the glass is sufficiently hot, it is painted with turpentine, a sheet of Flint paper is placed on it and brushed down with turpentine so that all the air between the paper and the glass is expressed, the guide rails are placed in position, and the wax is poured and rolled in the usual way. The wax maintains the temperature of the glass without further heating. Overheating of the wax and of the roller must be avoided, otherwise there is a risk of cracking the glass.

The advantages of this method are that the plate-glass is cheap and readily obtainable, it is easily moved from place to place and set up wherever desired, and it is speedily heated: it is, in fact, easier to handle in every way than a lithographic stone.

There are obviously great advantages in using material of more resistant qualities than wax, apart from the fact that the need for making the plates is eliminated. "Holzpappe" was suggested by His[5] so long ago as 1885; cardboard was used by Broman[6] in some of his reconstructions, and this method was elaborated by Triepel[7].

The blotting-paper method, originally suggested by Gage[8], appears now to be in general use. It is, however, expensive, and I wish to direct attention to the use of a wood-pulp board which serves the purpose equally well and is less than half the price of blotting-paper. I have been using what is termed "4 sheet pulp board 44 in. × 32 in.", the retail price of which is eight shillings per quire. After impregnation with paraffin wax (melting point about 55° C.) I find that this board approximates closely to a thickness of 1 mm., and it cuts very readily. This wax impregnation, which is carried out by soaking the sheets in the melted wax until all the air has been driven out, is important as it facilitates the process of cutting to a marked degree; it may be that it is a well-recognized step in the technique, yet I have only noticed it mentioned once in the literature[9].

I have found that it is useful to fill in the 'steps' in the completed model (if it is desirable to do so) with plastic wood instead of the usual wax; considerably greater rigidity is thus obtained, and the use of fine sand-paper gives a finished surface.

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[1] Born, *Morph. Jahrb.*, **2**, 577 (1876).
[2] Strasser, *Anat. Anz.*, **2**, 392 (1887).
[3] Fleischmann, *Z. wissen. Mikro.*, **21**, 445 (1905).
[4] Berner, *Z. wissen. Mikro.*, **27**, 44 (1910).
[5] His, "Anat. mensch. Embryonen", **3**, 5 (1885).
[6] Broman, *Anat. Hefte*, **11**, 558 (1899).
[7] Triepel, *Z. wissen. Mikro.*, **35**, 89 (1918).
[8] Gage, *Anat. Rec.*, **1**, 166 (1907).
[9] Pohlman, *Anat. Rec.*, **15**, 389 (1919).

Air Raid Precautions

WHILE we appreciate the fulness of the treatment which has been accorded to our book "The Protection of the Public from Aerial Attack", we should be grateful for the opportunity of commenting on certain points in the review in NATURE of April 10, p. 606. Regarding the purpose of the book, General Foulkes says, "It suggests no better defensive measures than those recommended by the Home Office". Better methods are not lacking, and our object simply was to provide some scientific data concerning the proposed precautions—because no such data had been published and we felt that the unsupported statements of Government spokesmen concerning their efficiency were no substitute for scientific fact.

The reason why a privately manufactured mask was tested is expressly stated in the book. Although we applied to the Home Office for specimens of the Government mask for civilian use and attempted to procure them through other channels, we were unsuccessful in obtaining any. The type of filter in the mask which we used was, however, the same as that described in the Press for the Government mask. General Foulkes does not mention the passage of arsenical smokes through gas masks of the type of the Government mask. From simple experiments with cigarette smoke on the free masks on exhibition at the Royal Horticultural Hall, it seems probable that they could transmit a few per cent of any arsenical smokes drawn through them. Is it therefore justifiable to claim that these masks give complete protection against all air-dispersed poisons? The French Government uses an entirely different type of filter—a pleated paper one—in all its service masks, and this mask transmits very much less arsenical smoke.

General Foulkes remarks that "in many of the poorer homes completely gas-proof shelters can only be provided with great difficulty" and continues "but that is no reason why the remainder should not be protected". We agree, but the number of poorer homes which cannot be gas-proofed is disturbingly great. The reviewer in discussing the carbon dioxide experiments quotes from Mr. Geoffrey Lloyd that they "had been proved to be open to grave criticisms". What are these criticisms? They are still unknown to us, though they have been repeatedly asked for in the House of Commons. Since General Foulkes says that "experiments showing the rate of leakage *from the open air into a gas-proof room* would have been of far greater interest", it is surprising that he makes no mention of the experiments we did in which gas passed from the outside to the inside of a gas-proofed room. These were of two kinds (see pp. 95–105) and showed that air passes readily from the outside into a gas-proofed room under normal atmospheric conditions. The suggestion that conditions in dug-outs are comparable with those in ordinary houses is obviously false, as the kind of walls, ceiling and floor and the degree of exposure are different. When General Foulkes says, "I do not believe that anything approaching a concentration of 5 per cent of gas can be established in the open air by an aerial or any other kind of bombardment", we may well agree with him. But the strongest concentration of non-persistent gas we assumed for our calculations corresponded to 0·004 per cent by volume of phosgene. It is stated by Engelhard that concentrations higher than this can be reached in the field. It is stated in a recent book ("Chemicals in War", by Prentiss) by an author who seems to have had much experience of these matters, that seven aeroplanes could establish a concentration of mustard gas of 0·025 gm./cubic metre when the atmospheric temperature was 17° C. over an area of 2·5 square miles. Such concentrations would be fatal if breathed for an hour, so that our calculations would appear to be well founded on reasonable premises. General Foulkes would apparently trust a "good strong wall-paper". We would not, nor would we trust a brick built room, for the data published by Pettenkofer in 1865 and in the *Architectural Forum* of March 1924 show that the ventilation of a room is very largely through the actual brick of the walls and is much less through the windows and doors than is commonly supposed.

The chief burden of General Foulkes's argument is that our experiments have little relevance to actual war conditions, that they are essentially academic and not practical. He considers the measures proposed by the Government as adequate to deal with the kinds of attack which are probable and points to the experience of the Great War. We believe, however, that with the immensely increased potentia force of modern air fleets, attacks of a different order of intensity are now possible, and that against suc attack the measures are hopelessly inadequate. This is certainly the belief of the French Government as judged by the methods actually being put int practice, which include among other provisions (*a*) evacuation, for the duration of the hostilities, o the inessential population (old persons, some wome and children), (*b*) nightly evacuation of all thos required for essential services, (*c*) bomb- and gas proof shelters with filtered ventilation in cellars o large and strong buildings, (*d*) communal shelter for districts with old and small houses (undergroun stations will be used for the purpose). English town are exposed to a danger at least as great and requir no less effective protection.

We have no desire to create panic, but those wh persuade the people of Great Britain to believe tha they are safe when they are not are inviting pani and worse than panic in the case of war. We woul be lacking in our duty as scientists and citizens if we were to accept, without question, assurances of the validity of which we have not been convinced.

Finally, we must admit that we would prefer to obtain "a still greater degree of safety . . ." by stopping war altogether, but we do not feel that this preference invalidates our results. Experiments are to be believed, not on account of the authority or bias of the experimenters, but because they can or cannot be repeated by anyone who chooses to do so. We would accordingly urge that the whole question of the protection of the population from aerial attack should be studied openly by representative scientists; then a rational estimate can be made of the probable efficiency of any measures which are finally adopted.

J. D. BERNAL.
J. H. FREMLIN.
SHIRLEY GLASSTONE.
A. F. W. HUGHES.
A. J. P. MARTIN.
JOSEPH NEEDHAM.
N. W. PIRIE.
R. N. ROBERTSON.
R. L. M. SYNGE.
J. S. TURNER.
D. H. VALENTINE.
C. H. WADDINGTON.
ARTHUR WALTON.
NORA WOOSTER.
W. A. WOOSTER.

Cambridge.

ONE of the grievances of the authors seems to be that they issued a challenge to the Home Office to produce the data on which their gas protection experiments were based, and that this challenge has been ignored.

The Government has, no doubt, its own reasons for not publishing the data, but it would be fair to suppose that the recommendations it has made are well supported by scientific facts which have been established by its own advisers—men, as I pointed out, who have carried out all its poison gas experiments during the last twenty-odd years.

The authors quote from a book recently published in America by Colonel Prentiss, and they refer to him as one "who seems to have had much experience of these matters".

I agree; so let me in turn quote from the chapter "Protection of Civil Population": it will be seen that the Home Office recommendations are supported in full.

> "Shelter from chemicals launched during air raids s to be obtained for the most part by the utilisation of existing structures with such gas-proofing as may be justified. The erection of special collective shelters designed exclusively for the protection of civilians during aerial attacks is only warranted under exceptional circumstances; at best, such buildings can accommodate no more than an insignificant proportion of the inhabitants of any community. . . .
>
> "The individual or small-group shelter of this type will not require special air-purifying devices to counteract noxious gases, but instead will be airealed when occupied, its occupants depending on the air present in the room for the necessary oxygen. Arrangements should be made in advance to prevent all in-drafts of air, while the shelter is in use, and overcrowding with consequent rapid exhaustion of ree oxygen must be avoided."

C. H. FOULKES.

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Walton-on-Thames.

An Air-borne Plant Virus

IN a recent issue of NATURE[1], Dr. Kenneth Smith described the virus of a new disease of plants as being "air-borne". The term in this connexion implies: (1) that the virus agent can escape from the tissues of the infected plant into the air under natural conditions; (2) that it is carried in the air; and (3) that the air-carried virus can infect a normal healthy plant.

In the light of the generally accepted view that the virus is intimately connected with the protoplasm of the host cell, and that it is unable to enter an uninjured protoplast, the demonstration of the easy passage of a virus from a plant into the air would be of great interest. It is not clear that Dr. Smith has succeeded in demonstrating this. All he has shown is that in three out of an unstated number of experiments, plants were found to be diseased after they had been rubbed with cotton-wool pads through which the air of a glass-house had been drawn. If the virus is present in the soil, as Dr. Smith suggests, and if it resists desiccation as he now states[2], it is not unreasonable to suppose that in the dust of a glass-house some traces of the virus might be present. Even if this were demonstrated, however, it would scarcely prove that the virus is air-borne; tobacco leaf dust contains the virus of the tobacco mosaics.

Dr. Smith has not shown that the virus does in fact reach the air from the tissues of a living infected plant, or that being in the air it can infect normal healthy plants. Until this has been demonstrated under controlled conditions, Dr. Smith's description of his virus as "air-borne" would appear to be premature.

JOHN CALDWELL.

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Exeter.

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[1] NATURE, 139, 370 (Feb. 27, 1937).
[2] cf. Smith, NATURE, 136, 396 (Sept 7, 1935).

DR. CALDWELL's chief criticism is directed against a point which has already been proved[1], namely, the ability of this virus to enter the roots of a plant without the aid of any known external agencies. Dr. Caldwell says that the term "air-borne" implies "that the virus agent can escape from the tissues of the infected plant into the air under natural conditions". I fear this is wider than my conception of the term; I only meant that the virus was carried in the air, with the added implication that it was able to reach and infect virus-free plants by this means. It never occurred to me that anyone would suppose that the infected plant was discharging virus particles into the air after the manner of an influenza patient. Indeed, the following sentence from my letter makes my meaning quite clear: "It is not perhaps surprising that such a minute virus . . . and one capable of withstanding complete desiccation should be present in the air."

Dr. Caldwell further says, "tobacco leaf dust contains the virus of the tobacco mosaics". Of course it may do, but this disease cannot spread in the same way, even if a suspension of tobacco mosaic virus is poured round tobacco plants growing in pots, and herein lies an interesting difference between these two viruses. Again quoting Dr. Caldwell . . . "it has not been shown that being in the air it can infect normal healthy plants"; this, of course, has been demonstrated experimentally. If a suspension of this particular virus is lightly sprayed into the air from an atomizer in the vicinity of tobacco plants growing *under controlled conditions*, a percentage of such plants is later found to contain the virus in the roots.

I take it that the main reason for Dr. Caldwell's strictures lies in his fear that my letter casts doubts on "the generally accepted view that the virus . . . is unable to enter an uninjured protoplast". If he will read my last paper[1] he will find this sentence on p. 90—"It appears therefore that some wounding must be necessary for infection, and this condition might be fulfilled by the breaking of root hairs as the root makes its way through the soil or sand". In this connexion I might perhaps mention that if a suspension of the virus is sprayed on to the leaves of French beans (*Phaseolus vulgaris*) by means of an atomizer, held at a distance of about 6 inches from the plants, numerous lesions develop on the leaves. One can of course explain this by saying that the virus is entering by broken hairs or minute wounds already existing, and this may be so, but it is a difficult point to prove or disprove.

Finally, I repeat what I said in my previous letter, namely, that the smallest quantity of virus which reaches the soil seems eventually to enter the roots of a plant growing therein, though the precise mechanism of its entry has not yet been demonstrated.

KENNETH M. SMITH.

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Molteno Institute,
Cambridge.

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[1] Smith, Kenneth M., *Parasitology*, 29 (1937).

Points from Foregoing Letters

THE solubility, in water, of various dusts (such as felspar, asbestos, calcined flint) known to produce silicosis, is found by Prof. H. V. A. Briscoe, P. F. Holt, J. W. Matthews and P. M. Sanderson to be a complex phenomenon depending upon tissue, particle size, quantity of dust submitted and presence of extraneous substances. Freshly fractured surfaces of silica and certain silicates appear to be in a highly reactive state, and yield alkalis and 'soluble' silica to water to a greater extent than in the normal state. The particles lose their reactivity after a certain time, and this may explain the failure to produce silicosis in animals in experiments with 'dead' dusts.

Prof. A. Brammall and J. G. C. Leech find that many rock-forming silicates, when finely powdered, yield alkali to cold water, and several micas yield an appreciable amount of alumina on treatment with weak solutions of sodium or potassium chloride. They direct attention to the possible importance of these observations in relation to the origin and composition of sedimentary rocks.

That the ability to absorb and concentrate salts out of very dilute solutions is widely present in animals as well as plants, is suggested by Prof. A. Krogh. The mechanism involved, as indicated by Lundegårdh's experiments on plants, appears to utilize energy derived from the oxidation of sugar, and to act by transferring negatively charged (acidic) ions.

In the production of pipe and cable sheath by the continuous extrusion machine, the splitting of the lead stream by a steel part before final amalgamation results in a modification of the structure which appears as a 'line' upon subsequent deep etching. A photomicrograph of such a 'line', possibly due to small quantities of oxide or other impurities, is submitted by Dr. P. Dunsheath. The 'line' passes continuously through several crystals and, unlike the well-known defects due to a mush of small non-crystalline particles, it does not reduce the bursting strength of the pipe.

A method of measuring the magnetic moment of free neutrons is proposed by Dr. O. R. Frisch, Dr. H. von Halban, jun. and Dr. Jørgen Koch. The method consists in studying the depolarizing effect of a magnetic field on a polarized beam of slow neutrons, which is obtained by passing the neutron beam through magnetized iron, as suggested by F. Bloch. Preliminary experiments have given evidence of the existence of the depolarizing effect. The proposed method can also be used to determine the sign of the magnetic moment of the neutron.

By bombarding sodium or magnesium with fast neutrons, a radioactive substance of 40 seconds half-life period is produced which is generally assumed to be neon of mass 23. To decide whether the active substance is really a gas, Dr. T. Bjerge has applied the method of transferring the radioactive substance produced by means of a current of air, and has obtained positive results.

Dr. S. Chandrasekhar directs attention to a combination of certain 'natural' constants (the velocity of light, the mass of the proton, the constant o gravitation and Planck's constant, *h*) which has th dimension of mass. A particular form of this combination occurs in the theory of stellar interiors. B substituting simple values for the arbitrary constan in the formula, the author shows that one can obta numbers comparable with the mass of the Milky Way and with the total number of protons and/or neutron in the universe—such as were derived by Prof. Dira from similar dimensional arguments.

Commenting on sources of inaccuracy in spectr graphic research due to the influence of foreig materials in intensifying the spectrum of a give element, Dr. E. J. B. Willey points out that in so fa as the spectra are due to direct collisional excitatio the ratio of the intensities might be taken as a fa measure of the relative concentrations. But whe the radiating particle receives energy from anoth excited body, this simple relation no longer hold as shown for example by the mercury-sensitiz fluorescence of sodium.

The addition of a small amount of potassiu permanganate to water containing oospores of t onion mildew *Peronospora schleideniana* stimulat their germination if other organic matter was presen according to experiments by R. McKay. The oospor used were five-six years old and weathered out doors. Eighteen months old oospores gave no resul

Research Items

Family and Clan in Hopi Economics

MR. ERNEST BEAGLEHOLD's study of Hopi economics (*Yale Univ. Contrib. Anthrop.*, No. 15) is based on observations made in 1932 and 1934 of the culture of the two Second Mesa Hopi villages of Mishongnovi and Shipaulovi. The Hopi household, which is matrilocal and consists of father, mother, children, and unmarried or widowed brothers and sisters of the wife, is the ultimate unit of consumption and production. In marriage, both partners assume definite obligations to contribute to the economic welfare of the household; and the members of the enlarged family are brought within the partnership. A frequent cause of family quarrels is that a member is not fulfilling his economic duty. Marriage also brings together two kin groups, which then act as a closely co-ordinated unit in a number of economic activities. The clan, the maternal lineage, also has economic, as well as ceremonial duties. For example, it controls land, one of the most important items in the wealth of the community, and it is from the clan that are drawn the working parties for planting, harvesting, house-building, sheep-shearing and the like. It would, perhaps, not be incorrect to define the Hopi clan as a body of men, women and children, of common blood, periodically united for the co-operative production of food supplies and other major forms of wealth. It assumes the duties and obligations incidental to a scheme of social insurance. While the man owns only his personal effects and earnings, the woman, in addition to personal effects, if she is married, owns the house and its contents, bedding, furniture, utensils, etc. She also controls the clan lands assigned to the household. Individual ownership of lands by the male is recognized, when a man breaks in and plants land from the waste. As each household is a self-sufficing unit, specialization in economic activity, whether by individuals or by groups, is unknown.

The Nesting of Hornbills

WITH great success, R. E. Moreau has employed natives to record over long periods the feeding times of East African hornbills, and by co-operative observation he has been able to keep one nest under observation for a total of 400 hours in four successive seasons. The results present the first tolerably complete account of one of the most curious of nesting habits, and reveal unexpected differences between the three species which were studied (*J. E. Africa and Uganda Nat. Hist. Soc.*, 13, 1; 1936). For example, the sealing up of the nesting hole in the case of *Bycanistes cristatus* was done by the female, which used mud pellets elaborated in the gullet of the male and disgorged by him, whereas in *Lophoceros deckeni* the material used was collected without help from the male and consisted of insect casts and rotten wood. In the former case the male disgorged up to 2 pellets at a visit, and during a day 235 pellets in 5 visits. The daily load involves the impregnation of some 33 cubic inches of dry mud with saliva, a very considerable call upon the secretory powers of the salivary glands. The female *Bycanistes* remained sealed up in the nest for 108 days, and during that period the male made about 1,600 visits with food, carrying about 24,000 fruits. A new observation of very great interest is that in both *Lophoceros deckeni* and *L. melanoleucos*, when the female issued from the nesting hole, the young, then about three weeks old, and unable to fly, at once replaced the plaster at the mouth of the opening, without any help from the parents.

Marine Research at Port Erin

IT is satisfactory to find that, according to the Director's report for 1936 (No. 49) of the Marine Biological Station at Port Erin, Isle of Man, people are now taking a keener interest in natural history. An increase is manifest both in enthusiasm of the visitors to the aquarium as well as in their numbers. Research work in various fields is progressing, and, besides the usual staff, many visitors have been using the laboratory. Hatching of plaice and lobsters still continues, and examination of herring shoals is carried on as before. It is of interest that some adult herrings were brought alive to the aquarium and that one of them, a female, lived for eight weeks, apparently dying of starvation. A steady flow of water, pumped daily from Port Erin Bay, was maintained in the tank containing the herring. It seems that it is comparatively easy to secure the fish alive from ring trawl boats, and if the food problem could be solved it would probably be fairly easy to keep the fish alive for long periods. The report of the oyster investigations by Mr. J. R. Bruce and Dr. Mary W. Parke shows two series of experiments, in 1936, growth experiments and settlement experiments. In the first, there has been no conclusive evidence this season that any advantage is gained by using running water. In the second, from the results obtained it appears that plunger jars are the most suitable for the settlement of larvæ.

Parasitic Copepods from Belgium

J. H. SCHUURMANS STEKHOVEN, jun., continues his work on Belgian parasitic copepods ("Copepoda Parasitica from the Belgian Coast II; including some Habitats in the North Sea", *Mém. Musée Roy. d'Hist. Nat. Belgique*, Mémoire No. 74. Brussels, 1936). His material is extensive, and includes collections made under the direction of Prof. G. Gilson during the exploration of the North Sea by the Museum. A number of years is covered, and some species are represented by hundreds of specimens. Most of the species are well known, but many of the hosts are new and the geographical distribution is much extended. *Lernæocera branchialis* was available in such large quantities that a close examination of the oral parts was possible. These were chiefly on the whiting, *Gadus merlangus*, but there were also specimens on the cod, *Gadus morrhua*, and on the haddock, *Gadus aegelfinus*, whilst one full-grown female was found on the sand-eel, *Ammodytes tobianus*. The author finds that the mouth parts of *L. branchialis* differ considerably from the descriptions of Wilson (1917). The paper is illustrated by five plates of clear outline drawings.

Some Beetles of Jehol

In the report of the First Scientific Expedition to Manchoukuo, 1933, the part published in September 1936 entitled "Insects of Jehol (VI)" (Tokyo: Waseda University, 1936) deals with certain families of Coleoptera. These have been studied by a panel of Japanese entomologists who describe and figure various new and other species. Each paper is written in Japanese, and is followed by an adequate English translation. A special feature of the report is the excellence of the illustrations, the coloured plates being exceptionally well executed. Among the species figured are well-known English and other European forms, of which the range is now extended into Manchoukuo.

Gardenia Canker

Mr. W. Buddin and Miss E. Wakefield direct the attention of gardeners to a canker disease of gardenias caused by a fungus belonging to the genus *Phomopsis* (*Gard. Chron.*, April 3, 1937, pp. 226–27). Canker may occur upon the stem, below ground-level, or it may appear if any 'snags' are left when the blooms are removed. The disease has appeared previously in Great Britain and in the United States, but it is reassuring to find that the present outbreak is not of serious proportion. Control of the disease appears to be effected if old cankered plants are burned, and cuttings are taken only from uninfected material.

Elastic Properties of Selenium

Work carried out during the last two or three years has shown that the elastic properties characteristic of rubber are associated with the existence of the substance in the form of long chain molecules. These have been shown to occur in filiform sulphur and in polyphosphonitrilic chloride $(PNCl_2)_n$, which has been described as an inorganic rubber. K. H. Meyer and J. F. Sievers (*Naturwiss.*, 25, 171; 1937) have now shown that amorphous selenium, when heated to 70°, possesses elastic properties. If the threads are rapidly stretched and allowed to contract at ordinary temperatures, they become crystalline, but the substance becomes elastic once more on warming to 72°. Selenium possesses, in the crystalline state, the necessary chain-like arrangement of atoms.

Structure of Polished Metal Surfaces

According to the ideas first put forward by Beilby, polish on a metal surface consists of an amorphous layer of 'flowed' metal. Several attempts to investigate this layer have been made using electron diffraction, and while the experiments support the idea of an amorphous layer, there have been difficulties in their interpretation. In particular, the diffraction rings observed seem to have much the same size for all the metals examined. S. Dobinski (*Phil. Mag.*, March) points out that the process of polishing in air is likely to lead to the formation of an oxide layer. He has therefore ground and polished specimens of metal under benzene or pentane and transferred them, still wet with the liquid, to an electron diffraction camera which was at once evacuated. Diffuse haloes were observed in the diffraction pattern, showing that an amorphous layer was present, but the spacing of the atoms was in most cases appreciably different from that observed in specimens polished in air. The layer is apparently close-packed, with an atomic separation approximately the same as that in the crystal lattice of the metal in question, and differing considerably from metal to metal.

Photo-Decomposition of Acetone

In certain circumstances acetone vapour has been found to decompose on absorption of ultra-violet light with the production of equal volumes of ethane and carbon monoxide. Hence the primary reaction is formulated as: $(CH_3)_2CO + h\nu = 2CH_3 + CO$. It is now shown by R. Spence and W. Wild (*J. Chem. Soc.*, 352; 1937) that, in the circumstances in which they worked, the value of the C_2H_6/CO ratio at room temperatures is 3/2, both in presence of hydrogen and with pure acetone. Diacetyl was found to be produced in considerable amount and they bring forward evidence that the primary decomposition is into the methyl and acetyl radicals: $(CH_3)_2CO + h\nu = CH_3 + CH_3.CO$. The composition of the products was found to depend largely on the experimental conditions. The presence of free methyl radicals (which is required by both alternative equations) has been well established. It is suggested that light absorption in the banded region leads to the production of an excited molecule which may dissociate directly into ethane and carbon monoxide without the intervention of radicals. The effective life of the acetyl radical decreases rapidly with rise in temperature, and increase of acetone pressure or decrease of light intensity increases the proportion of methane in the products at 60°, owing to the occurrence of the reaction: $CH_3 + (CH_3)_2CO = CH_4 + .CH_2.CO.CH_3$.

Railway Traction Problems

This is the title of an article by Lord Monkswell which appears in *Discovery* of March and in which the author discusses some of the present-day problems of railway transport. The resistances due to gravity and acceleration are invariable and easily calculable. The author is more concerned with the resistances, referred to as irreversible, such as friction, or only partly reversible, as the compression of the rail-bed. In well-lubricated axle-boxes, friction is inconsiderable, but when bogies and axles require to adjust themselves to curves it is perceptibly increased. In the steam locomotive itself, owing to the number of parts having reciprocating motion under heavy pressures, friction has to be reduced by the most efficient means of lubrication and by the use o metallic packings with lateral self-adjustment. The greatest possibilities of improvement are associated with the reduction of air resistances, but there is as yet, little accurate knowledge on this subject The practical value of stream-lining at speeds less than 50 miles per hour is problematical, but where it has been adopted on trains of higher speed the results have been beneficial. The author, however expresses doubt as to the validity of the extent o the advantage claimed in some cases. On the subject o engine performance, some figures are given—notabl those relating to that of a reconstructed locomotive o the Chemin de Fer du Nord when hauling a train o twelve vehicles weighing 559 British tons. It was abl to maintain an average speed of 66 miles an hour for length of 14 kilometres on the Survilliers bank gradient 1 in 200 to 220, a performance representin about 32 h.p. developed per ton weight of locomotiv Although higher values have been obtained, it regarded as improbable that so high a figure h been maintained over the same length of time.

International Association for Testing Materials

LONDON CONGRESS

IN opening the Congress of the International Association for Testing Materials at the Institution of Civil Engineers on April 19 and in welcoming the visitors from abroad, Sir William Bragg suggested that the name did not quite fully convey the extent of the Association's work and interests, which include the investigation of the nature and properties of materials and make use of the whole range of available methods, from the most highly scientific to those which are entirely empirical. This is well illustrated in the range of papers which have been presented by prominent workers in this exploratory field and engaged in most, if not all, of the twenty-five countries which were represented at this meeting. The function of the Association is to secure international co-operation and an exchange of views, experience and knowledge in regard to materials and their testing. As has been pointed out by Dr. H. J. Gough, chairman of the British Committee responsible for the arrangements, the achievements of this age of great scientific and technical development owe much to the present-day knowledge and skilful use of the properties of materials. Direct application of these are of prime importance in transport, power generation and supply, construction, inter-communication and even in some forms of entertainment. Further, the study of existing materials leads to the production of new and improved materials, and it is this study which the Association promotes and, by means of such as the present Congress, the results and ideas are discussed. Once entirely empirical, the study of materials is now developing along lines of scientific method and, in due course, may become established as a true science.

In connexion with this meeting, an exhibition of testing plant and apparatus was arranged; manufacturers of the instruments and machines used in this class of work have collaborated with the organizers in showing their most up-to-date and reliable products. Although described as limited in size and scope, the range and comprehensiveness are remarkable, so that only a few of the most recent apparatus can be referred to in detail.

Refractory laboratory ware in alumina, now manufactured in England, is suitable for temperatures up to 1,950° C. for the fusion of metals, alloys and alkalis, and is highly resistant to the action of fuzed metals, oxides, salts and acids, while its high electrical resistance makes it eminently suitable as an insulator at high temperatures. The possibilities of the practical applications of the fluorescence test in food testing, police work, banking, philately—to take just a few random cases—are indicated by the useful types of lamps made by several firms. The Smith wear and lubricant tester is a new type of machine using a steel ball as the active member and its worn impression on the sample as the means of measurement. The cement-testing pistol makes a ball impression by a blow on the surface of the standing cement, and is claimed to give a measure of the compressive strength. For the rapid and accurate estimation of the specific gravity of gases, the new type of balance devised by Messrs. Hales and Moss, of the Fuel Research Station, is of particular interest. It operates by measuring the loss of buoyancy of an air bulb in an atmosphere of the gas in question. The Griffin Gale testing machine enables tensile, compression, indentation and bending tests to be carried out on small samples of metals and other solid materials. In the same class is the Hounsfield tensometer, while the Quinney autographic testing machine is of larger scale and gives load extension diagrams recorded by a pointer moving on smoked glass. Several firms engaged in research exhibited apparatus devised for their own work, among them Metropolitan-Vickers Electrical Co., Ltd., which has an apparatus for detecting conducting particles in textile sleeving, a magnetic crack detector and a dilatometer for determination of coefficient of expansion. In addition, the Department of Scientific and Industrial Research arranged a special section illustrative of apparatus and methods used in the laboratories co-operating in this congress.

As regards the papers presented at the Congress, most of them were available in advance; the accounts which follow were prepared from such advance proofs.

GROUP A (METALS)

The 77 papers in the Metals Group were sub-grouped under four headings: (1) Behaviour as dependent upon temperature; (2) progress of metallography; (3) light metals and their alloys; and (4) workability and wear.

In Sub-Group 1, the mechanism of the creep of metals and creep testing methods receive considerable discussion. H. J. Tapsell (National Physical Laboratory) directs attention to the phenomenon of creep recovery, a continuous contraction after unloading, which may continue in certain cases for thousands of hours after the release of stress. Two possible hypotheses are put forward, and it is considered that the study of creep recovery should assist in furthering the knowledge of the nature of creep. Dr. C. L. Clark and Dr. A. E. White (University of Michigan) summarize two theories concerning the mechanism of creep, on the basis of which the known influences of a number of factors on creep resistance can be readily explained. Dr. A. Nadai briefly surveys the results of work at the Westinghouse Laboratories, and emphasizes, among other things, that methods are needed in industry to shorten the time of creep tests from a duration of three months or more to times of the order of hours or days; these must be based on a better knowledge of the speed law connecting stress with strain rate.

Dr. U. R. Evans discusses corrosion as influenced by increased temperature, pointing out that at high temperatures the rate of combination between metallic atoms and oxygen atoms is very rapid, and the rate of wastage of metals exposed to hot oxidizing gases is usually only limited by the rate of penetration of oxygen inwards through the oxide-coat, or by the rate of diffusion of metal outwards to the oxygen. The testing of high endurance oxidation-resistant alloys is described by F. E. Bash, of the Driver-Harris Co., New Jersey. Improvements in these materials have greatly increased the difficulty and the time required in their testing; the present test temperature, 1,175° C., is 110° C. higher than that originally standardized, but wires last as long to-day at this temperature as was the case formerly with the lower temperature.

In the sub-group on the progress of metallography, the papers were again classified into sections on micrography, X-ray interference, electron diffraction and emissivity, equilibrium diagrams, non-metallic inclusions, solidification of ingots and recrystallization.

W. H. Dearden (University of Bristol), contributes a valuable survey of recent progress in the preparation of specimens for macro- and micro-examination, with a very full bibliography on etching reagents, and Dr. A. J. Bradley gives an account of the development of quantitative metallographic X-ray methods. Dr. H. J. Gough summarizes the results of his extensive study of the mechanism of deformation and fracture in metals, while Prof. G. I. Finch, in a paper on electron diffraction in the study of metal films and surfaces, emphasizes that the realization of the full advantages of electron diffraction and of the older methods must lie in their future co-operation. Dr. W. Burgers describes the method of electron-optical observation of metal surfaces. This method permits of the study of phases which are stable only at high temperatures, and of the direct observation of transition and recrystallization processes.

In a paper on "The Solidification of Ingots", Dr. C. H. Desch ably summarizes the somewhat conflicting views of various workers on the causes of inverse segregation.

The Sub-Group concerned with light metals and their alloys contains several papers of a more practical nature. Dr. A. G. C. Gwyer and Mr. H. G. Dyson report recent progress in aluminium casting alloys, and emphasize the increasing use of heat-treated alloys and of grain-refining additions such as titanium. Progress in this sphere in America is summarized by E. H. Dix and Zay Jeffries, while Dr. G. Siebel reviews improvements in magnesium alloys leading to increased resistance to corrosion. Dr. J. L. Haughton describes recent work at the National Physical Laboratory on the development of new magnesium alloys, particularly those containing aluminium and silver, and cerium, cobalt and manganese, which have improved physical properties.

GROUP B (INORGANIC MATERIALS)

Inorganic Materials (Group B) constitute a most interesting section, not only on account of the intrinsic importance of the cements, stones and ceramic materials which it includes, but also because the methods of testing are in a state of active development. Although these materials are in quite a different class, the methods of testing have been, in the past, greatly influenced by those devised and used for the ductile materials. The proceedings of the Conference may therefore be generally looked to for information as to the tests and procedure which are being found most practicable and reliable.

One of the difficulties met with in carrying out tests is the time required for the materials to mature or 'age', and a typical paper is that in which A. Brund (Härnösand, Sweden) submits the results of tests hastened by means of electric heating. Heat is generated in the paste by alternating current, and thereby accelerates the reaction between water and cement. The resistance is found to decrease during the first period of hardening, reaching its minimum as binding begins and increasing during the later period of hardening. It is claimed that the heat development and curing automatically regulate one another, thus ensuring uniformity of hardness throughout the specimen and a smaller amount of variation in the test results. Variations arising from the personal element introduced in mixing, mould filling and compacting are also a source of difficulty in standardizing tests, and the improvement in this respect effected by the use of a high-frequency vibrator, and the several steps and reasons which led to the use of this machine, are described by Dr. W. H. Glanville (Road Research Laboratory, Harmondsworth). In several papers, suggestions are put forward recommending variations which have been made in laboratory technique and found satisfactory.

Several reports of studies on the control and measurement of the heat of hydration of cements in large masses are presented. Dr. F. M. Lea (Building Research Station, Garston) discusses the merits of the present methods of measuring its value. The 'heat of solution' method is the calculation of the difference of the values for hydrated and unhydrated cement in a nitric-hydrofluoric acid solvent. The adiabatic calorimetric method, in which the samples are stored so that no heat is lost and the temperature therefore rises in proportion to the heat evolved by the hydrating cement, is considered to be more reliable. In "Methods of Testing Cements for Large Dams", B. Hellström, judging from comparative tests carried out at different laboratories in England, Sweden and Norway, regards this latter test as sufficiently accurate for adoption as a routine method. Dealing, on the other hand, with the control of this heat, P. H. Bates (U.S. National Bureau of Standards) directs attention to three different methods by which cements of low heats of hydration can be produced, the first and most usual being to effect a change in composition in one of several possible ways, the second being a process of preheating the clinker, and the third depending upon a system of partial pre-hydration in an atmosphere of steam at 212° F. No very definite data are, however, available as to the relative merits of these methods.

Numerous issues are raised in connexion with the action of different qualities of water on cement which is immersed, and several of the contributors deal with one or other of these. In describing some properties of *ciment fondu* and, in particular, its resistance to the action of soft waters, E. Rengade advances the view that the chemical resistance of a mortar is not necessarily directly related to the solubility of its individual constituents, but depends upon the manner in which these are arranged in the heterogeneous mass of which it is composed. Prof. G. Batta (University of Liège) submits some notes on several causes of disintegration, including solubility of constituents and attack by sea-water and by sulphated waters, this last case also being dealt with by G. Baire (Boulogne-sur-Mer Cement Laboratories) in a paper in which he gives the results of mechanical tests on specimens treated with solutions of the sulphates of magnesia and lime.

On the mechanical side, there are several papers devoted to testing, to the value of vibration as a means of compacting and improving the strength of the mixtures and to the grading and workability of aggregates. In his paper, Dr. Glanville sets out a concept of the term 'workability' as a physical property of concrete, and explains its measurement by analysis of the applied work, the useful work and the useful internal work done on a mix, and by the introduction of a compacting factor to define the degree of freedom from air voids at each stage. Considerable interest is attached to a group of papers dealing with the influence of the compressive strength of concrete in relation to the yield point of steel on the degree of safety of beams, particularly those presented by Prof. Rudolf Saliger (Vienna) and by F. G. Thomas (Building Research Station, Garston). In this section, too, a prominent feature is the analysis by Prof. M. Roš (Zurich) of the stresses and deformations produced in cement pipes by internal and external pressures and by bending moments such as may be imposed upon them.

GROUP C (ORGANIC MATERIALS)

In Sub-Group 1 (Textiles), an extensive review of chemical tests at present applied to textiles as well as to accessory materials such as oils, sizes and wetting-agents, is given by Dr. H. Phillips, while B. H. Wilsdon provides a similar summary of mechanical tests. Among individual tests, determination of resistance of fabrics to wear is critically examined by R. Severi, who proposes the use of the fabric itself as an abrasive, and by Dr. F. Maillard, who maintains the desirability of abrading the fabric on both sides. Methods for measuring the fastness to light, washing and perspiration of dyed textiles are described by W. D. Appel, whereas a method for determining the fading of dyes and pigments, claimed to give reproducible results independent of the observer, is put forward by R. Toussaint. The detection of damage, especially of a chemical nature, produced during finishing of artificial silk, is discussed in considerable detail by W. Weltzen. Means of assessing the resistance to anærobic bacterial attack of textiles used for building and insulating purposes are described by Dr. J. P. Pfeiffer and H. Eilers. An accurate calorimetric method for determining cotton present in asbestos yarn is proposed by Dr. R. de Benedetti.

Sub-Group 2 (Wood Cellulose) consists of nine papers by authors representing six separate countries.

Cellulose has not yet been isolated as an absolutely pure chemical individual, but it has been established that the celluloses from all known sources have certain well-defined constitutional and structural factors in common. Dr. De Witt Smith (U.S.A.) points out that a wide gap exists between our know-edge of the cellulose molecular chain and the fibril, which latter is large enough to consist of several million molecular chains side by side. This gap has been bridged to some extent by the discovery that fibrils can be broken down to smaller units which have been variously named 'dermatosomes', granules', 'crystals' and 'fusiform bodies'. These maller units appear to be held together in the fibril by a cementing material of a pectic nature.

So far as wood cellulose is concerned, W. G. Campbell (Great Britain) indicates that the chief onstitutional point at issue is the relationship etween that portion which consists of anhydrolucose residues and the remainder. The suggestion i advanced that, although immediately after forma- on all celluloses may be chemically identical, their espective constitutions may be modified by purely hysiological agencies which may vary from species o species in the plant kingdom or even from organ to organ in the same species. A second paper on wood cellulose by Dr. Forster (Great Britain) is to be published in the Congress book. Prof. H. Mark (Austria) discusses the present position regarding the influence of fine structure on the properties of artificial fibres. Although artificial fibres, the properties of which emulate those of the natural fibres, have been prepared, research is still required in order to establish all the conditions necessary for the attainment of consistently reproducible results. Dr. G. Hostomský (Czechoslovakia) describes the Hoeppler viscosimeter and discusses its application to the control of rayon pulp manufacture. Four papers by Prof. G. Jayme (Germany), D. Johansson (Sweden) and L. G. Cottrall (Great Britain) respectively, offer a comprehensive review of current practice in the testing of pulp and paper.

Sub-Group 3 (Timber Preservation) consists of ten papers dealing with the structure, mechanical properties and preservation of timber. A. Nowak (Austria) mentions recent successful moisture proofing of plywood, etc., by impregnation with wax dissolved in an organic solvent, the solvent being afterwards recovered. Owing to the use of creosote for other purposes, many countries are turning to oil emulsions and water-soluble salts for preserving timber against decay. Leise (Germany) further describes the use of water-soluble salts, and mentions the development of the bichromate mixtures which, by depositing insoluble compounds in the wood, are rendered highly resistant to leaching. The lack of a uniform practical definition for the fire resistance of wood is mentioned by E. Azzarello (Italy), who describes four tests which he has adopted for inflammability, flame propagation, flame penetration and rapidity of carbonization. A. Breazzano (Italy) describes a laboratory toxicity test for wood preservatives in which thin samples of wood soaked in the preservative solution are placed in large tubes, and a small piece of active inoculum attached to one face of the sample. The toxicity of the preservative is measured by the minimum concentration which will prevent the hyphæ passing through the thin slip of wood and showing on the opposite face. The author claims that this method gives maximum accuracy and much quicker results than the method adopted at the Berlin Conference in 1930.

The use of large wooden beams built up of pieces of relatively small dimensions is an increasingly important aspect of wood utilization. P. T. Landsem (U.S.A.) describes the properties of such beams and quotes the efficiencies of the various types of connexions. Using the modern type of ring shear connectors, it is possible to obtain an efficiency of 95 per cent, whilst beams built up of laminations placed horizontally and glued together are easily made stronger and stiffer than equivalent solid beams by proper selection of material.

Products discussed in Sub-Group 4 (Ageing of Organic Materials) comprise hydrocarbon oils, bitumens, rubber and some textiles. Methods of following the course of oxidation of mineral oils in general are discussed by Dr. G. Barr, while the detection of ageing in oils and bitumens used for special purposes, chiefly lubrication and insulation, is dealt with by Dr. F. Evers and by Dr. H. Stager. Rapid methods for testing the physical properties of asphalts and bitumens are described by Prof. R. Matthis, who also proposes the use of *p*H determinations for testing the ageing of materials soluble in or extractable by water. The causes, effects and methods of detection of ageing in vulcanized rubber are brought under review by B. D.

Porritt and Dr. J. R. Scott. Methods used in the United States for testing ageing of rubber, paper and silk are described by W. E. Emley. The testing of road tar is discussed by G. Batta and that of asphaltic bitumens by Dr. J. P. Pfeiffer and R. N. J. Saal.

A general tendency towards elimination of the personal factor in testing is discernible in Sub-Group 5 (Colours and Varnishes), as may be seen from the general review by Dr. L. A. Jordan of methods of assessing behaviour of paint films in practice, and the description by Dr. E. Rossmann of test methods used in Germany. An apparatus for measuring the fastness of colours to soap solutions, water and perspiration, also designed to eliminate the personal factor, is described by W. Kaczkowski, while Prof. A. R. Matthis puts forward a simple and rapid method of measuring fluidity of oils such as are used in the paint and varnish industry. The corrosive action of insulating varnishes on copper receives attention in a paper by Dr. G. Rossi. Theoretical considerations of the effect of oxidation, polymerization and addition of plasticizers on the molecular structure of oil films are made use of by Dr. A. V. Blom to explain the effect of such agents on the mechanical properties of the paint and varnish films afterwards produced. A plea for more rational terminology in the industry is brought forward by H. Rabaté.

GROUP D (SUBJECTS OF GENERAL IMPORTANCE)

The papers comprising Group D of the Congress are described as covering "Subjects of General Importance". They actually fall into three sub-groups: (1) the relation between the results of laboratory tests and behaviour in use and service; (2) the bearing of recent advances in physics and chemistry on the knowledge of materials; and (3) the properties of materials for the thermal and acoustical insulation of buildings.

The papers under (1) deal in a general way with problems which are more fully discussed in other sections, in relation to specific materials. The reviews of testing methods do not bring anything new before the Congress, but three papers, which from their titles may raise more important questions, have not been received in time for printing in advance. A paper by Sir Robert Hadfield and S. A. Main directs attention to the impossibility of imitating service conditions exactly in any laboratory test, and to the fact that most such tests are really designed to ensure that a given material conforms to a standard which has been found in practice to be satisfactory. It is pointed out that there is still no satisfactory means of determining resistance to abrasion, or the wearing quality of cutlery, whilst the behaviour of such parts as the pistons and piston rods of steam and pneumatic hammers under repeated shock is still imperfectly understood. Accelerated tests for resistance to corrosion are also very uncertain in their indications. M. Roš deals with the general question of factors of safety, giving values for a number of concrete instances.

Sub-Group 2 includes, besides several papers of a general character, an account of the methods to be adopted in testing for flaws in metals by means of gamma rays, by F. Guyot, and a short comparison between the methods of testing by X-rays and by radium, by Dr. V. E. Pullin. A. Pogány describes the study of the propagation of cracks in such masses as cement or concrete while under load in a testing machine by means of a microscope employing vertical polarized light. The gradual separation of the grains of sand from the matrix in a cement briquette can be clearly followed in this way. Sir Gilbert Morgan and his colleagues review the principal types of plastic materials of chemical origin, including synthetic resins and rubber-tar products, together with an account of the improvement of tar for road purposes by adding to it a calcium soap. The equations which have been proposed to describe the flow of dispersed systems are surveyed by M. Reiner.

The third sub-group is more homogeneous. The problems of insulating buildings against heat and sound are closely related, although the best materials for the one purpose are not necessarily the most suitable for the other. Several papers deal with the practical methods of studying the efficiency of different means of insulation against sound, particulars being given of the laboratories at Brussels, Berlin, Stockholm and Teddington, whilst P. Sabine, of the Acoustics Laboratory at Geneva, Ill., in describing the methods adopted by the American Standards Association, urges a careful standardization of test procedure among the various laboratories which are co-operating in this field. It is desirable that, by applying a correction factor to the results from any given laboratory, comparable figures should be obtained from which coefficients of wide practical applicability can be derived. Porous materials, such as slag or glass wool or various organic fibres, are used for both thermal and acoustical insulation, as is a construction consisting of sheets of solid material separated by air spaces. Dr. E. Griffiths refers to the use of lightweight concrete, made by mixing with the cement some substance which can cause the evolution of a gas and the production of a stable foam. With such an aggregate as pumice, foamed slag, or expanded slate, a very light concrete of open texture is obtained, with fair mechanical strength. The subject of protection against noise is one of public interest at present, and this series of papers provides much useful information concerning it.

Heredity versus Environment

IN a paper recently presented before the Eugenics Society, Dr. David Forsyth returns to that interminable argument 'Heredity *versus* Environment'. By him, heredity is taken to imply transmission from one generation to another, this transmission comprising structural and functional tendencies to develop organic life. By environment he understands the conditions around an organism. He has bee examining the commonly accepted view that heredit and environment play indispensable parts in development, and that each operates separately from th other, and now finds it quite impossible to entertai this view any longer.

If, Dr. Forsyth argues, heredity and environmen are indeed independent of each other, then it shoul be possible logically to trace the extent of the spher of influence of each, their influences should be detectable separately, and their origins should be differen If this should prove on examination to be impracticable, then it must become necessary to jetison th present-day concept of heredity and environment being two discreet forces, and to replace this b another more in harmony with the facts. If, as done nowadays, heredity, as a term, is applied onl to the germ cell and to what that cell comprises at the moment of fertilization, all factors outside this fertilized ovum which may affect it being regarded as environmental, then, as Dr. Forsyth proceeds to show, the use of these terms quickly leads into error.

The fertilized egg, with its chromosomes and genes, has long been residing within its environment: the maternal body. It grows and differentiates, and soon, within the embryo that evolves, the gonads appear. These have now a multiple environment: the embryonic soma, the maternal body and the outside world. It is taught that the embryo's body is hereditarily derived, whilst the mother's is environmental; but, according to this argument, there must have been a time when the mother's body itself was the product of inherited factors exclusively, so that what was heredity at one time is now environment! The terms are apparently interchangeable, and therefore lose their distinctiveness. Then again, the embryo, just as do the chromosomes and genes themselves, grows because nutriment of every kind passes into it from its outer world. Thus the embryo itself must necessarily be a compound of heredity and environment, the two so inextricably intermingled that it is beyond our powers to disentangle them. This division of heredity and environment is purely hypothetical and artificial, and, Dr. Forsyth maintains, lacks experimental confirmation.

Dr. Forsyth then proceeds to argue that an environment itself can be inherited. The character of an individual is deeply moulded during early childhood by its parents. The latter are environmental influences. The characters of these parents were, in turn, largely fashioned in their childhood by their own parents; and these by theirs. Dr. Forsyth asks if this is not an instance of the transmission of hereditary psychological qualities. If so, then the moulding of a child's nature by its parents is environmental only when its own generation is taken into account, and, from the wider view of successive generations, it is hereditary.

These extracts, taken from Dr. Forsyth's paper, may serve to show that what he has to say must necessarily be of interest to the philosopher. The biologist, and especially the geneticist, will be provoked to wonder how Dr. Forsyth's difficulties arose. It is clear that they have their origins in the definitions he employs and in his lack of contact with experimentation. Did he but seek his solutions in the laboratory rather than in the library, he would quickly persuade himself that it is eminently possible to disentangle genetic and environmental forces and to study them separately. To all intents and purposes it is possible to stabilize and standardize the environment and, in this, examine the effects on development of different genes and, by using genetically identical individuals, to study the effects of different environmental factors. It is impossible to deny the facts revealed and abundantly confirmed by genetic experimentation, or to disregard the firm conclusions which have been built so carefully upon them. There is no real conflict between the hereditarian and the environmentalist: each is right and both are wrong, for the simple reason that without an environment there could be no expression of genetic potentialities, and, in the absence of the power to become, no environment can evoke anything. Nevertheless, though the two are at all stages of the individual's development so interwoven, it is possible, by appropriate experimentation, to separate them and to study each alone.

Science News a Century Ago

The Royal Institution

ACCORDING to the *Gentleman's Magazine*, the anniversary meeting of the Royal Institution was held on May 1, 1837, the Duke of Somerset, president, being in the chair. "The report of the visitors announced that, after a long season of difficulty, the Institution was now placed in that independent station, which as the most active and popular establishment in the Empire, adorned with the celebrity imparted to it by more than one great philosopher, it ought always to have occupied. The whole of the debt had, during the past year, been cancelled, and a balance now existed in favour of the Institution. The premises were in a state of substantial repair, and the visitors expressed a hope for the speedy accomplishment of the proposal of giving to the exterior of the building an appearance more in accordance with the importance of the scientific body to which it belongs. The thanks of the meeting were voted to Mr. Faraday, for his devotion and services to the interests of the Institution, and the usual ballot for officers took place."

Power of Galvanism

THE issue of the *Dublin Journal of Medical Science* of May 1, 1837, contains the following note. "A paragraph is going the rounds, said to have been extracted from a late foreign Journal, but which, however, we cannot find in any of our exchange favours, which describes the restoration of speech, taste and hearing in a Polish officer who had been deprived of them ever since the battle of Ostrolenka in consequence of an unsuspected discharge of cannon. The concussion was so tremendous as to throw him down; and although there was not the slightest external wound, when he recovered himself he found that two of his senses, viz., taste and hearing, as well as the power to articulate words, were completely gone. All the eminent physicians of Vienna had made trial of their skill to restore the loss, but ineffectually. Being finally conveyed to Paris, the advice of M. Magendie was sought. He applied the galvanic fluid to the tympanum, and by that means speedily overcame the deafness."

Lyell and his "Principles"

WRITING to his sister on May 3, 1837, about his book "Principles of Geology", which had appeared during 1830–33 in three volumes, Lyell said: "I have at last struck out a plan for the future splitting of the 'Principles' into a 'Principles' and 'Elements', as two separate works, which pleases me very much, so now I shall get on rapidly. The latest news is, that two fossil monkeys have at last been found, one in India contemporary with extinct quadrupeds, but not very ancient—Pliocene perhaps—another in the South of France, Miocene and contemporary with Paleotherium. So that, according to Lamarck's view, there may have been a great many thousand centuries for their tails to wear off, and the transformation to men to take place."

William Henry Barlow on Lighthouse Illumination

ON May 4, 1837, Peter Barlow (1776–1862) communicated to the Royal Society a paper he had received from his son William Henry Barlow (1812–1902) entitled "On the Adaptation of Different Modes of Illuminating Light-houses, as Depending on their Situation and the Object contemplated in their Erection". The paper was contained in a letter sent from Constantinople on March 14, 1837. The younger Barlow had been trained as an engineer at Woolwich Dockyard, and in 1832 had been sent to Turkey by Mandslay, Sons and Field, to erect cannon-boring machinery, and had then been employed by the Turkish Government on the erection of lighthouses at the Bosphorus entrance to the Black Sea. The object of his paper was to investigate the principles on which the illuminating power, resulting from the employment of reflectors and of lenses, depends. He had arrived at the inference that the advantage gained by the employment of lenses does not arise from their superior perfection as optical instruments, but from their using the light more economically, in consequence of their producing less divergence of the rays both horizontally and vertically, and illuminating a much smaller space on the horizon.

Peter Barlow was for forty-one years professor of mathematics at the Royal Military Academy, Woolwich; his son became famous as a railway and bridge engineer, and was one of the committee appointed to consider designs for the Forth Bridge.

The Worary Poison

At a meeting of the Medico-Botanical Society on April 26, reported in *The Lancet* of May 6, 1837, Dr. Hancock showed specimens of the worary plant gathered from the mountain Courantine on the Rio Parime, with a bundle of arrows poisoned thereby. Dr. Hancock said that worary was undoubtedly a species of *Strychnos*, although its flowers had never been seen by any botanist. The poison was put up in small gourds or fruit capsules of the worary plant, and the arrows were propelled by blowing them through a reed formed of a slender spike of palm. Divers false reports had been published with regard to the manner in which the poison was prepared and its toxicological effects on the animal economy. Many native charlatans living near the settlement made Europeans believe that it was formed of a great variety of substances, such as pepper, serpent's teeth and other such ingredients. The genuine poison, however, was undoubtedly prepared as an extract formed solely from the bark of the plant. Its mode of action was curious, for though when introduced into the blood it soon became fatal, when taken into the stomach, it produced no sensible effect, in which respect it differed from every other species of the *Strychnos* family.

United Service Museum, Whitehall

The *Gentleman's Magazine* of May, 1837, gives the following account of the activities of this museum at that date: "Dr. Ritchie has begun a series of lectures on experimental Philosophy—the properties of matter—statics, mechanics, strength of materials, laws of motion, hydrostatics, etc., and Dr. Lardner is delivering others on the particular subject of steam communication with India.—Captain Norton, late of 31st regt., is also about to discourse on rifles, shells and sundry modern projectiles, with some remarks on the Boomerang, or New Holland spear, and on the ancient Balista. . . . . Already has the Museum acquired respectable funds from which it is proposed by the Council to found a permanent Professorship for the instruction of the members in mathematical and experimental science."

University Events

Belfast.—Dr. J. H. Biggart, at present lecturer in neuropathology in the University of Edinburgh, has been appointed to the Musgrave chair of pathology as from October 1 next.

Birmingham.—Prof. L. G. Parsons has accepted an invitation to deliver the opening address at the annual meeting at Niagara Falls, Ontario, of the Canadian Society for the Study of Diseases of Children, and Prof. H. Beckwith Whitehouse, of the Department of Gynæcology, is to represent the British Medical Association at a conference at Ottawa in June next.

Cambridge.—It is recommended that the degree of M.A., *honoris causa*, be conferred upon Colonel F. J. Hayter, honorary keeper of the Australian and Fiji Collections at the Museum of Archæology and of Ethnology since 1928.

The Linacre Lecture will be delivered by Prof. A. V. Hill, Foulerton professor of the Royal Society, on May 10, at 5 p.m., in the lecture room of physiology. The title of the lecture will be, "The Heat-Production of Muscle and Nerve: A Critical Survey".

Oxford.—Prof. T. G. B. Osborn, of the University of Sydney, has been appointed Sherardian professor of botany, as from October 1 next (see p. 746).

Dr. J. L. Stocks, vice-chancellor of the University of Liverpool, has been elected an honorary fellow of St. John's College.

Societies and Academies

Dublin

Royal Irish Academy, March 16.

J. J. Dowling and T. G. Bullen: Precision measurements with a radial deflection oscillograph. The cathode beam is caused to revolve in the annular space between an extra pair of concentric conical electrodes in a modified cathode ray oscillograph. Two applications are specially considered. Using a double frequency synchronized circular time-base, the radial deflection results in a limaçon-like curve. This was employed to measure instantaneously small variations in the radio-frequency of the Droitwich carrier-wave during the U.R.S.I. emission of March 1935. The use of high-speed spiral time bases in 'comparator' measurements of long time intervals (Nature, 137, 279; 1936) is also dealt with in detail. Preliminary results indicate that the difference in the periodic times of two two-second pendulums can be determined to one tenth microsecond in an experiment lasting less than half a minute. The method is being applied to the measurement of the gravitational attraction constant *G*.

Paris

Academy of Sciences (*C.R.*, 204, 925–1016; March 22).

Henri Lebesgue: A construction of the regular polygon of 17 sides due to André Marie Ampère, from some documents preserved in the archives of the Academy of Sciences.

Charles Achard, Augustin Boutaric and Mlle Suzanne Thévenet: Viscosimetric researches on solutions of the various proteins of the serum.

Jules Haag: The theory of oscillations of relaxation.

Dimitri Riabouchinsky: Some remarks on the vortex theory of the helix.

Jacques de Lapparent: The kaolinites capable of being rendered active.

Henri Lagatu and Louis Maume: The agricultural interest of the separate measurement of the nutritive effect and the improving effect of an addition of manure.

Claude Chabauty: Series of powers with p-adic coefficients.

Paul Lévy: The arithmetic of the laws of probability and the finite products of Poisson's laws.

Mlle. Britt Ranulac: The derivability of certain functions represented by an integral.

Karl Menger: A new demonstration of the Euler-Lagrange equation.

Chi-Tai Chuang: A theorem relating to the directions of Borel of meromorph functions of finite order.

Albert Toussaint and Svetopolk Pivko: An approximate method of calculation of infinite multiplane cells in plane stream.

Paul Dumanois and Georges Desbrosse: The classification of heavy combustibles. The relation between the ketene number and the delay in ignition.

Henri Grouiller: The light variations of Nova Lacertæ, 1936. A curve is given based on 810 observations made by twenty-five observers,. This nova can be classified definitely in the group II*a* (flash novæ properly so-called).

Mlle. Paulette Février: The general form of the definition of a logical system.

Francis Perrin and René Lucas: The mechanical actions of elastic thermal waves of liquids.

Jean Roig: Electrical and optical measurements on the illumination of helium in the high-frequency discharge.

Raymond Zouckermann: Curves of explosive potential in the case of ionization by collision of the second kind.

Henri Triché: A method of studying the corrosion of alloys. By means of the high-frequency spark, extremely thin layers of metal can be analysed: advantage is taken of this to study the composition of the surface layers of an alloy after corrosion by a reagent.

Mlle. Marguerite Quintin: The hydrolysis of copper benzenesulphonate.

Stefan Procopiu and George Vasiliu: The torsion of an iron or nickel wire facilitates discontinuities of magnetization with an axial alternating current.

Serge Nikitine: Theoretical considerations on photodichroism (Weigert effect).

Salomon Rosenblum and Marcel Guillot: Certain regularities in the nuclear levels of radioactive atoms.

Mlle. Jeanne Foret: The synthesis under pressure of the hydrated calcium silicates.

Léon Malaprade: The existence of crystallized cupriperiodates.

R. Michaud and E. Segol: The recrystallization of aluminium-magnesium alloys.

Mme. Yvonne Khouvine: The reduction of α-*d*-glucoheptulose by Raney nickel.

Raymond Calas: The preparation of camphorone and of two stereoisomeric dihydrocamphorols.

Max Mousseron and Robert Granger: Some cases of reduction caused by organomagnesium compounds.

Charles Prévost and Joseph Wiemann: The halogen-argento-benzoic complex compounds. Bromine and chlorine react with silver benzoate like iodine, and the complex compounds formed possess properties very similar to those of the iodine compounds already studied.

Louis Royer: New observations on the thermoluminescence of certain crystallophyllian rocks.

René Bernard: The electronic origin of the nitrogen bands in the spectrum of the aurora borealis. Determination of the energy of the exciting electrons.

J. Cluzet and P. Ponthus: The variations of the electrical conductivity of the air as a function of the barometric pressure, in the pneumatic caisson.

Mme. Cécile Sosa-Bourdouil: The comparative elementary composition of some floral organs.

René Moricard and Pierre de Fonbrune: A new technique for the study *in vitro* of the maturation mitoses of the ovum in mammals. The case of parthenogenetic segmentation.

Raoul Lecoq: Do the fatty acids of high melting point (above 50° C.) upset the food equilibrium in the same way as the fatty acids liquid at the temperature of the organism?

René Herpin: The role of sea-acorns and of serpulæ in the fouling of ships' hulls.

Mme. Paulette Chaix: The oxidation and fermentation of glucose by *Propionibacterium pentosaceum*.

Claude Fromageot and Georges Bost: The reducing power of living yeasts in the course of alcoholic fermentation.

Henri Colin and Henri Belval: Cane sugar gum.

Michel Weinberg and Mlle. Maylis Guillaumie: The titration of antitoxic sera.

D. Broun: The modifications brought about in the action of insulin by the addition of a colloidal suspension (gelatin).

Moscow

Academy of Sciences (*C.R.*, 14, No. 1, 1937).

M. Krein: Some problems of the geometry of convexities situated in a complete linear space.

D. Raikov: Decomposition of Poisson laws.

V. I. Smirnov: Solution of a problem of limits for the equation of curves in the case of the circle and the sphere.

W. A. Ishnailski and B. M. Bogoslowski: Colour of the nitrobenzol derivatives of aromatic amines (4). Auxo-enoid system separated from chromophore.

F. M. Šemiakin: A new kind of multiple emulsion and on spontaneous formation of emulsion systems.

A. A. Jacenko-Chmelevskij: Transformation of the plastic matter in wood after the cutting of a tree.

S. A. Borovik and A. F. Susedko: Presence of gallium in the samples collected by expeditions of the Lomonsoff Institute of the Academy of Sciences of the U.S.S.R. Greater quantities of gallium are found in minerals of endogenous origin than in those of exogenous origin, and muscovite contains up to 0·1 per cent of gallium.

A. M. Arenstein: Evaporation from water reservoirs overgrown with aquatic plants.

V. Kirpičnikov: Principal genes of scales in carp.

N. N. Medvedev: Body-colour mutants in *Drosophila* as studied by transplantation.

V. P. Popov: The role of combined water in the frost resistance of winter wheat.

D. Tretiakov: Spectacles in the anchovy (*Engraulis encrassicolus*).

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, May 1

Royal Institution, at 5.—Annual Meeting.

Monday, May 3

University College, London, at 5.—Prof. H. Rein: "Some Economising Mechanisms as a Condition of the Body's Adaptation to Increased Activity" (succeeding lectures on May 4 and 6).*

Imperial College of Science and Technology (Huxley Building) at 5.30.—Prof. H. H. Plaskett: "Problems in Astrophysics" (succeeding lectures on May 10 and 13).*

Royal Geographical Society, at 8.30.—Miss Isobel Hutchison: "Plant-hunting in the Aleutian and Pribilof Islands".

Tuesday, May 4

Royal Institution, at 2.30.—Prof. K. S. Krishnan: "Some Aspects of Crystal Physics" (succeeding lectures on May 5 and 6).*

Imperial College of Science and Technology, at 5.30.—Sir Thomas Holland, F.R.S.: "The Permanence of Oceanic Depressions and Continental Elevations" (Huxley Memorial Lecture).

Wednesday, May 5

Institute of Metals, at 8—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—Prof. E. N. da C. Andrade, F.R.S.: "The Flow of Metals".

Royal Society of Arts, at 8.15.—Prof. A. W. Nash: "The Fuel Supplies of Great Britain".

Thursday, May 6

Institution of Electrical Engineers, at 6.—Annual General Meeting.

R. S. Whipple: "Electricity in the Hospital (Faraday Lecture).

Friday, May 7

Institution of Electrical Engineers (Meter and Instrument Section), at 7.—Sir Frank Smith, F.R.S.: "Fundamental Electrical Measurements".

Geologists' Association, at 7.30—(at University College, London, W.C.1).—N. E. Odell: "Nanda Devi, Central Himalaya".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned

Two Women Assistants at the Low Temperature Research Station, Downing Street, Cambridge, to prepare index of literature of food investigation—The Superintendent (May 3).

Assistant (grade II, ref 429 *O*), Two Assistants (grade II, ref. 426 *O*), Assistant (grade II, ref 428 *O*), Assistant (ref. 431 *O*), and Assistants (grade III, refs. 432 *O* and 433 *O*) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (May 7).

Lecturer in Mechanical Engineering in the County Technical College, Worksop—The Principal (May 8).

Inspectors of Agricultural and Horticultural Education and Research for the Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1—The Secretary (May 10)

Head of the Lancaster Storey Institute Technical College and Junior Technical School—The Director of Education, Education Department, High Street House, Lancaster (May 10).

Superintendent of Commercial Horticulture for the Middlesex County Council—The Clerk of the County Council, Guildhall, Westminster, S W.1 (May 11).

University Professor of Bacteriology in University College Hospital Medical School—The Academic Registrar, University of London, W C 1 (May 14)

Lecturer in Civil Engineering in the University of Bristol—The Registrar (May 17).

A Physicist and a Biologist at the Bermuda Biological Station—The Secretary, Bermuda Oceanographical Committee, The Royal Society, Burlington House, W.1 (May 20).

University Professor of Physical Chemistry in Birkbeck College—The Academic Registrar, University of London, W.C.1 (May 21).

Woman Lecturer in Geography and Physics in the Huguenot University College, Wellington—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (May 25)

Meteorologist for the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S W.1 (May 31).

Chemists in the War Department—The Under-Secretary of State (C.5), War Office, S W.1 (quote Appts. 30)

Assistant in Engineering in the County Technical College, Dartford—F. L. Notley, 11 Essex Road, Dartford

Two Assistant Lecturers in Mathematics in the Royal Holloway College, Englefield Green, Surrey—The Principal

Lecturer in Engineering in University College, Rangoon—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, W.C 1.

Headmaster of the Worsley Junior Technical School and Technical Institute—The Secretary, Worsley Higher Education Committee, Town Hall, Walkden, near Manchester.

Official Publications Received

Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 51: Research on Thin Layers of Tin and other Metals. 3. The Interaction between Metals and Lubricating Oils. By P. J. Haringhauzen and D. A. Was. Pp. 10. (London: International Tin Research and Development Council.) Free. [94

Report of the Rugby School Natural History Society for the Year 1936. Pp. 58. (Rugby: George Over, Ltd.) [94

Other Countries

Stammering: its Cause and Cure. The Handbook of the Stammerers' Club of New South Wales. Pp. 72. (Sydney: Stammerers' Club of New South Wales.) [124

U.S Department of Agriculture. Circular No. 411: A Study of Arsenical Dusting of Cabbage in relation to Poison Residues. By Chas. E. Smith, W J. Reid, Jr, P K Harrison and C. O. Bare Pp 8. (Washington, D C. Government Printing Office.) 5 cents. [124

Bulletin of the American Museum of Natural History. Vol. 72, Art. 7. Siwalik Antelopes and Oxen in the American Museum of Natural History By Guy E. Pilgrim Pp. 729–874. (New York: American Museum of Natural History.) [124

Publications of the Observatory of the University of Michigan. Vol. 7, No. 1. The Tower Telescope of the McNath–Hulbert Observatory By Robert R. McNath Pp 56+19 plates. (Lake Angelus, Mich.: McNath–Hulbert Observatory) [124

Universidad Nacional de Cordoba Facultad de Ciencias Medicas. Registro e Interpretacion de la Actividad Cardiovascular del Lactante Normal. Por Dr. Angel S Segura. Pp. 118. (Cordoba: Universidad Nacional) [124

Ministero dell'Interno. Istituto di Sanità Pubblica I medicinali e il metodo Rinaldi per la cura delle artriti. Per D Marotta, G. Lazzarini, A. Calò. Pp. 38 (Roma: Istituto di Sanità Pubblica.) [134

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 13. An Annotated Catalogue of Sugarcane Varieties in Mauritius, Present and Past. Compiled by A. Glendon Hill. Pp. 37. (Port Louis: Government Printer.) [134

Union of South Africa. Department of Mines: Geological Survey. Memoir No. 30: A Bibliography of South African Geology for the Years 1931 to 1935 (inclusive). Authors' Index by Dr. A. L. Hall. Pp. 168. (Pretoria Government Printer.) 5*s*. [134

U.S. Department of Agriculture. Circular No 419: The Fir Engraver Beetle, a Serious Enemy of White Fir and Red Fir. By G. R. Struble Pp. 16. 5 cents Technical Bulletin No. 552. Trace Elements in the Soils from the Erosion Experiment Stations, with Supplementary Data on other Soils. By C. S. Slater, R. S. Holmes and H. G. Byers. Pp. 24. 5 cents. (Washington, D.C.: Government Printing Office) [134

U S. Department of the Interior: Office of Education Bulletin, 1937, No. 3. Public Affairs Pamphlets, an Index to Inexpensive Pamphlets on Social, Economic, Political and International Affairs. Compilation revised February. Pp. 85. (Washington, D C. Government Printing Office.) 10 cents. [134

Washington University Studies (New Series). Language and Literature, No. 6: Ancients and Moderns; a Study of the Background of the "Battle of the Books". By Prof. Richard Foster Jones. Pp xi+358. (St. Louis, Mo.: Washington University.) 3 dollars. [134

Ontario Research Foundation. Report for the Year 1936. Pp. 31 (Toronto: King's Printer.) [134

Imperial College of Tropical Agriculture. The Principal's Report for the Year 1935–36 and the Accounts for the Year ended August 31, 1936. Pp. 36. (Trinidad and London: Imperial College of Tropica Agriculture) [134

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The Ceremonial of Coronation

IN the ceremonial and pageantry of coronation, such as that now at hand, there draws to a close a period of transition in which the royal power passes from dead to living. The solemn investiture of the new monarch with the symbols of kingly dignity and the acclamation and rejoicings of his people mark the final stage in a ritual of change, which, from the earliest days of primitive kingship, has been held of gravest moment for the community. Although we may no longer believe with our primitive forefathers, as still do some of the less-advanced peoples of to-day, that the vigour and fertility of crops and herds, and even the prosperity of the nation, may depend directly upon the virility of the ruler, this much of the mystical lingers in our mode of thought, that only with the ceremonial of coronation do we feel that we have passed in full sense from waters, which might prove turbulent, to the haven of a new reign.

To the coronation of His Majesty King George VI, must be attached an added significance over that of his predecessors. The change in the interrelation of the constituent parts of the Empire under the provisions of the Statute of Westminster has thrown into high relief the personal responsibility which now rests upon the King-Emperor as the sole constitutional link of Empire. For the first time the Coronation Oath, in its amended form, assumes a position of outstanding import in the ceremonial observances. It has become something more than the solemn undertaking to make just use of the royal prerogative than it has been in the past. In the imperial sense, it is now the head and front of the rite.

This process of evolutionary development, which we see taking place before our eyes, is in full accord with the history of the ceremonial of coronation in Great Britain. Like the British constitution, of which it is an appanage, its ability to endure rests on its capacity to change without break in continuity. So far from being a collection of survivals, the coronation ceremonial, even though close parallels may be cited from ancient pagan custom and the practices of 'savages', in each of its rites expresses some one aspect or another of the emotional force which inspires workaday citizenship. Each change in form, and more especially each variation in emphasis as between the elements in the ceremonial, to be marked in the course of its history, has expressed the general sense of the community at that period in its reactions of loyalty towards the monarch, successively as head of the English State, as ruler of the United Kingdom, and as King-Emperor of the Empire.

The British ceremonial of coronation, like the monarchy, is the oldest in the European States which still adhere to the monarchical form of government. It is also the most elaborate. Its history begins in the eighth century with an Anglo-Saxon rite, in which the ceremony of sacring the king was introduced in the middle of a Mass. Oil was poured from a horn on the king's head, the anthem "Zadok the Priest" was sung, the bishops and nobles placed a sceptre in the king's hand, the staff was delivered to him, and finally a helmet was placed upon his head. The assembly then cried "May King . . . live for ever". The enthronement followed, and the nobles swore fealty. The Mass then concluded with special prayers.

In part, and especially in so far as it was an enthronement with acclamation, this ceremony was of much earlier origin. The Germanic tribes, after the election of their ruling chief, used to enthrone or elevate him on their shields. He was then carried on the shields around the assembled people on the shoulders of certain of the nobles. This custom was adopted by the Franks, and was the method by which Clovis and his immediate successors were elevated to the throne. It continued in use for some time after the introduction of Christianity with the addition of a religious service. It survived in part in the procession from the Tower to Westminster and the elevation to the marble throne in the English ceremony, and in France in the showing of the king to the people.

The tribal ceremonial, in which the elected chief was elevated on the shields of his subjects, in accordance with the needs of the times, symbolized his function as leader of his people, more especially in war. With the coming of Christianity and the participation of the Church in affairs of State, another aspect of kingship, no less primitive, was brought into prominence in the inaugural ceremony. This was the spiritual and magico-religious element, which in early and primitive forms of the kingship identifies the ruler with divinity or accredits him with magical powers to be used for the benefit of his people. In the coronation ceremonial of Western Europe, its immediate source must be sought in the Bible, and as time went on in the Eastern conceptions of monarchy which came with Byzantine influence, rather than directly in survivals of pagan ideas. For although pagan chiefs and rulers claimed descent from heathen deities and demi-gods, such as Odin or Wotan, neither English monarchs nor His Most Christian Majesty of France appear to have laid claim to divinity, but rather to rule through divine influence—by the grace of God. At the same time, a detailed comparison with non-Christian rites indicates so many similarities in form and idea as to suggest at least a strong colouring of a mode of thought, which belongs to a more primitive phase of religious belief. As is well known, the early Church was not averse from adapting the concepts and ideas of paganism to further the advancement of Christianity.

It is a reasonable assumption that the magico-religious conceptions, which Sir James Frazer has shown to play a predominant part in the evolution of early forms of kingship, should be much in evidence at the inauguration of a new ruler. The problem before the primitive mind must always have been how best to ensure that the qualities and powers, which secured in the ruler who has now passed away the prosperity of his people, should be continued in the person of his successor. When the succession was determined by mortal combat, in which the victor either remained, or became, the ruler, as in the priesthood of Nemi, the result determined the issue. Where the cult of the ancestors prevailed, especially when the spirit of an ancestor was believed to reappear on earth in his descendants, as among certain of the Bantu-speaking peoples, the principle of inheritance was adequate to their need. Failing the direct assurance of such determinants, however, it was deemed necessary, as we can see from the character of the inaugural rites themselves, to ensure the continuance of the qualities and powers of the old ruler in the new by a ceremonial which in its origin and essence was magical, or at best magico-religious, however it may have come to be regarded later, when incorporated in a more advanced system of religious belief.

In royal and chiefly inaugural ceremonies which are of a traditional character and not modern innovations, there are certain recurring features, some appearing sporadically, others again and again with regularity. Mr. A. M. Hocart in his acute and ably argued study of the kingship (Oxford, 1927), analysing this ceremonial, notes some twenty-six characteristic features. His analysis is too long to quote here ; but the most important point he makes is that the ceremonial is one in which the ruler dies, and is born again as a god. Among other characters may be mentioned a ritual combat in which the ruler must prove victorious, baptism with water and anointing with oil, investiture with special garments and regalia, the enthronement, the acclamation of the people, the sacrifice of a victim—often human—and usually the bestowing of a new name on the king.

Lest it seem that the interpretation of the coronation ceremonial as a re-birth is somewhat remote from the form of rite with which most are familiar, it may not be out of place to refer briefly to one or two examples which support this contention. Only the more significant points are mentioned.

In the ceremony of inauguration of a ruling chief in Fiji, which Mr. Hocart quotes as his 'type specimen', a specially prepared sheet of barkcloth is wrapped round the chief's arm, and a bowl of kava is presented to him, after a period of fasting and abstinence. When he drank this, he was not permitted to take the bowl with the arm which had been swathed in the bark-cloth sash. For four nights kava was made; and at the end of that period the chief bathed, while a raid on a village secured a human victim who was killed, baked and eaten at a feast. At one point in the proceedings a man offered to fight as a champion for the chief. Muskets were fired so that the whole land might know that the ceremony was completed.

The points of interest in connexion with this ceremonial are that in part it is similar to the ritual which is observed on the death of a chief, while the ceremonial drinking of kava, and the bark-cloth scarf, apparently are intended to suggest that the god is brought to the chief in the bark-cloth and enters his body after he has died in the form of the kava. He is then born again and bathes to cleanse himself from the impurities of the womb.

The theory that the inauguration of a chief or king is a new birth is more clearly brought out in the ancient Indian ritual, in which the priest in investing the king with three garments speaks of two of them as cauls out of which he is born, while the mantle which is thrown over him last of all, is called "the womb of sovereignty". In this ceremony there is a magical victory in a mock fight, while the climax of the rite is a lustration of the enthroned king with a double stream of water. This purification by water is followed by an anointing with clarified butter.

Although little is known of the actual coronation rites of Ancient Egypt, the Sed festival, which took place at a late date in a reign, renewed the vigour of the monarch by a rebirth and rejuvenation in which the rites were in all probability a repetition of the rites of coronation.

The idea of continuity through rebirth is most clearly expressed, perhaps, in the ceremonies which accompany the accession of the Adah of Idah, northern Nigeria—a vigil of eight days at the royal necropolis; a period spent at the "birthplace", where the future ruler is joined by the chief wife of his predecessor; and the action of two officials who sport as man and wife, the latter then mimicking childbirth and delivering the Adah to the chief eunuch as 'her' son. The Adah is then divested of his birth garments and adorned with the royal robes.

While it is undoubtedly true that neither in France nor in England, as already mentioned, was it claimed that the king was divine, yet there are many similarities in detail with the ceremonies mentioned which are suggestive of at least a cognate mode of thought, and it may be even a more intimate connexion: the vigil—no longer observed—the anointing, the robing and investiture, the acclamation of the people, the perambulation, and the challenge of the king's champion, which takes the place of the ritual combat, though the office and not the rite alone remains.

Most significant, perhaps, in the older ritual is the ceremony of the anointing, which until the Reformation was the most important element in the ceremonial. By it, the person of the king was made sacred. Indeed it was held by some that the king henceforth was both priest and layman; and although this doctrine does not seem to have prevailed in England, in France the king appears to have held priestly office and on occasion is said to have officiated in priestly vestments. It is evident that in both the English and the French ceremonial the Divine Spirit and the kingly office were brought into peculiarly intimate relation. These two closely related forms of the rite, with the Empire, made use of the chrism, the most sacred of the blessed oils, in France mixed with a drop of oil from *La Saincte Ampoule*, in which the Holy Dove had once placed holy oil for the coronation of Clovis, in England from the time of Edward II, when the coronation ritual reached its most elaborate development, for anointing the parts of the king's body, while for his head was used oil from the flask which, as the Pope wrote to Edward, the Virgin Mary had delivered to Thomas à Becket for that use at some later day. From this anointing the two monarchs derived their power of healing by 'touching' for the King's Evil.

With the Reformation and the personal rule of the Tudors, the idea of the sanctification of the king's person gave place to other concepts of monarchy. The importance of the unction waned to give place to the ceremonial of placing on the monarch's head the crown, the symbol of territorial dominion, as had been shown by the triple crown of Charlemagne, silver for Germany, gold for Rome, and the sacred crown of iron, made from a nail of the Cross, for Lombardy. The crown, it is true, is not without a 'magic' of its own—otherwise why should our kings still be crowned with the crown of St. Edward, though that venerable relic was broken up under the Commonwealth—but its real significance lies not in its interpretation as a survival, but in its living meaning as an emblem of a constitutional and personal relation between king and people.

Audubon the Magnificent

(1) Audubon

By Constance Rourke. Pp. vii+342+12 plates. (London, Bombay and Sydney: George G. Harrap and Co. Ltd., 1936.) 12*s*. 6*d*. net.

(2) Singing in the Wilderness:

a Salute to John James Audubon. By Donald Culross Peattie. (Country Books, 2.) Pp. xvi+245+8 plates. (London: George Allen and Unwin, Ltd., 1936.) 7*s*. 6*d*. net.

(1) THIS is the biography of a genius in ornithological art, in the early days of American science and culture. But more than this, it is the story of a personality so gallant and vivid, so unworldly and unbusinesslike, so unconquerably gay in adversity and prosperity alike, as to make extraordinary the present-day ignorance of him and his work. He was the pioneer of a new ornithology, describing birds as living and sentient beings rather than as specimens—more naturalist than man of science, and perhaps more artist than either.

Mystery surrounds his birth. He was adopted at the age of nine years by Captain and Mrs. Audubon. Captain Audubon, son of a poor fisherman, owned a merchant ship which traded in San Domingo, where he bought a sugar plantation and prospered greatly. During his stay on the island, a boy was born to a Mdlle. Rabin, for whom Captain Audubon evidently felt some responsibility. He therefore took a boy with him when he left San Domingo for his home in Nantes and he and his lawful wife formally adopted a boy four years later, of an age to correspond with the birth of Mdlle. Rabin's son. The Audubons later used the name of Jean Rabin to indicate this boy. In the face of these facts, it must be due to the general glamour of the man, that Miss Rourke indulges in special pleading for identifying the future naturalist with the little son of Louis XVI, the lost Dauphin.

The boy had very strong tastes from the first, seeking the woods and streams at all times, for ever trying to observe, draw, and stuff birds. He was a handsome healthy boy and was intended for the Navy, but Captain Audubon had to remove him from the naval school as he was always playing truant. For a time he studied in Paris under David, the great art teacher, but classical drawing had no charms for him, and he returned home. Eventually Captain Audubon sent him to America, to manage an estate of his, Mill Grove, at that time in the care of Quakers. Here he had great freedom, hunting, drawing, shooting, and making friends with the neighbouring settlers.

An English family named Bakewell lived near Mill Grove, and the young Audubon and Lucy Bakewell fell in love at first sight, and irrevocably. Never was man more fortunate in his love, for Lucy understood his wayward nature, was convinced of his greatness, and bore with cheerfulness the poverty and hardship of his early years.

Young Audubon's business misfortunes began early, and he returned to Nantes for a year. His adopted father arranged a partnership between him and an earnest youth, Ferdinand Rozier, and they were smuggled out to America to avoid conscription in Napoleon's forces. Audubon was henceforward known as John James Audubon. After some time, the young partners began storekeeping, and in this book we have the account of the long journey of the newly wed Audubon and Lucy, by coach and "flat boat" to Louisville on the Ohio, at that time a "frontier village". The account of this journey is a delightful piece of description. Louisville was the centre of a small settlement of French refugees of good birth, and one of these, Nicholas Berthoud, married Lucy's sister later and was a great help to the Audubons. Throughout all this time, Audubon was making drawings ot birds, perfecting his technique, rushing off to the woods and streams in season and out of season. His personality made friends for him, but his lack of any business instinct, and his inveterate habit of playing truant from business, must have been a sore trial to poor Rozier.

Kentucky was a birds' paradise at that time, and Audubon became less and less of a storekeeper and more of an artist-naturalist. At Louisville he had the first of his two meetings with Alexander Wilson, his predecessor in American ornithology Wilson had started life as a poor Scottish weaver, was self-taught, anxious, reserved and dour. He was travelling in order to get commissions for his work "American Ornithology". Audubon showed his own drawings, which Wilson praised, and the two went "hunting" together, but without any resultant friendship. Audubon's poverty and possibly a certain jealousy prevented him from subscribing to Wilson's book, and Wilson records surprisingly that he left Louisville without receiving one act of courtesy, one subscription or seeing one new bird. Audubon gives a different account of the meeting, but the result of it was a rancour and jealousy on Wilson's part which extended to his supporters, publishers and others, and pursued

Audubon throughout his career. Audubon never denied Wilson's priority, but it is certain that the clash of two such different temperaments produced in each a jealous antipathy.

Miss Rourke takes us through the various phases of Audubon's business ventures, interspersed with lively interludes of voyage and hunting, ending with the breaking of the partnership, and Audubon's ultimate bankruptcy. He was now thirty-five years old, penniless; Lucy had helped him by teaching and by her own private fortune. By this time they had two sons, and had buried two little girls. Audubon's record effectually closed the door to other employment in commerce. It was now, when most men would have been in despair, that Audubon, and with him the faithful Lucy, became convinced anew of his genius, and decided that he should publish a great book "The Birds of America". Lucy and the boys remained behind, and the father set off for New Orleans, later to Philadelphia, to seek the wherewithal for publication. Many were his failures and vicissitudes; he taught dancing, he painted portraits, he stuffed specimens for museums. His drawings did not find favour with publishers in America, and moreover he suffered from the active animosity of Wilson's publishers, who wanted no rival "Ornithology". Eventually in 1826 he was able to go to England. He was well received in Liverpool, and in Edinburgh he was elected fellow of its Royal Society. He met Sir Walter Scott, Bewick and other men of note. Lizars, the engraver of Selby's "Book of British Birds", undertook to prepare plates from Audubon's pictures, but later gave up, and Havell, the London engraver, took the work in hand. Audubon's faith in himself was such that he decided to publish in four great volumes, double elephant, although ten years would be needed for completion. He toured England for subscriptions, and also France, meanwhile painting portraits and selling drawings. When he had a little money, he sent gloriously extravagant presents to his Lucy.

Two years passed, and Audubon returned to America to make still more drawings. Subscriptions were coming in slowly, but enough to secure continuance of publication. He returned to England, Lucy with him now, and faced a storm of attacks this time on the truth of his observation. But now at last Audubon's star was in the ascendant; he had many good friends, Sir Thomas Lawrence, Christopher North and others. A new project was started, and the "Ornithological Biography" was begun, as companion text to the great work. For this he had the inestimable help of William McGillivray, who gave scientific value to the publication. Audubon's individual treatment of the book was shown in the interposition of "Episodes" of hunting adventures between the scientific descriptions. Despite warnings, and the growing volume of animosity from Wilson's partisans, he published the first volume himself, and, elated by its enthusiastic reception, returned to America for another joyous hunting excursion. His sons were now able to work with him.

The magnificent "Birds of America" was published in 1839, and, the "Biography" being also finished, Audubon and his family returned to America and settled in Harlem. America, having failed to recognize his worth earlier, now rushed to acclaim him, and the rest of his life was spent in happy pursuit of art, music and natural history. Another work "The Quadrupeds of North America" was carried through, largely with the help of Audubon's sons, and Mr. Bachman. Audubon's sight failed some years before he died in 1851, and at last his mind had dimmed.

Audubon was an artist rather than a scientific ornithologist and as such was a surprise to his generation. His very technique was new—water-colour combined with pastel. New also was the presentation of birds in active movement, and in natural surroundings of flower and leaf. Most surprising of all is the decorative balance of each plate; some of them are instinct with a feeling beyond art or bare naturalistic presentment. Like Audubon's character, his work is something unique and apart, joyous and spontaneous, yet entirely individual and determined.

(2) Mr. Peattie's book is in a measure complementary to the other. It is written almost in 'novel' form, and centres round the love idyll rather than the grim struggles for fame. The earlier part of Audubon's life is more fully treated than are his efforts in England. The illustrations are particularly well chosen. The coloured frontispiece shows Audubon's decorative art at its best, and we note the tender beauty of the pictures "Passenger Pigeons" and "Barn Swallows". The interesting self-portrait of the artist shows the limitations of the amateur in this *métier*, in contrast with his mastery in bird illustration. Those who lack leisure for the longer biography, will find here an unforgettable presentation of a unique and great personality.

Both books before us contain illustrations representative of Audubon's art. Both contain a wealth of anecdote culled from his journals, which he wrote almost all his life. The accounts of his long struggle for means to accomplish his destiny fill the reader with alternate hope and despair, sympathy for his business partners and unbounded respect for his Lucy. The records of his journeys on the rivers are valuable as history of a bygone day, and the beauty conjured up by them is a sad reminder of the glories that commerce and ever-increasing population have destroyed. E. G. G

Primitive Behaviour

Primitive Behavior
an Introduction to the Social Sciences. By William I. Thomas. (McGraw-Hill Publications in Sociology.) Pp. ix + 847. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30*s*.

THE impulse to collect is almost universal. Some people collect cigarette cards, others stamps or coins. Ethnological museums collect the skulls, weapons, utensils and works of art of primitive societies. Mr. Thomas has collected records of their customs and beliefs. Like most collectors, he has carefully arranged and catalogued his booty. Therefore his eight hundred closely printed pages of facts will be invaluable, as a work of reference, to the student. But those who seek explanations, or the stimulus of theory, will have to go elsewhere. Mr. Thomas has not, indeed, refrained from comment altogether. He has adopted certain general conclusions. He believes that different peoples have reacted in different ways to similar situations, and so rejects the over-simplified view that development has been unilinear. He believes that a society is more influenced by its neighbours than by its physical surroundings—that the cultural area is more important than the geographical area; and he believes that any innate differences there may be between different races has had little or no effect on their respective cultures. Here Mr. Thomas, in repudiating an over-emphasis on innate factors, seems to have gone to the opposite extreme.

Apart from these general conclusions, there are few theories to be welcomed or attacked. Mr. Thomas, therefore, has had no temptation to select his material, and has collected it entirely without bias. But the striking feature of the book is not that explanations are avoided—this might be the result of caution—but that Mr. Thomas finds so little to explain. The astonishing persistence of a primitive custom, even when it serves no obvious function, is, for him, only a particular example of the perseveration of habit. Thus the real problems of psychology do not exist for him at all. Had he paid more regard to the fact that the perseveration of habits varies within wide limits, that while some are unbreakable others can be broken without effort, his curiosity would have been less easily satisfied, and he would have suspected the presence of hidden motives behind those primitive customs which are unalterably fixed. Had he suspected the presence of hidden motives for the persistence of a custom, he would have suspected that the same motives might have been, in part, responsible also for its origin.

To take an example: Mr. Thomas sees in the Jewish abhorrence for the flesh of pigs a habit, which through long duration has acquired the force of law. He does not feel the need for any further explanation. As, for him, no special motive is required to account for the perpetuation of this taboo, he is prepared to believe it originated without a motive—at any rate, he quotes, with evident approval, an author who derives this 'habit' from the supposed difficulties of pig-keeping in an arid land. Or, take another taboo, that of incest and the marriage of near kinsmen. Here Mr. Thomas finds a real motive: the desire to establish an alliance between two groups, or to have relations-in-law on whom to call in case of need. This is sound enough, so far as it goes. But such a practical consideration can scarcely account for the extreme horror of incest, for the common belief that it blights the crops and brings nameless calamities not only on the guilty couple, but also upon their clan. This extreme horror is, for Mr. Thomas, merely another example of the rigidity with which any long-standing habit comes to be observed. But the curiosity of anyone who is not hypnotized by that magic word 'conditioned reflex' will not be lulled so easily to sleep.

The obsessional neurotic has certain taboos and rituals of his own. For example, he cannot touch a knife, or must dress in a particular order. If he touches a knife accidentally, he is overwhelmed with nameless dread. If he makes an error in the order of his dressing, for example, cleans his teeth before he brushes his hair, he must go back to bed and begin all over again. If he is prevented from doing so, he suffers an outbreak of acute anxiety—as acute as if his wife or children were dangerously ill; indeed, he often feels dimly that they are in some mysterious way threatened by his lapse. Are such obsessional taboos and rituals trains of conditioned reflexes, mere habit systems? Certainly, but so is a great part of normal behaviour, which, nevertheless, can be broken without anxiety. There is clearly some important factor that distinguishes the obsessional from the non-obsessional habit, which is ignored when the same word is used, without qualification, for both.

Now many of the taboos and rituals of primitive people are obviously obsessional—as Freud pointed out in 1912. Primitive man, indeed, is an obsessional neurotic, who is provided by tradition with taboos and rituals, and thus saved the trouble of developing private symptoms of his own. Freud's explanation of these taboos and rituals may be neither wholly accurate nor complete. In particular, the secondary social advantage, where it exists, is important and should not be neglected. But to ignore the deeper motives, to dismiss primitive behaviour as habit fixed by repetition, originating in a judgment—wrong perhaps, but reasonable within the limits of primitive man's intelligence and knowledge—this is to make a retrogressive step, which can only lead to the complete sterility of socio-psychological research.

Although Mr. Thomas is blind to the deeper motives behind primitive behaviour, he has a good eye for secondary and social motives; and as a collector and classifier he can have few rivals. His book is a mine of information, and may retain its value far longer than would a more stimulating and imaginative work, which would almost inevitably have soon been obsolete.

ROGER MONEY-KYRLE.

A Yearbook of British Universities

The Yearbook of the Universities of the Empire, 1937

(Published for the Universities Bureau of the British Empire.) Pp. xxix+1125. (London: G. Bell and Sons, Ltd., 1937.) 15*s*. net.

THE present issue of this handy guide to the learned world follows closely the lines of its recent predecessors. The main body of the work consists of a series of summary accounts, one for each university, grouped by countries and each comprising: (1) a directory of the officers and members of the staff of the university, (2) general information regarding organization, etc., and (3) reports of events of outstanding interest which occurred during the past year. Preceding the compendia relating to the institutions in (1) Great Britain and Ireland, (2) Canada, (3) Australia, (4) South Africa and (5) India, respectively, are five chapters reviewing their history, regulations, practice and distinguishing characteristics. Appendixes deal with: professions and careers, admission to universities, open post-graduate scholarships, etc. (several hundred paragraphs covering 47 pages), centres of scientific research and information (70 pages), and other matters of interest to the learned world and the public generally.

Of the Universities Bureau of the British Empire, the body responsible for the production of the Yearbook, full particulars (memorandum and articles of association and membership) are given on pages x–xxix. Among the objects are "to facilitate . . . the interchange of information . . . and . . . of students and teachers between the said universities and between them and the universities of foreign countries". It is therefore natural that in the reports of events of the past year, a considerable amount of space should be devoted to particulars of "visits of teachers from other universities, etc.". It is noteworthy, at a time when channels of international intercourse are deliberately obstructed in pursuit of nationalistic policies, that many visitors from foreign countries lecture in the universities of Great Britain. The list of visitors to Cambridge, for example, includes professors from Harvard, Paris, Breslau, Copenhagen, Amsterdam, Utrecht, Lund, Lwow, Madrid. The significance of such international visits would perhaps be more strikingly disclosed if the particulars of them were exhibited in one place instead of being scattered among the several university sections.

As regards students from other countries in the universities and university colleges of Great Britain and Ireland, a numerical statement compiled from returns received from all those institutions (except Trinity College, Oxford), appears on pp. 994–995. It gives the total number of such students as 5,882, which is one tenth of the total number of *full-time* students in those institutions. It reveals the remarkable fact that German students (416) outnumbered those from any other European country by more than five to one. Switzerland came next with 77, then France (76), Poland (72), Holland (69), Norway (50), Austria (44), Hungary (38). Other notable contributions were from India (1313), China (295), Palestine (157), Egypt (348), South Africa (568), United States (592), Canada and Newfoundland (280), Australia (248), New Zealand (148).

In fulfilment of one of its principal objects, the Universities Bureau organized last year the fifth quinquennial Congress of Universities of the Empire, which was held at Cambridge last July. It seems odd that the Yearbook should contain no reference to this event except by the inclusion of the Congress report in a list of books on p. 1015. In a "Yearbook of the Universities", should not some record of such outstanding events of the year, directly affecting them though not peculiar to any one of them, find a place in a general or regional chapter ?

Lecture Experiments in Chemistry

By G. Fowles. Pp. xvi + 564. (London: G. Bell and Sons, Ltd., 1937.) 16*s.* net.

One of the difficulties facing the young teacher of chemistry is the devising and executing of experiments suitable for class and laboratory use. For some years before taking up the first post, the teacher will have been performing experiments in what are regarded as more advanced parts of the subject, and when the time comes to deal with the supposedly simple experiments involved in a course of School Certificate standard, trouble begins for those who are unaware of the great difficulty of many such experiments and have not the necessary skill and experience.

To such teachers the work of Mr. Fowles will be both welcome and beneficial. His book is confined mostly to School Certificate standard, and the material is arranged in lessons, which will also be useful until the teacher has enough confidence to evolve an independent scheme of teaching. Many alternative experiments are given, and the references to books will be useful to older teachers who wish to keep up to date. Several sections deal with subjects not adequately dealt with in the usual text-books, such as colloids, indicators, etc., although in some cases the treatment here seems rather too difficult for the standard at which Mr. Fowles aims.

There is some repetition in the book, as for example, when the preparation of a gas such as ammonia is described several times in different experiments, and the size of the book could have been materially reduced by more careful arrangement of material, cross references, etc. The appendixes on aims and methods of teaching chemistry will be read with interest by teachers. The range of the book is too restricted to make it of much use in more advanced courses, and the disconnected order is also a drawback to its use in courses in universities, for which it is obviously not intended.

The Extra Pharmacopoeia

By W. Martindale. Twenty-first edition. In 2 vols. Vol. 1. Pp. xxxv + 1182. (London: The Pharmaceutical Press, 1936.) 27*s.* 6*d.*

The Pharmaceutical Press has now taken over the publication of this standard work from Messrs. H. K. Lewis and Co., Ltd. A new edition of the first volume has now appeared with an enlarged page and a blue cover. This volume is complete in itself and gives an account of the pharmaceutical and therapeutic properties of practically all the drugs prescribed by medical men. The revision must have involved a great deal of work, even when divided among seventeen pharmacists. Thousands of references to recent medical literature have been included, in the place of older and less important information.

The general arrangement has been to some extent rationalized, so that drugs with similar actions appear together, but the process has not been carried far enough. For example, the section on acidum aceticum in the twentieth edition included the acetates, acetylcholine, choline, glycine and betaine hydrochloride. The latter has been properly transferred to the section on hydrochloric acid, but choline has been left where it was, with new company in the form of thallium acetate and cysteine. The extensive index largely compensates for defects of arrangement, but it would be difficult, for example, to find the substance commonly known as benzedrine under the alias of desoxynorephedrine.

The book contains an amazing quantity of information and is remarkably up to date. The inclusion of the names of manufacturers of proprietary remedies is a very welcome addition. The information about these substances will do much to encourage rational prescribing. Every medical man and every pharmacist should possess this book.

A Monograph of the British Neuroptera

By F. J. Killington. Vol. 1. (Ray Society Vol. 122 for the Year 1935.) Pp. xix + 269 + 15 plates. (London: Bernard Quaritch, Ltd., 1936.) 25*s.*

It is now nearly seventy years since the appearance of McLachlan's monograph on British Neuroptera. In the meantime, the most notable contributions to a knowledge of this subject have been the studies by the late C. L. Withycombe, which were mainly in the fields of morphology and biology. The book before us provides, as nearly as possible, a complete account of the British members of the Planipennia. Its author has also incorporated the results of his own observations, and has succeeded in producing a remarkably well-balanced treatise. It is gratifying to see morphology, biology and taxonomy all come in for adequate treatment.

The first 180 pages provide the reader with a general introduction to the order, including also some accounts of its fossil representatives and of the phylogeny. There follows a detailed treatment of the British species up to the beginning of the family Hemerobiidæ. The rest of this family, together with the whole of the Chrysopidæ, are to form the subject of a second volume which has yet to appear. The book is well arranged and excellently illustrated, the greater number of the figures being new. The author is to be congratulated on having produced a work of real merit and of a character which might well be emulated by monographers of other groups.

A. D. I.

Aeroplane Structures

By Dr. A. J. Sutton Pippard and Capt. J. Laurence Pritchard. Second edition. Pp. xvi + 368 + 13 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 21*s.* net.

This book forms an excellent introduction to the problems connected with the structural design of aircraft. The presentation starts from first principles, which are fully explained, and proceeds in easy steps to numerous practical applications, many of which are carried through to the numerical solution. A number of diagrams and tables should prove also of value for those engaged in actual design work. The authors, whose great practical and teaching experience makes itself felt throughout the book, have succeeded in bringing home the fundamentals, and the book can be unreservedly recommended. A. B.

Optical Contact*

By the Right Hon. Lord Rayleigh, F.R.S.

WHEN two glass surfaces are put together without special precautions, they do not come into close contact, and their separate individuality is completely preserved. Yet this is not what might be expected. If the two glasses were really close, they would be equivalent to one piece, and no reflexion would be observable from the interface. Ordinarily this does not happen, because various agencies prevent the glasses coming close enough together. Thus particles of dust and traces of grease tend to do this, and moreover, ordinary surfaces, such as those of spectacle prisms, are not flat enough to come into close contact, except over a very limited area.

However, by using really flat surfaces, scrupulously clean, and by sliding them together so as to exclude dust, two surfaces may be made to *contact*, that is to say, they will come into contact so close that the reflexion at the interface practically vanishes, and when once this has been achieved –and it is easier said than done—the glasses adhere with very considerable force. Such glasses are said to be in optical contact.

Although, as we shall see, the germs of this subject are to be discovered in much earlier work, optical contact has mainly come into notice in connection with the manufactures of Messrs. Adam Hilger, Ltd., under the management of Mr. F. Twyman; Mr. Green, the foreman of their optical shop, has been prominent in this. To mention one example, the echelon transmission gratings made by the firm have the glass plates put into optical contact, which improves the transparency and makes the instrument much more efficient. I have heard the late Prof. A. A. Michelson, who was perhaps not very lavish of praise, speak with enthusiasm of this great improvement in his invention. Nevertheless, the interface, even of contacted glass, does give a faint reflexion. I shall have more to say about this presently.

There is a strong force of adhesion between two contacted glasses. Glasses having an area of less than 2 square inches can be shown to withstand a pull of 56 lb. weight. On occasion, contacted glasses have been made to stand even considerably stronger pulls than this, up to 56 kilograms per square centimetre. However, there does not seem to be anything very definite about it, and there is little doubt that the separation starts at points of local weakness.

The germ of this subject can be discovered in the writings of long ago. Let me recall the well-known experiment of Newton's rings. Two glass wedges, one of which has a convex face of 50 ft. radius, are clamped together without any special precautions, except ordinary cleaning, and give by reflection a circular patch of optical contact—the familiar black centre, surrounded by a system of coloured rings. It is interesting to recall that the blackness of the centre was felt to be a difficulty by the early exponents of the wave theory of light. Yet a simple consideration shows that it ought to be black, the consideration namely that an infinitely thin crack is equivalent to no crack at all, and therefore cannot reflect light.

We obtain local optical contact at the centre of Newton's rings without the technical difficulties which are encountered in contacting flat plates. This is natural, because all the pressure that we use is taken locally, and if there is any dirt or obstruction in the way it is crushed.

It may seem a discrepancy in what I have been saying, that the optical contact which we get in this case is not accompanied by strong mechanical adhesion. This fact will conveniently serve as a starting point in considering the character of the adhesion between flat plates. Although the adhesion is very strong in resisting a fair pull, it is not at all strong in resisting what I may call an *unfair* pull, that is to say, a force tending to strip the plates apart. Such a force can be applied by wedging or pulling the plates apart at one edge or one corner, and we then overcome the adhesion in detail, for the force applied is all concentrated at the edge of the contacted area. It is like tearing a strip of calico when a start has been made by making a short cut with the scissors. All the force is concentrated locally, the breadth of the strip of calico contributing nothing to increase its strength. In the case of Newton's rings, when the convex surface is squeezed flat locally, as soon as the force is relaxed the elasticity of the material brings a stripping force of the kind to bear, and the two glasses separate themselves easily.

If, however, the convexity is very slight, and the amount of flattening involved in contact is consequently small, we may obtain Newton's rings with adhesive contact, no clamping being necessary to keep the glasses together (Fig. 1). This case may be regarded as intermediate between the case of Newton's rings and the case of accurately contacted flat plates.

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* From the Friday evening discourse at the Royal Institution delivered on December 18, 1936.

Newton's rings result when we have contact in the middle, and separation outside; but the converse case may also occur. If a piece of glass gets scratched, experience shows that it becomes difficult to contact it. The reason of this is that the hard particle that causes the scratch, ploughs up a sort of ridge, which of course prevents contact near it. If the scratch is short, we may nevertheless obtain contact at a distance from it by the flexure of the glass. A specimen of this kind shows the scratch in the middle, the interferential tints all around, with contact and blackness at the circumference. If it is allowable to be a little Irish, we might describe it as "Newton's rings with the black centre at the outside." The interferential tints enable us to determine the height of the ridge.

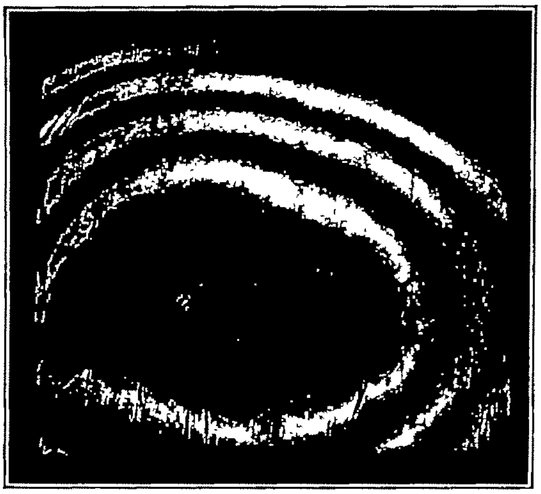


Fig. 1.

Although to a first approximation the reflexion from the interface of contacted plates is black, or in other words non-existent, yet there is a slight reflexion. In the ideal case when the surfaces are in contact the reflexion should be evanescent, but the intensity should increase as they are separated, all this occurring within the range when the interface reflexion is still black to the casual observer. The wave theory allows us to connect the intensity of reflexion with the distance, and it was hoped in this way to obtain a direct measure of the distance between the surfaces, which might be brought into relation with the energy required to separate them.

I found, however, that there was a very curious uncertainty in the amount of reflexion, particularly when surfaces of silica glass were used. I mean that one pair of contacted surfaces would give quite a different reflecting power from another, sometimes ten times as much. What could be the explanation? It was natural to seek it in the character of the surfaces themselves. Since it is not so easy to modify the surfaces experimentally while preserving the flatness necessary for contacting, I thought of trying a single surface immersed in liquid of the same refractive index, which automatically adjusts itself to the shape of the immersed surface. This at once gave a clue to the mystery. Carbon tetrachloride has nearly the same index as fused silica, and by adding a little ether an exact adjustment can be made for green, the brightest part of the spectrum, so that green light passing through a prism of silica immersed in the liquid suffers no deviation.

In this way we get a liquid which matches optically the inside of the silica prism, irrespective of what the optical quality of the skin may be. The skin, on the other hand, determines the reflecting power of the immersed silica. If the skin is the same as the inside, then there should be no reflexion. When I tested a surface commercially polished, there was usually very little reflexion, and if a fired surface, or a surface slightly washed with dilute hydrofluoric acid was used, the reflexion became practically evanescent. On the other hand, any attempt to polish it further with the somewhat amateurish technique of my laboratory increased the reflexion largely; and rubbing it on a dry felt wheel with a very fine abrasive powder did so still more, until a practical maximum had been reached. An abrasive powder used in this way does not destroy the polish. The increase of reflexion produced is so great that it can readily be seen even without immersion.

The felt wheel with the fine abrasive produces a modified skin; and it is interesting to inquire what is the optical character of the skin and, also, what is its thickness? By putting the surface in a series of refracting liquids, we can find which liquid reduces the reflexion to a minimum. I find that a mixture of 75 volumes of carbon disulphide and 25 volumes of benzene, index 1·596, does this. It is to be concluded that the skin is quite as refractive as light flint glass, whereas the body of the silica (index 1·46) is much less refractive than crown glass.

This is a surprising result, and shows that the skin produced by the treatment is something quite different from any of the known modifications of silica. Yet it is difficult to see what else than silica can enter into its composition. By dipping part of the plate in dilute hydrofluoric acid we may dissolve off the modified layer from that part, leaving a kind of step. To estimate the height of this step, we apply a flat test plate and observe the dislocation of interference fringes when they cross the step. In this way the height of the step, and hence the thickness of the layer, has been estimated at $\frac{1}{20}$th of the wave-length of light in air. Fig. 2 shows a strip of this kind; it has, however, been etched more deeply than is necessary to remove the layer. Similar effects to those with silica can be obtained with glass surfaces, but the layer produced by the felt wheel with abrasive is definitely less refractive than in the case of silica, and since the material is more refractive to begin with, the change is a good deal less conspicuous.

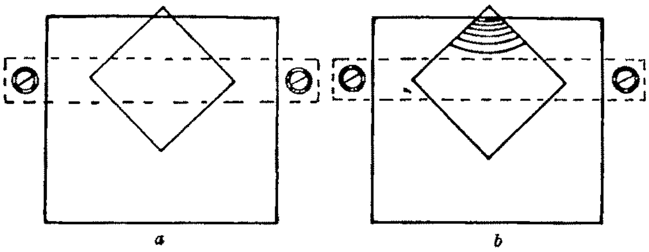
Fig. 2.

Returning to the contacted surfaces, it will now not be difficult to understand why some have a stronger reflexion from the interface than others. It is because the ordinary process of polishing is somewhat haphazard. It may produce a modified layer, as the felt wheel with fine abrasive does, or it may remove the layer already produced. This depends on the exact conditions of the polisher. I have verified this, using a cloth polishing wheel with rouge, which was quite wet to begin with and was allowed to dry. The reflexion of the silica surface was tested at intervals, and was found to pass through a minimum at a certain degree of moisture of the polisher. Concurrent weighings showed that this was the stage at which material was being most rapidly removed.

It is evident that if the contacted surfaces are not exactly alike, residual reflexion is to be expected, even if there is no separation of the surfaces. Further, even if they are alike, there will be reflexion at the separating surface between the skin and the body of the material in each of the glasses. If therefore we wish to reduce the interface reflexion to a minimum, we must get rid of the skin. I have tried contacting two glasses which have been deprived of their skin by means of hydrofluoric acid or caustic potash, but this is not as satisfactory as might have been hoped, because the chemical treatment develops all kinds of defects which were latent in the polished surface, and the light scattered by these makes it very difficult to investigate the faint residual reflexion. I have not been able to determine with certainty that the reflexion is in any case less than would correspond to about 10 A. distance between the planes. This is three or four times as much as the distance apart of the atoms in crystals.

In conclusion, I wish to explain how we may determine the amount of work done in separating two contacted surfaces, or even the amount of work which can be gained by the action of the attractive forces when they are contacted. These amounts of work are not the same, for the process of decontacting and contacting again is not, in the thermodynamic sense, reversible. We must start with a contacted surface and slowly tear the contact away. A square of glass is contacted diagonally on to a larger piece, but one corner of the square overlaps the edge (Fig. 3). For security, the two pieces are clamped together as shown by the dotted outline, and the non-contacted surface of the smaller glass is blackened to diminish false light. Projecting the reflexion through the larger basal glass, initially, all is dark. On pulling the corner of the smaller glass away from the larger one with the forefinger, the contact is stripped away, and interference fringes spring into view (Fig. 3*b*). These extend as the pull is increased, five or six orders of colours being brilliantly developed. On releasing the corner, the glass becomes flat again, the contact is restored, the fringe system recedes, and a moment later it vanishes entirely, leaving all dark as at first.

The quantitative experiment is on the same principle; but the pulling apart is done by weights gradually added, instead of by the finger. The glasses are horizontal, and to find how far the weights attached to the corner have descended, we count the number of interference fringes. This shows how much the corner, initially in the plane of the larger glass, has been depressed from it. Hence the work of decontacting may readily be calculated. On removing the weights, the plate recontacts, and the work recovered may be determined. The work spent in bending the glass is readily allowed for. Experiments made in this way gave 71·2 ergs per square centimetre for the work of stripping, and for that recovered by recontacting about half this amount.



a *b*

Fig. 3.

It is interesting to note that the work done in creating a liquid surface (surface tension × length) is of the same order as this.

Modern Aristotelianism

By Dr. Herbert Dingle

And we do hereby make and constitute the said Society by the Name, President, Council, and Fellows of the Royal Society of London, to be a Body corporate, to be continued under the same Name in a perpetual Succession; and that they and their Successors (whose Studies are to be imployed for the promoting of the Knowledge of natural Things and useful Arts by Experiments . . .) shall . . . (First Charter of the Royal Society, 1662.)

It is, in fact, possible to *derive* the laws of dynamics rationally . . . without recourse to experience. (Prof. E. A. Milne, *Proceedings of the Royal Society*, A, 158, 329; 1937.)

IT is not easy to express in a phrase the idea which early in the seventeenth century became the 'experimental philosophy' now called science, but we shall not err seriously if we adopt the statement that the first step in the study of Nature should be sense observation, no general principles being admitted which are not derived by induction therefrom. The 'Aristotelianism' with which this idea waged what is usually regarded as a successful and final battle was, by contrast, the doctrine that Nature is the visible working-out of general principles known to the human mind apart from sense perception.

Both sides thought of Nature as existing externally and objectively. It would conform better with modern physics to speak of science in more subjective terms as the formulation of rational relations between sense observations. This definition has the advantage of providing an automatic safeguard against the Aristotelian fallacy: Nature conceived objectively may have parts inaccessible to observation about which we are tempted to dogmatize; but if our aim is simply to rationalize observations, such inaccessibles cannot distract us.

Nevertheless, the issue between Galileans and Aristotelians is still sharply defined. In the new language, the controversy was concerned not so much with the proper way of doing a thing as with the thing which it was proper to do: Should we deduce particular conclusions from *a priori* general principles or derive general principles from observations? Intellectual activity involves two elements—call them either Nature and the human mind, or experience and reason. To the Aristotelian the human mind had super-sensory knowledge of the principles which Nature obeyed, or alternatively reason could, apart from sense, dictate the course of experience; to Galileo, Nature was independent, and the mind could watch and try to describe in general terms her processes, or alternatively reason could seek to correlate sense observations into a logical system. To the Aristotelian, man was, in a sense, the measure of all things. To Galileo, "Nature nothing careth whether her abstruse reasons and methods of operating be, or be not, exposed to the Capacity of Men".

History shows few examples of loyalty to a trust comparable with that of the succeeding generations of scientific workers. It is no idle boast that until now the thoughts and practices of men of science have been such as Galileo would have approved. Even merely verbal heresies, such as the statement that science is based on faith in an 'Order of Nature' have been few and harmless; we may have said such things, but we have always acted as though Nature might nothing care for what our minds call order. It is not a light matter, then, when we find in our own day a revival of Aristotelianism in the front ranks of science itself.

The phenomenon may be described in broad terms as an idolatry of which 'The Universe' is the god. Precisely what 'The Universe' means is not always easy to discover; its worship is sometimes mono- and sometimes poly-theistic, and no two votaries appear to bow before the same altar. But its various forms have this in common, that they transcend observation and cannot be derived by induction from observation alone. Furthermore, having been created, they dominate experience instead of representing it.

This cosmolatry, as might be expected, came by metaphysics out of mathematics. What is more surprising is that the world of science generally is accepting it with at best a silent protest, kept inarticulate by a lurking fear that what cannot be understood might haply be true. Thus we find among the general public a vague belief that physics is simply the study of the universe, and in the scientific world itself the wholesale publication of spineless rhetoric the irrationality of which is obscured by a smoke-screen of mathematical symbols. It is worth while to see how this has become possible.

The theory of relativity appears to be the innocent cause. It is no secret that when that theory burst upon the world it was very little understood. The new mathematical knowledge and the uprooting of deep-seated prejudices which understanding demanded were thought exorbitant, and the price was not paid. But the theory could not be ignored. It solved a long-standing astronomical problem and successfully predicted a new phenomenon, and these were the hall-marks of true science. Hence relativity had to be accepted. Now it happened that early in its career it was speculatively applied to the universe, and the most widely read introductions to the theory included descriptions of this application. Consequently the bewildered physical world came to imagine a necessary association between relativity and cosmology and, believing where it could not prove, extended to the cosmical speculations the scientific sanction which had been earned only by the underlying system of mechanics.

This was a mistake. The relation of relativity to the universe is in principle precisely the same as that of Newtonian mechanics: both concern the behaviour of any mechanical system whatever, and can therefore tell us nothing about the peculiar character of any particular system. Newtonian mechanics could not state the number of planets in the solar system or the distribution of masses in the universe, but if these things were found by observation, it could tell how the bodies would interact. Relativity mechanics has exactly the same limitation and the same power—a fact which, so completely has the situation been misunderstood, will probably be news to many physicists. How, then, is it applied to the universe? Simply by making assumptions, which by now have become dogmas. It is assumed that the universe is homogeneous. Why? Because the possible alternatives, being infinitely numerous, must be ignored if we are to make our speculations definite. It is assumed that the universe is isotropic for the same reason. It is assumed that the characteristics of the possibly infinitesimal region we have observed are not merely local but also are copied by all that we have not observed. Why? Because that assumption brings the universe within the scope of our mathematical attainments. In this way we reach our grand modern conception of 'The Universe', on which we proceed to build laws of Nature far superior to those paltry inductions from phenomena that Newton ranted about. Our new laws are universal, eternal, established on the rock of divine mathematics, and in the tumult of their coronation no one hears a still, small voice which says, "Nature nothing careth whether her abstruse reasons and methods of operating be, or be not, exposed to the Capacity of Men."

The new Aristotelianism has now grown so confident that we have no need to unmask it: it has itself discarded masks, and we have only to recognize it for what it is. Sir Arthur Eddington, for whom the "cosmical constant", which Prof. A. Einstein thinks illusory, is a "fundamental constant of nature", tells us that "there is nothing in the whole system of laws of physics that cannot be deduced unambiguously from epistemological considerations. An intelligence, unacquainted with our universe, but acquainted with the system of thought by which the human mind interprets to itself the content of its sensory experience, should be able to attain all the knowledge of physics that we have attained by experiment". But Eddington's own practice refutes his creed. He is too great to be the slave of chimæras, and his generalizations are but unsuccessful attempts to utter what he finds inexpressible. If he had a philosophy big enough for his intuitions we should know something.

Prof. E. A. Milne's "kinematical relativity" has quite a different character. Here we not only establish mechanics on 'The Universe' instead of on Newton's "manifest phenomena", but also we invent our own universe so as to be seraphically free from the least taint of observability. This creation is defined by the "Cosmological Principle", which selects out of all conceivable bodies those which, if they had observers on them, would restrict the behaviour of such observers to a certain mutual conformability. Verbal respect is paid to old-fashioned prejudices by the admission that there *is* an actual universe of which this is only a selected part, and, etiquette having thus been observed, hundreds of pages and thousands of pounds are being spent on calculation of the properties of this "selection" by a growing army of "research" workers. In this campaign observations can be what they will provided the functions keep their ancient places; a question is "answered" when the equation is formulated. Thus the question how long the system of nebulæ has existed is "resolved" by saying that it may be for years or it may be for ever, "according to circumstances". The further question, how the possible "circumstances" are related to experience, is not worthy even to be asked. "Whether the actual universe follows the details of the extrapolation is quite immaterial," says Milne. In other words, we admit that Galileo had a programme, but we, for our part, will be Aristotelians.

Perhaps this comparison is unfair, for no one can deny to the Aristotelians the gift of logical acumen. To their modern representatives it seems as though a fancy is no sooner in the head than it is on paper and sent for publication regardless of logical consistency. Thus, in the first paragraph of a recent paper, Milne, after asserting that "all the matter in the universe . . . must necessarily be taken into account in describing the motion even of a free particle", immediately announces that he fulfils this requirement by restricting his considerations to matter which obeys the cosmological principle. Again, he claims to deduce the Doppler effect from the manner in which the cosmological principle leads two or more observers to reconcile their clock readings, and hails this as evidence that the actual universe obeys the principle (indeed, Milne believes that God could not have made the universe otherwise). But obviously the Doppler effect could be detected if only one observer existed, so its derivation from the sociability of many must be fallacious. And so on.

This combination of paralysis of the reason with intoxication of the fancy is shown, if possible, even more strongly in Prof. P. A. M. Dirac's letter in NATURE of February 20 last, in which he, too, appears as a victim of the great 'Universe' mania. In essence the argument is this. Large numbers need an entirely different type of explanation from small ones (since the number of pure numbers is infinite the distinction is meaningless, but meaning seems to be irrelevant to these considerations). If, from an indefinitely wide choice, we select a certain unit of time ("say the unit e^2/mc^3"), the age of the universe according to one cosmological speculation is "about" equal to the square root of the number of protons in the universe according to another, and to the ratio of certain electronic forces. Hence we may take it as a "general principle" that *all* large numbers, etc. "In this way," adds Dirac, "we avoid the need of a theory."

The position must not be misunderstood. We are not dealing here with legitimate imagination transcending the temporary limits of exact demonstration. Nothing is easier and nothing is more deadly than to call for the stifling of all ideas that cannot here and now be proved of permanent value. But the question presented to us now is whether the *foundation* of science shall be observation or invention. Newton did not lack imagination, but he chose to examine pebbles rather than follow the Gadarene swine, even when the ocean before him was truth. Milne and Dirac, on the other hand, plunge headlong into an ocean of "principles" of their own making, and either ignore the pebbles or regard them as encumbrances. Instead of the induction of principles from phenomena we are given a pseudo-science of invertebrate cosmythology, and invited to commit suicide to avoid the need of dying. If anyone is uncertain about the place of imagination in science, let him compare Lord Rayleigh's discovery of argon with Dirac's discovery of the contemporary creation of protons which, according to *The Times*, "alters fundamentally our ideas of the structure of the universe and the nature of time".

Nor are we dealing with a mere skin disease which time itself will heal. Such ailments are familiar enough ; every age has its delusions and every cause its traitors. But the danger here is radical. Our leaders themselves are bemused, so that treachery can pass unnoticed and even think itself fidelity. It is the noblest minds that are o'erthrown, the expectancy and rose of the State which was lately so fair and in which there is now something so rotten that the very council of the elect can violate its charter and think it is doing science service. Five years hence we shall be celebrating the tercentenary of the death of Galileo and the birth of Newton. It rests with us whether we shall present to their memories a living monument of their own foundation or the resurrection hymn of their adversaries.

Rural England at the Royal Academy

MANY of the subjects which enlisted the enthusiasm of British artists fifty years ago, notably the historical and military, have faded out of modern exhibitions, but the scenery of the English countryside and coast retains its attraction, and is fully represented in this year's Academy. Landscape, and especially English landscape, is the principal subject of the water-colour paintings. These, relegated to a side gallery, are generally viewed after the eye has become attuned to the larger and stronger oil paintings.

It may be well, therefore, for those interested in landscape to visit the South Rooms first. Here are studies of the coast of Cornwall, the Cotswolds, the Sussex Downs, the Fens and Yorkshire moors, and examples of historic architecture such as the castles of Richmond, Bamburgh and Holy Island. The country church as the principal feature in East Anglian landscape is well treated in "Morston, Norfolk" (889) by Mr. Harry Morley. The seasonal aspect of the country landscape is beautifully rendered in Mr. E. W. Haslehust's "Winter" (764), where yellow reed beds are reflected in still water and backed by a dark thicket of bare boughs. "March Landscape" (949), by Mr. Victor W. Burnand, is a careful rendering of the tracery of elm boughs seen against the evening sky.

We come now to the oil paintings. The pictures entitled "The Evening Meal" (133) and "Pigs in a Barn" (332) by Mr. Frederick W. Elwell, are excellent studies of the interior of old timbered barns which, when the doors are open, give such opportunities for light and shadow. Mr. Fred Hall has a study of the same subject "In the Old Timbered Byre" (283). Mr. Edwin Byatt's "Mills at Outwood, Surrey" (164) shows the exterior view of roofs and gables of old barns and reminds us of the necessity for keeping in repair a picturesque feature, which when allowed to fall into dilapidation becomes a melancholy object in the countryside. It is perhaps from landscape paintings, rather than from direct observation, that the average person learns how decorative are the roofs and gables of old barns in the landscape of agricultural England. This is not entirely the average man's fault, for in actual fact there are few farmyards in which some part of the old roofs has not been repaired or replaced with unsuitable materials. The painter, however, can ignore these unsightly additions and represent the group of ridges and gables as they ought to be. There are a number of such studies in the present exhibition: "Afternoon on the Farm" (134) by Mr. Douglas P. Bliss, "Swanborough Pond" (266) by Mr. Vignoles Fisher, "A Sussex Lane in Winter" (650) by Miss D. H. de Carteret and "Essex Farmyard" (678) by Mr. Douglas Relf.

These studies lead one to consider the part of the landscape painter in the pressing task of preserving the scenery of rural England. The names of landscape painters figure very little on the councils of the numerous societies concerned in this important task, neither is it necessary that the exercise of their special talent should be interrupted by such activities. Rather should those engaged in the preservation of England's beauty study with care the outlook of the artist as embodied in contemporary exhibitions, and note particularly those artifices of composition by which disfigurements are passed over, and the yet more important devices by which the pictorial characters of a view are so enhanced as to carry the imagination from the actual to the infinite.

In the latter connexion, it is worth while to consider the titles which should be given to landscape pictures. The prevailing practice at the Royal Academy is to give the actual name of the locality or local feature without indication of the type of beauty which the picture embodies. Here and there, however, is a generalized landscape with an ideal title, as Mr. Reginald Hallward's "A Window on Eternity" (849). If the local names be retained in the case of a feature highly idealized, the artist provokes unfavourable comment; if it be not retained, the interest of association is lost. I venture on the suggestion that in such cases the picture should be given the title of the locality and the sub-title of the pictorial quality which it embodies. As a case in point I may cite the very interesting study of "Early Morning: Corfe Castle" (456) by Mr. Stanley Royle. An essential pictorial character of a castle set upon a hill is the verticality of the lines which carry to infinity the gradient of the natural feature. But the walls of Corfe, undermined and blasted by Cromwell, have in parts been left leaning over, and so the ruin has lost considerably in effect. But in this painting the artist has straightened up the walls, and in the houses and church below has emphasized the vertical lines. Here, therefore, it might be well to give a sub-title which would explain to the general public that departure from photographic representation, which is in this case more than justified by the ideal attributes the picture embodies.

One of the most perfect landscapes in this year's Academy is Mr. Oliver Hall's "Greenholme Bridge, Westmorland" (215). The curve of the single arch, the upward sweep of the approaching road, the reflection in running water and background of trees make a delightful grouping of forms, and the subject suits the tonality which characterizes this artist's work. Of the pictures of inland waters the large "River Scene" (510) by Mr. Algernon Newton, shows the sigma curve which is one of the essential beauties of streams which wander across the plain In the matter of coastal scenery we are once more indebted to Mr. Julius Olsson, among whose studies are "Opal Moon: Irish Coast" (317) and "The Storm Cloud" (169), an impressive picture of sea and sky.

The picturesque occupations of the countryside have received comparatively little attention, but two works at least deserve special attention, among pictures that by Miss L. Kemp-Welch of "The Lumber Team" (551) and among sculptures the very pleasing and unusual study "Lakeland Dalesman", equestrian statuette (1470) by Miss Ophelia Gordon.

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The following portraits are of interest to the scientific fraternity, Sir Albert Seward (52) by Mr. Harold Knight, the late Brig.-General Sir Capel Holden, by Mr. P. Connard (158), Prof. T. B. Abell (290) by Mr. W. C. Penn, Mr. Sydney Evershed, by Mr. G. Harcourt (324), Sir George Hill, by Mr. J. Gunn (433), Sir Alexander Gibb (656) by Sir William Rothenstein, Sir Arthur Evans, charcoal drawing (1137) by Mr. Francis Dodd, and a marble bust of Sir Arthur (1451) by Mr. David Evans, a bust of Dame Helen Gwynne-Vaughan (1430) by Mr. Julian Allan and a stone bust of Prof. R. W. Reid (1435) by Sir W. Reid Dick.

VAUGHAN CORNISH.

Obituary Notices

Dr. J. K. Fotheringham, F.B.A.

JOHN KNIGHT FOTHERINGHAM, who died on December 12 of last year, was the greatest authority of his time on ancient chronology. The name Fotheringham is derived from the Manor and Castle of Fotheringay, held in the twelfth century by the royal family of Scotland as part of the Honour of Huntingdon in Northamptonshire. Mr. Walter de Fodringaye was one of the executors of Devorgilla, Lady of the Manor and wife of John de Baliol in 1289, and was appointed by her as the first principal of Baliol (Balliol) College, Oxford. By their close connexion with the House of Baliol, some of the Fotheringay family settled in Scotland at the end of the thirteenth century and the name was changed to Fotheringham. One William Fodringhay had a charter from David II of lands in Aberdeen and Banff. In 1296 Hugh de Foderingaye of Perthshire and Roger, vicar of Kilmuir in Ross-shire, did homage to Edward I. Duncan, Bishop of Dunkeld, granted Fordell, County Perth, to Walter de Fotheringham in 1340.

The family has, therefore, a long Scottish ancestry. They became Presbyterians at the Reformation. Dr. J. K. Fotheringham's father was born at Dunbarrow Bridge, and was minister of Glanton Presbyterian Church, Northumberland, in 1859–65, and of Tottenham Presbyterian Church, Middlesex, in 1865–1905; he was moderator of the Presbyterian Church of Scotland in 1912. John Knight Fotheringham was born at Tottenham in 1874, one of three brothers. He was a delicate child, and had indifferent health during his whole life. The inheritance of his remarkable genius must be partly attributed to his maternal ancestry; his mother was Jane Ross, also descended from an ancient Scottish family; her father was master of the Lancasterian School at Tottenham, and she taught at that school. He was educated at a school in connexion with the Tottenham Presbyterian Church and then at the City of London School, where he came under the instruction of Dr. Abbott, the headmaster. Under Abbott and Rushbrooke he received a sound classical training and entered Merton College, Oxford, in 1891 with a leaving scholarship. At Merton he obtained a first in Greats in 1896 and then proceeded to obtain a first in Modern History in 1897. Magdalen College gave him a Demyship, 1898–1902; he attended the British School in Athens for one year, settled in Oxford and became a coach. Magdalen College elected him to a research fellowship in 1909. He became reader in ancient history, University of London, 1912, and was a lecturer in classical literature at King's College, 1904–9, lecturer in ancient history at King's College, 1909–12.

About 1898, Fotheringham began the serious study of mathematics and astronomy, and made such astonishing progress that in 1908 he was able to make a valuable correction to the work of Ginzel, Nevill and Newcomb on eclipse calculations. He was made assistant at the Observatory at Oxford in 1918. About 1910 he became interested in Babylonian astronomy, and I then made his acquaintance; from that time until his death we collaborated constantly. In the meantime, he had been applying astronomy to Greek chronology, and had produced fundamental results. He now began to apply Babylonian astronomy to still earlier chronology and attained the undisputed position of the greatest living authority in these matters. The University of Oxford, therefore, created for him a post as reader in ancient astronomy and chronology in 1925 and he was elected to the British Academy in 1932.

It will be seen that the mental range of this scholar probably exceeded that of any one of his contemporaries in any land. An excellent classical scholar, a man of wide reading in modern history, an astronomer of great originality, a brilliant mathematician, and a specialist in ancient history—these are his attributes. Moreover, he was regarded as an authority on Presbyterian Church policy and was a devoted layman and elder.

The first contribution of Fotheringham to learning was an edition of the text of Jerome's version of the "Chronicle of Eusebius" (1905). The Bodleian MS. together with two others (Undine and Paris) is reproduced in collotype prefaced by a history and palæographical examination of all the extant manuscripts. For this work he visited many European libraries. In 1923 appeared his printed Latin text of the "Chronici Canones" of Eusebius with a complete *apparatus criticus*, and Latin introduction. It is obvious that this work of Eusebius on the *fila regnorum* or lists of reigns in Jewish, Persian, Assyrian, Greek and Roman history with historical comments was of fundamental interest to him as a student of ancient history; the tale that he took up this work because his birthday fell on August 14, a day dedicated to a Saint Eusebius, is surely apochryphal. In 1906 appeared vol. 11 (1801–37), second edition 1911, of Longman's "Political History of England", but henceforth his life was to be almost entirely devoted to astronomy and its application to ancient history. Here he was destined to make contributions to science on which his great fame will for ever rest.

Fotheringham edited the fragments of Cleostratus with a critical discussion of his importance as the first astronomer to introduce the signs of the zodiac into Greek science, together with the eight-year cycle of intercalation. In this work he combined a knowledge of philology with astronomy so as to enable him to clear up the meanings of several Greek words and to interpret passages which had baffled the greatest classical scholars. Several articles were devoted to the date of the Crucifixion, or the problem, "In what year between A.D. 27–34 did Nisan 14 or

15 fall on a Friday". His tables for the visibility of the new moon enabled him to place this problem on a more scientific basis, but he never came to a conclusion which he proclaimed infallible. In his last article he prefers A.D. 33, April 3.

In 1915 Fotheringham published a very learned work on Marco Sanudo, the Venetian prince who conquered the whole of the Grecian Archipelago in 1205–6 for his native city in wars with Genoa. To do this piece of work he had to use Italian, Byzantine Greek and French sources. He showed himself master in this department of medieval history, a strictly philological investigation. But astronomy was claiming more and more of his attention, particularly the history of that subject, and he was naturally drawn to Babylonian astronomy. I supplied him with the texts of the observations of the risings and settings of Venus during the reign of Ammizaduga, tenth king of the First Babylonian Dynasty. The book which we published together, "Venus Tablets of Ammizaduga", contains his *opus magnum*. I cannot enter into details here, but suffice it to say that he and his colleague Carl Schoch undertook to construct tables by which the new moons and risings of Mercury, Venus, Mars, Jupiter and Saturn can be fixed back to 3507 B.C. in the case of the moon, 2099 Mercury, 2999 Venus, 2148 Mars, 2153 Jupiter, 2123 Saturn. By elaborate astronomical control of the calendar and by the Venus tables, Fotheringham's calculation for the sixth year of Ammizaduga at 1916–1915 B.C. was agreed to by Schoch after long discussion; Schoch, recognized as the most brilliant constructor of historical planetary tables, at first opposed this calculation, but was finally convinced. (So far as I know, astronomers were convinced by Fotheringham's work, with the exception of Neugebauer.)*

Fotheringham also devoted much time to the work of the Babylonian astronomers Naburianos and Cidenas, whom he regarded as the principal sources on which Greek astronomy was founded. In the last months of his life he made a brilliant interpretation of figures on Babylonian astrolabes which had baffled Assyriologists to the present day. He studied the voluminous publications of Greek astronomical texts, "Catalogus Codicum Astrologorum Græcorum", and was able to prove that much of it was borrowed from Babylonia.

Fotheringham was now recognized as a man of unique knowledge; in fact, no man living combined his immense classical knowledge with astronomy and chronology. His fame spread in intellectual centres all over the world and his correspondence was heavy. He left a minute catalogue of all his books and articles, together with a list of all the inquiries he received on chronology and astronomy. The list of inquiries runs to more than 350, and includes most of the eminent names of archæologists of the last three decades in all lands. This notice is only a very restricted résumé of the work which J. K. Fotheringham accomplished. The printed testimonials which he submitted from various astronomers when he stood for the Savilian professorship at Oxford fill 34 pages. One of them states concerning his work on the secular acceleration of the sun and moon, "Fotheringham's theory is the only one which definitely solves the problem and means the death blow to the gravitation theory (as applied to eclipses) and will be the theory of the future", and this scholar pronounced Fotheringham to be the most brilliant mathematical astronomer of his age. He had a profound influence in Germany and America; in fact, he was far better known abroad than he was in Great Britain. I must for my own part assert that I was always fully aware of his almost unlimited ability. His death has completely deranged my plans. He was a typical Oxford product, modest, accurate and profound. One can readily believe after working with him more than twenty-five years that he was never angry about anything in his life. Many were his disappointments in academic promotion, and worst of all he suffered constantly from poor health. All these things he bore like a Christian gentleman, a title which gave him more satisfaction than any other. S. LANGDON.

An astronomical correspondent writes as follows:

Dr. J. K. Fotheringham's interest in astronomy developed from the study of ancient chronology. In order to be able to study astronomical chronology he took some lessons in spherical trigonometry and elementary mathematical astronomy from the late Prof. H. H. Turner, and afterwards received some further help in the use of lunar tables and the calculation of eclipses from Prof. J. B. Dale, of King's College, London, and Dr. P. Cowell, superintendent of the Nautical Almanac Office. With this modest preparation for astronomical studies, he proceeded to write a series of papers, in which his knowledge of ancient chronology had full scope, which are of great astronomical importance. In these papers he discussed the occultations of stars by the moon preserved in Ptolemy's "Almagest", the equinox determinations of Hipparchus, and ancient observations of solar and lunar eclipses. The result of these investigations was to establish that the sun has a secular acceleration of 3·0″ per century per century, and the moon has a secular acceleration of 21·6″ per century per century. Lunar theory predicts a secular acceleration for the moon of 12·2″. The residual acceleration, 9·4″, for the moon, and the whole of the secular acceleration of the sun cannot be accounted for by gravitational theory. It is now generally accepted that these secular accelerations are attributable largely, if not entirely, to the action of tidal friction, more especially in narrow seas such as the Irish Sea and the Bering Straits.

From these studies, Fotheringham was led on to the study of the discordances between the observed positions of the moon and the positions computed from pure gravitational theory. Newcomb had allowed for the major discordances by the introduction of an empirical periodic term. This so-called "Great Empirical Term" was incorporated by Brown into his "Tables of the Moon". But there remained minor fluctuations, which showed some correlation with the departures of the sun, Mercury and Venus from their predicted positions. Fotheringham made a careful analysis of the departures of the moon and sun from pure theory, and showed that there was a fairly constant ratio between the departures for the two bodies, the explanation of which is to be found in fluctuations in the earth's rate of rotation. Though other investigators were working on the same problems at the same time, Fotheringham's contribution was an important one.

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* Neugebauer's objection to Fotheringham's dating of the First Babylonian Dynasty seems to be subjective and unscientific, for he himself adopted Fotheringham's values for the acceleration of Venus and the moon

In a further paper, Fotheringham made a study of precession, galactic rotation and equinox correction, in which he made a determination of the rotation of the galaxy, and revised the values of the precessional constants. This paper lost some of its importance through the discovery by Oort in the following year of the differential rotation of the galaxy. From this paper Fotheringham was led to the investigation of the mass of Venus. He believed that he had established that there was a fluctuation in the mass of Venus. These results have not been accepted by astronomers. Fotheringham was apt to be led astray by his failure to appreciate the value of observations and the systematic errors to which they were liable. This was due to his lack of any observational experience and to the limitations of his astronomical knowledge. That he was able to obtain the results that he did with so inadequate a training is greatly to his credit.

Other astronomical work of Fotheringham's included a study of the earliest visibility of the moon to the naked eye, which is of chronological importance because, in both the Babylonian and the Jewish calendars, the beginning of the month was fixed by observation of the moon; a restoration of the calendars of Meton and Calippus; discussions of the new star of Hipparchus and of the dates of the birth and accession of Mithridates. He also made a contribution to astronomical history in a monograph on Cleostratus, in which a complete text of the fragments of his work was given, and the nature of his contributions to astronomy was discussed.

WE regret to announce the following deaths:

Dr. J. J. Davis, curator of the Herbarium, University of Wisconsin, known for his work on parasitic fungi, on February 26, aged eighty-four years.

Dr. S. F. Grace, senior lecturer in applied mathematics in the University of Liverpool, author of works on hydrodynamics and tides, on April 30, aged forty-one years.

Prof. E. Perroncito, formerly professor of parasitology in the University, and professor of general pathology and director of the Royal School of Veterinary Medicine, Turin, aged eighty-nine years.

Prof. Stephen Soudek, professor of applied zoology in the Agricultural College, Brno, known for his work on pests of agriculture and forestry, on February 20, aged forty-six years.

News and Views

Magnetic Disturbances and Auroras

As reported in NATURE of May 1, p. 752, considerable magnetic disturbance, presumably related to an active region of the sun containing some big sunspots, began on April 24, and this terrestrial disturbance or series of disturbances was continued until about April 29^{d} 0^{h} U.T. The activity, as recorded at the Greenwich magnetic station at Abinger, includes four distinct disturbances or 'storms', of which the most active periods and extreme ranges in horizontal force have been kindly supplied by the Astronomer Royal, as follows:

April 24^{d}	21^{h} to April	25^{d}	2^{h} U.T.	280γ
25	16	26	1	300
26	18	27	5	395
27	19	29	0	> 305

The greatest ranges at Abinger over the whole period of disturbance were 50′ in declination, 500γ in horizontal force and 355γ in vertical force.

IN a letter addressed to the Editor, Father J. P. Rowland, *S.J.*, director of the Stonyhurst College Observatory, directs attention to these four storms and suggests that the last, which was of longest duration and produced the most rapid oscillations in the traces, might perhaps be attributable to the largest of the groups of sunspots (with central meridian passage on April 24·6) which extended some 14° in longitude on the sun's surface. The ranges of the magnetic elements recorded at Stonyhurst (about 200 miles north-north-west of Abinger) during this period of magnetic activity were 93′ in declination and >620γ in horizontal force, thus exceeding any recorded ranges at Stonyhurst since February 1929. In another letter, Mr. J. McWilliam describes a notable display of the aurora which he saw about midnight when ten miles south of Grantham and which was still visible, though less striking, when seen from Sheffield about two hours later. The display was seen even though there was brilliant moonlight. (As previously mentioned, on p. 752, Mr. Hawke reported this display in *The Times* of April 27, and information of another about midnight on April 26–27 comes from Mr. Housman, of the Seaton Observatory, Workington.)

THE Royal Observatory, Greenwich, was informed by the British Broadcasting Corporation that a brilliant aurora was reported from Halifax, Nova Scotia, on the night of April 27–28. During this last period of magnetic activity, there was for several hours a complete dislocation in short-wave wireless communication between Great Britain and Canada. In point of fact, throughout the period, April 24–29, short wave communication was often impossible on this channel, other channels being variously affected but to a less extent. Cable and Wireless Ltd. also report during the same period frequent interruption due to earth currents in cable circuits operating between Great Britain and Newfoundland and vice versa. On the morning of April 28 between 1^{h} and 7^{h} and again from $10\frac{3}{4}^{h}$ to $12\frac{3}{4}^{h}$ U.T., the earth currents on this circuit were so severe that trans-atlantic communication by cable was impossible.

University of London's Institute of Archæology

ON April 29, the Earl of Athlone, Chancellor of the University of London, formally declared open the Institute of Archæology, housed for the present in St. John's Lodge, Regent's Park, and unveiled wall-tablets to the memory of Mrs. Tessa Verney Wheeler, who was honorary secretary of the original Appeal Committee to collect funds for the foundation of the Institute, and of Mrs. Mary Woodgate Wharrie, a generous benefactor. The Chancellor was welcomed by Sir Charles Peers, chairman of the Committee of Management, and thanks were conveyed to him after the ceremony by the Right Hon. W. G. A. Ormsby-Gore, who was First Commissioner of Works when St. John's Lodge, as Crown property, was allotted to the use of the Institute, and Dr. R. E. Mortimer Wheeler, director of the Institute. Arrangements have been made for the tenure of the present premises for a period of years; but it is hoped that eventually quarters for the Institute will be found among the University buildings in Bloomsbury near the Historical Institute and the Institute of Art.

IT is usual on an occasion such as this opening ceremony to describe it as "epoch-making". In the present instance this term might be used with nearer approximation to the truth than is common. As was pointed out at the time, the proposal for an Institute of Archæology in the University of London was first made, the expansion of archæological investigation and the increased interest in the application of its results had made the provision of some such organization as a training ground a matter of urgency. As Sir Charles Peers said in welcoming the Chancellor, archæology, if one of the newest sciences, has the vigour of youth; and although in the nine years which have lapsed since the original proposal was formulated, progress towards meeting the requirements of archæological training may have seemed slow, it has been substantial. The Institute is already well on the way to providing in its library, its collections of antiquities and its training in methods of research the requirements which Sir Charles laid down as the minimum. Lord Athlone's reference to the present importance of Palestine in British field archæology not only emphasizes the value of the collection of Palestinian antiquities—the largest in existence outside Palestine—which the Institute owes to Sir Flinders Petrie and the generosity of the British School of Archæology in Egypt, but also, by endorsing his support of the appeal for a chair of Biblical archæology, afforded convincing testimony that in saying he regarded the ceremony he had just performed as the laying of a foundation stone rather than as a formal opening, he was expressing something more than a conventional compliment.

Celtic and Saxon Art in Early England

THE exhibition of photographs of stone crosses and other forms of Celtic and Saxon sculptural art in stone now on view in the Iron Age Gallery of the British Museum (Bloomsbury) is an indication of the remarkable wealth of this material still surviving, which, in its mass, is something of a revelation even to the expert. The indefatigable labours of the late Romilly Allen, Baldwin Brown and W. G. Collingwood, the last-named more particularly in the north of England, have made known to archæologists the extent and value of this class of evidence, especially as afforded by the stone cross, in the interpretation of racial and cultural movement in the early historic period of Britain; but the work of the survey initiated by the Department of British Antiquities of the Museum some eighteen months ago, in which the assistance of the layman and amateur student has been enlisted widely, has brought together a record of examples of the various classes of this art in the form of photographs, which is surprising. As a whole, it is claimed, probably with justice, that this collection of examples of Celtic and Saxon sculptural art is the finest in existence.

SOMETHING of the work which already has been accomplished by the survey is shown in a selection of the photographs, primarily of the stone crosses, but also including fonts, tympana, capitals and the like. Geographically, the area covered is England, with the 'Anglian' crosses of southern Scotland; but selected examples from outside England are shown for purposes of comparison. The Isle of Man and Ireland, important areas which are a study in themselves, naturally are not included. Special features have been made of photographs by John and Mrs. Piper, who have made an extensive collection of photographs of Anglo-Saxon and late Romanesque sculpture, of a group of sculptures from the West Riding of Yorkshire by Mr. J. E. Tetley and of a regional survey of Cheshire and Staffordshire, which is illustrated by distribution maps and a map prepared in collaboration with the School of Geography of the University of Liverpool, showing relation to forest clearance and habitation in the eleventh century.

Armagh Observatory

DR. E. M. LINDSAY, at present an assistant in the Harvard Observatory in Bloemfontein, South Africa, has been appointed astronomer at Armagh Observatory. This Observatory was founded in the year 1791 by Richard Robinson, Baron Rokeby, Archbishop of Armagh and a great benefactor of the city of

Armagh. The Primate gave as an endowment of the Observatory twenty acres of land close to Armagh, on which the Observatory is built, and the estate of Derrynaught, which he had bought out of his private means. He further provided for the salary of an assistant and the current expenses of the Observatory. The power of nominating and appointing the astronomer is reserved for the Archbishop of Armagh and Primate of all Ireland for the time being. The first astronomer of the Observatory was the Rev. Dr. J. A. Hamilton, who was succeeded in 1815 by the Rev. W. Davenport, and then, in 1823, by the Rev. T. R. Robinson, who held the post until his death in 1882—a period of more than fifty-eight years. The anemometer which bears Dr. Robinson's name was first put up on the roof of the Observatory in 1846, but meteorological observations had been commenced thirteen years earlier. Dr. J. L. E. Dreyer succeeded Dr. Robinson in 1882, and the next director appointed was Mr. J. A. Hardcastle, who, however, died in 1917 without having actually taken up the post. The Rev. W. F. A. Ellison became director in 1918 and occupied that position until his death at the end of last year.

Royal Institution: Annual Meeting

THE annual meeting of the members of the Royal Institution was held on Saturday, May 1. In the unavoidable absence of the president, the Right Hon. Lord Eustace Percy, the chair was taken by Major Charles E. S. Phillips, secretary and vice-president. In submitting the annual report of the Visitors to the meeting, the chairman referred to the satisfactory state of the membership, which has increased steadily in recent years, and which stands now, including honorary as well as full members and associate subscribers, at 1,055. The reconstruction of the Library and other rooms, which the Managers were forced to undertake when a large part of the building was found to be in an alarming state of disrepair, was completed in October. This work, which the accounts show had cost nearly £16,000 at the end of the year, and included the construction of a large new laboratory, has added greatly to the beauty and convenience of the house. Owing to the withdrawal of the direct current mains in Albemarle Street and neighbourhood, it has been necessary for the Institution to provide its own equipment for the supply of direct electric current. A large storage battery and two mercury arc rectifiers, supplied from the A.C. mains, have been installed. The output from the rectifiers has been specially smoothed, and is found to be sufficiently free from ripple for most experimental purposes. The battery is used for arc lanterns in the lecture theatre.

THE expenditure on these and other purposes has been largely met from the munificent bequest of the late Mr. Harry Brown, which, it is now reported, has amounted to more than £29,000. No. 19 Albemarle Street, adjoining the Institution's premises, recently purchased, has now been fully occupied. The two top floors are used for library and museum extension, and the lower floors have been let off for the present, producing income which is being devoted to research purposes. The accounts of the Davy Faraday Research Laboratory, in which the Institution's research expenditure is accounted for, show a deficit of nearly £2,000 on the year's working. The chairman was able to announce a generous Coronation year gift by the honorary secretary of the Laboratory, Sir Robert Mond, of a sum of money sufficient to meet the deficit. The following were elected to the various offices: *President:* The Right Hon. Lord Eustace Percy. *Treasurer:* Sir Robert Robertson. *Secretary*. Major Charles E. S. Phillips. *Managers*—Sir John Cadman, Sir James Crichton-Browne, Dr. Cecil H. Desch, Sir James Devonshire, Prof. A. C. G. Egerton, Lord Falmouth, Mr. J. S. Highfield, Mr. Arthur Jaffe, Sir William Larke, Mr. V. Warren Low, Sir Murdoch MacDonald, Mr. C. C. Paterson, Prof. J. C. Philip, Sir Thomas Purves and Admiral C. V. Usborne. *Visitors*—Mr. C. Cuthbertson, Prof. C. L. Fortesque, Dr. J. J. Fox, Captain A. C. Goolden, Prof. H. Hartridge, Mr. Emil Hatschek, Prof. F. L. Hopwood, Dr. R. Lessing, Mr. A. H. Levy, Mr. F. I. G. Rawlins, Mr. Russell J. Reynolds, Prof. H. R. Robinson, Dr. G. Shearer, Major W. S. Tucker and Colonel W. A. Vignoles.

Shakespeare's Universe

FOR his Friday evening discourse before the Royal Institution on April 30, Prof. J. Dover Wilson discussed "Shakespeare's Universe". To understand Shakespeare, he said, one must understand his universe—a very different one from that of Newton, and still more from that of Einstein. In his day the ideas of Copernicus and Galileo were just beginning to penetrate to the consciousness of the ordinary man, and did not become really influential until after the middle of the seventeenth century. Shakespeare lived in a universe which, first described by Ptolemæus of Alexandria in the second century A.D., held sway over men's minds throughout the Middle Ages and had thus served humanity for fifteen hundred years. The best picture of this universe in our literature is to be found in "Paradise Lost", for though Milton understood the new astronomy and actually refers in his poem to Galileo, whom he had met in Italy, he made use of the old scheme of ten concentric spheres with the earth at the centre. As the spheres revolved at different rates and with their own peculiar motions on one another, they made music which was known as "the music of the spheres"; the sound was inaudible to mortal ears. Shakespeare's description of this astral musical box is well-known. Thus the universe was a 'harmony'; and harmony is the master-key of Shakespeare's thinking, whether upon the world at large, upon human society, or upon man himself, man the microcosm which reflected the macrocosm in little.

MUSIC meant a great deal to Shakespeare. It had medicinal properties to which he often refers. Moreover, the man of harmony would be at once fond of music and a good citizen, because human society was thought of as a harmony also. What kept concord in man, in society and in the universe as a whole was order or degree, the virtues of which are celebrated by Ulysses in the long speech in "Troilus and Cressida" (1.3.84–124), which gives us Shakespeare's most elaborate and explicit statement of Elizabethan political philosophy. This correspondence between humanity and the starry universe was no mere poetical metaphor. In that day, the stars and the human race were thought of as intimately linked. Comets and eclipses were portents. Astrology, the study of the influence of the stars, was a most learned and elaborate science in which everyone believed. We have no right to condemn such notions as mere superstition. Men toiled at them, gave up their lives to them, as modern men of science do to science. The Elizabethans were as intellectual as ourselves, probably more intellectual. Three hundred years hence, will not our roads to truth seem as strange, as ill-directed as theirs seem to us ?

The Flow of Metals

PROF. E. N. DA C. ANDRADE delivered the twenty-seventh annual May Lecture before the Institute of Metals on May 5. Flow is most easily observed in the liquid state, but whereas there is a satisfactory theory of gases, and the structure of crystalline solids has been elucidated by the methods of X-ray analysis, very little is known of the actual behaviour of the molecules in the liquid state. Prof. Andrade has put forward a theory of liquid viscosity on the basis that the momentum is transmitted from layer to layer not, as in a gas, by the passage of molecules from one layer into the other, but by instantaneous association of the molecules when they touch, so that at any nearest approach two molecules share their momentum. On this basis, a formula can be derived which gives the viscosity of a simple liquid at its melting point, and another which gives the temperature variation of the viscosity. Molten metals are particularly suitable for experiments designed to throw light on this problem of viscosity, because they constitute liquids which consist of one kind of atom only, and they are not, in general, associated. The viscosity is conveniently measured by sealing up the molten metal in a sphere, suspended *in vacuo*, and observing the damping of the torsional oscillations of the sphere about a vertical axis due to the enclosed liquid. The method has already been used for the alkali metals, and is being extended to other metals. The flow of solids is, perhaps, at first sight, even more troublesome theoretically than the flow of liquids, for single crystals of metals exhibit plastic flow under very small stresses, whereas a perfect crystal should be strong, and also brittle. It cannot be said that there is any fully satisfactory theory of the flow of single crystals of metals, but a good beginning has been made. It is, of course, a far step from the single metal crystal to the polycrystalline metal of industry, but we know that any crystal boundary is likely to stop the propagation of a dislocation, or glide in general, and so will make the metal less weak and less liable to flow. Industry cannot, of course, wait for theory, but the only really satisfactory way to approach the problem of the strength of metals is by way of the single crystal.

Exhibition of Opals at the Geological Museum

A SPECIAL loan exhibition of Australian opals and other gemstones, from the collections of Mr. Kelsey I. Newman, has been arranged for this Coronation month at the Geological Museum in South Kensington. The exhibition comprises many of the most beautiful opals hitherto obtained from New South Wales, including the famous 'Flame Queen', a magnificent and unique stone reputed to be the finest specimen yet won from Australian opal fields. Most of the stones are 'black' opals from the Lightning Ridge field, New South Wales, where the gem occurs in fissures or joints in sandy sediments of Cretaceous age. Since the 'black' opals from this area first came into the market about 1908, more than a million pounds worth of these stones has been produced from Australian sources. A collection of Australian sapphires, principally golden stones, is also exhibited. These are from the alluvial deposits of Anakie in Queensland, from which locality stones to the value of £113,000 have been produced since 1921. Other temporary exhibitions at the Museum include a display of recent presentations of semi-precious and ornamental stones presented by H.M. Queen Mary; and a small exhibit on the geology and history of the Coronation Stone, which is compared to Old Red Sandstones of similar petrography from the neighbourhood of Scone in Perthshire

Coronation Planting Schemes

IN order to encourage planting and the beautifying of the countryside as one aspect of Coronation celebrations, the Coronation Planting Committee has been formed under the presidency of the Marquess of Lothian, with an office at 68 Victoria Street, Westminster. The Committee is fully representative of practically all associations which aim at preserving the beauty and natural scenery of Great Britain. Its objects are explained in a pamphlet entitled "For King and Countryside: Towards a more Beautiful Britain", and it may be recalled that the scheme was launched at a meeting in Guildhall on November 26, 1936. Other booklets have now been published dealing with the village and how to make it beautiful, commemorative tree planting, design of allotment areas, play-parks, window-box gardening, etc. The Committee has also issued a leaflet with suggested forms of competitions for village communities, in order to foster pride in the village, floral displays and a care for trees. It is proposed to prepare a volume recording all the amenity schemes undertaken throughout the country in commemoration of the Coronation. The Committee's aims should make a wide appeal especially to those bodies which feel that transitory decorations need to be supplemented by permanent records of the occasion.

Causes of the United States Floods

THE unprecedented floods of the Ohio River in January of this year are the subject of a paper by Prof. C. F. Brooks and Major A. H. Thiessen in the *Geographical Review* of April. Floods may occur in the eastern United States at any time of the year, for there is always an extensive warm water surface near by to provide great volumes of water vapour, and not far distant are cold surfaces to furnish moving wedges of cold air to elevate the tropical air. Outstanding floods, however, occur only where a persistent high pressure area over the western Atlantic sends air currents inland for days in succession, and a winter high pressure area over the central or northern interior of the United States sends cold air southward or south-eastward. Along the front between the masses of polar air and the tropical air continuous ascent of the warmer air occurs with resultant heavy rains. In an ascent of two miles, three quarters of the water vapour in the warm air is precipitated. The authors calculate that a mass of air, nearly saturated at 77° F. over the Caribbean Sea, chilled over land in middle latitudes to 68° F., would contain about 80,000 tons of water vapour for every square mile of surface. If this were forced upward to a height of two miles the rainfall would be 0·8 inches. This would probably occur in one day with wind at a velocity of four to eight miles an hour. Since the average speed of the tropical air mass is 30 - 40 miles an hour, it is easy to understand the occurrence of torrential rains of some five inches a day.

The Czechoslovak National Research Council

THE Czechoslovak National Research Council, which is affiliated to the International Council of Scientific Unions, was founded in 1924 originally with ten (now twenty) sections and with a membership limited to two hundred. It includes all branches of science as well as mathematics, medicine and philology, and at first its activities were mainly concerned with establishing good international scientific relations. To-day, its aims are specially directed towards the promotion and financial support of scientific research in general. In this it has the co-operation of the Czechoslovak Ministry of Education, and its work assumed considerable importance when the economic depression began to impede both international relations and the prosecution of pure researches. In 1935, a Masaryk Foundation for the endowment of scientific work was established with an initial capital of three million crowns (about £25,000 at the time) to ensure that adequate financial assistance was available for the purchase of apparatus needed for research purposes, for the publication of scientific books and memoirs and for travelling scholarships. These funds of the Czechoslovak Research Council are intended especially for the support of promising young men of science in Czechoslovakia, irrespective of their nationality or creed. In the annual report for 1936 it is mentioned that the Council awarded travel fellowships to ten students and granted 193,000 crowns (about £1,400) towards the publication of some fifty noteworthy scientific works and for acquiring apparatus. During 1937, thirteen students have been sent abroad to continue their studies. The president of the Council is Prof. B. Němec, and the general secretary, Prof. F. Ulrich, whose address is Prague II, Albertov 6.

Solar Heaters in California

THE large amount of sunshine available in California during the summer has led to the extensive use of solar water-heating apparatus for domestic purposes, and a detailed account of their construction and use is given by Prof. F. A. Brooks of the Berkeley Agricultural Experiment Station in *Bulletin* 602 of the College of Agriculture. The solar absorber consists of a zigzag pipe in a glass-covered, thermally insulated box placed on a sloping roof facing south, in front of attic windows so that the glass may be readily cleaned. An insulated pipe leads from the top of it to the top of an insulated hot-water tank in the attic roof and another pipe from the bottom of the absorber to the bottom of the tank. In the winter the solar absorber is supplemented by a coil in the range connected to the tank in the same way. The useful life of such an installation is fifteen years, and the cost per 1,000 British thermal units of solar heat absorbed is about one ninth of a cent.

Prof. M. N. Saha, F.R.S.

WE have received a pamphlet summarizing the scientific work of Prof. M. N. Saha, who, as indicated in NATURE of March 13, has recently been elected president of the National Institute of Sciences of India for the current year. In addition to his theory of stellar spectra, which in fact was begun in India before he came to England, Prof. Saha has made experimental researches with the object of confirming the theory and has produced papers on selective radiation pressure, active nitrogen, spectroscopy and atomic and molecular structure, the colours of inorganic salts, thermodynamics, Dirac's theory of the electron, and upper atmospheric phenomena. He has also written treatises on heat and on modern physics, and has promoted much research on molecular spectra by students working under him.

Association of Teachers in Technical Institutions

THE twenty-eighth annual Conference of the Association of Teachers in Technical Institutions will be held at Coventry on Saturday May 15-18 under the presidency of Mr. W. E. Park. All meetings will be held in the Technical College, Coventry. Resolutions to be discussed by the Conference comprise the following: courses of training for technical teachers; tenure of university scholarships; leave of absence for technical teachers; assistance to teachers attending short courses of the Board of Education; co-operation in technical education; the Factory Act; day technical classes. Further information can be obtained from the Secretary, A.T.T.I., 29 Gordon Square, London, W.C.1.

Congress on Spectroscopy

A FIFTH spectroscopy conference will be held at the George Eastman Research Laboratories of the Massachusetts Institute of Technology on July 19–21, repeating to a considerable extent the type of conferences held during the past four summers. A programme of papers and discussions is being prepared on analysis of materials by the emission spectrum, absorption spectro-photometry, photographic photometry, biological and chemical effects of spectral radiation, and industrial applications of spectroscopy. The usual summer courses on practical and applied spectroscopy will be offered at the Institute between June 14 and July 24. Further information can be obtained from Prof. G. R. Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

The Partial Transit of Mercury on May 11

ON May 11 next, a partial transit of the planet Mercury across a narrow segment of the sun's disk occurs between $8^h\ 31^m$ and $9^h\ 30^m$ U.T., the maximum ingress being only 7·3″. The partial transit will not be visible from Great Britain but can be seen generally from over southern Asia, the Philippine Islands, Western Australia, the Indian Ocean and Central and Southern Africa. The "Nautical Almanac" for 1937 on p. 519 gives the local circumstances for several places from which the partial transit may be observed. Dr. A. C. D. Crommelin has pointed out that it is important for observers in the southern hemisphere to watch for the appearance of any arc of sunlight around the limb of the planet (projected on the sun's limb) due to a Mercurian atmosphere. Such an arc has been observed in the case of Venus but never with certainty in the case of Mercury Although this partial transit is not visible from Great Britain, Dr. Crommelin suggests further that spectroscopists in Great Britain may see Mercury projected on the chromosphere; the nearest approach to the sun is at $9^h\ 0^m$ (Summer Time $10^h\ 0^m$) at position angle 154° from the north point.

Announcements

SIR FREDERICK GOWLAND HOPKINS has been awarded the Harben Gold Medal of the Royal Institute of Public Health. The Medal is awarded triennially, under a trust created by the late Sir Henry Harben, to the person, irrespective of nationality, who, in the opinion of the Council of the Royal Institute of Public Health, has rendered the most eminent services to public health. Past recipients of the Medal include: Louis Pasteur, John Simon, Max von Pettenkofer, Lister, Koch, Metchnikoff, Behring, Roux, Ronald Ross, Sir Charles Sherrington, and Kitasato.

THE Council of the British Scientific Instrument Research Association has accepted with regret the resignation of Dr. Harry Moore, who, since the retirement of the late Sir Herbert Jackson, in July 1933, has been the director of research of the Association. The period during which Dr. Moore has been in charge of the Association's research work has been one of great activity and usefulness to the British scientific instrument industry. Dr. Moore's particular knowledge and experience of the research needs of industry will not be lost, as he has accepted an appointment in which he will direct the research work of an industrial corporation. Mr. A. J. Philpot has been appointed to succeed Dr. Moore as director of research.

DR. E B. WORTHINGTON, demonstrator of zoology in the University of Cambridge, has been appointed director of the Laboratory at Wray Castle on Lake Windermere of the Freshwater Biological Association of the British Empire.

DR. N. K. ADAM will open a discussion, under the auspices of the University of London Animal Welfare Society, on "The Destruction of Sea-Birds by Oil Waste" in the Chemistry Theatre at University College, London, on May 10 at 5.30. Admission is free.

SIR JOHN RUSSELL will deliver the thirty-eighth Bedson Club lecture at Armstrong College, Newcastle-upon-Tyne, on May 21, at 6.30. The subject of the lecture will be "Chemistry in Modern Food Production".

THE ninth International Congress for Psychotherapeutics will be held at Copenhagen on October 2–4. The official languages are English, French and German. Further information can be obtained from the president, Prof. C. G. Jung, Kussnacht, Zurich.

AN International Congress is being organized by the International Abolitionist Federation to be held in Paris from May 20–22, when the problem of prostitution will be studied from the legal, medical and moral points of view. Further information can be obtained from the Secretariat of the Federation, 8 rue de l'Hôtel de Ville, Geneva.

THREE fellowships in psychiatry, each of the value of £300, are offered for half-time work at the London Child Guidance Clinic, 1 Canonbury Place, N.1. Further information can be obtained from the Secretary of the Council, Woburn House, Upper Woburn Place, London, W.C.1.

WE regret that in a short notice of "The Hair in Health and Disease", by Mr. Edward Lawrence, in NATURE of May 1, the statement was incorrectly made that the author was a barber. Mr. Lawrence has been a fellow of the Royal Anthropological Institute and member of the Geologists' Association since 1885. He is described on the title page of his book as scientific correspondent of the *Hairdressers' Weekly Journal* and author of "Savage Life and Custom", etc., and his works include, he informs us, "Over 400 contributions on folk lore, antiquarian and other subjects to *Hairdressing Fashions* and *The Hairdressers' Weekly Journal*".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 805.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

An Attempt to Detect the Disintegration of the Neutron

EXPERIMENTS performed by Kikuchi, Aoki and Husimi[1] were interpreted as evidence for the disintegration of the neutron. When neutrons from a heavy water target bombarded by deuterons were passed through various substances, electrons having energies up to 1 MeV. were observed, and it was suggested that these could be accounted for by the reaction :

$$n \rightarrow p + e + 1 \text{ MeV.}$$

The probability that this should happen during the interaction of a neutron with the field of any given nucleus was expressed in terms of a collision cross-section, varying from about 10^{-24} sq. cm. for heavy nuclei to about 10^{-25} sq. cm. for light nuclei.

We have failed to confirm this in two different types of experiments. The first set of experiments were made to detect the proton and the electron starting from a point in the gas in a Wilson cloud chamber. Experiments to determine the statistics of the neutron-proton collision were in progress, and the same apparatus was used in these experiments. A description of the apparatus and the method of measurement will shortly be published elsewhere[2]. Oxygen at about three atmospheres pressure was used in the chamber, so that any proton recoils obtained would be due to the water vapour. This number could be estimated from the previous experiments with the apparatus. 150 photographs were taken, and the number of recoils observed was 0·6 per expansion, and this is the number to be expected from the hydrogen in the water vapour. In no case was there an electron track starting at the beginning of a proton track. The condition of the chamber was such that electron tracks due to the X-radiation from the accelerating tube were clearly visible. The ranges of the recoil protons were measured, together with the angles they made with the direction of the source. In most cases these were consistent with the assumption that they were due to proton recoils from 2·5 MeV. neutrons. The number of pairs of proton and electron tracks to be expected, if the neutron disintegrates into a proton and an electron with a collision cross-section of 10^{-24} sq. cm., is 30 per expansion. Hence we conclude that the cross-section for the disintegration of the neutron is at least 1,000 times smaller than that suggested by Kikuchi

The second experiment was an attempt to observe by a coincidence method the simultaneous production of a proton and an electron from a neutron. An intense source of neutrons was obtained by bombarding a target of $Al(OD)_3$ with deuterons accelerated through a potential of 70 kV. The ion source was of the type described by Tuve, Hafstead and Dahl[3]. Later, a still more intense source was obtained by using a heavy water target cooled with liquid air. By comparison with a standard radium-beryllium source, using a boron trifluoride chamber, the strength of the neutron source was found to correspond to about 600 millicuries. A small argon-filled ionization chamber connected to a linear amplifier was used to detect the protons produced in the argon or in the walls of the chamber, and a Geiger counter was used to detect any electrons produced in the chamber. The front of the ionization chamber was covered by an aluminium window of 2 cm. air equivalent stopping power, and was placed about 5 mm. from the front of the Geiger counter. From the geometry of the apparatus, it was estimated that 1/10 of any sufficiently energetic electrons produced in the ionization chamber would enter the Geiger counter. A 'scale of two' thyratron counter was arranged to count coincidences between the kicks in the two counters. The centre of the ionization chamber was placed 4–5 cm. from the neutron source.

The number of coincidences observed with and without the interposition of a brass sheet, capable of stopping the electrons, between the two counters were compared. 72 coincidences were observed without the brass and 70 with it present. The experiment therefore gives no evidence that the neutron disintegrates into a proton and an electron. From the dimensions of the apparatus it is estimated that the cross-section for the disintegration of the neutron, if it takes place, is less than 3×10^{-26} sq. cm.

C. W. GILBERT.
C. L. SMITH.
J. H. FREMLIN.

Cavendish Laboratory,
Cambridge.
April 23.

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[1] Kikuchi, S., Aoki, H., and Husimi, K., NATURE, **138**, 841 (Nov. 14, 1936). *Proc. Phys.-Math. Soc. Japan*, **18**, 727 (1936).

[2] Dee, P. I., and Gilbert, C. W., in course of publication.

[3] Tuve, Hafstead and Dahl, *Phys. Rev.*, **48**, 240 (1935).

Thermal Precipitation of Radioactive Substances

THE usual method of separating solid radioactive particles from the gas phase is precipitation by an electric field. This is the classical procedure for the collection of the active deposit of radon and thoron, and can also be applied to artificial radio-elements, such as radio-arsenic prepared in arsine by neutron bombardment[1]. The process depends on the presence of an electric charge on the particles ; and unfortunately, at least in the case of artificial radio-elements produced by slow neutrons, such a charge does not necessarily exist. It is, therefore, of practical as well as theoretical importance to seek other means of concentrating the radioactive particles. One promising means which we have tried is 'thermal precipitation', which is based upon a very simple principle.

A heated body in a cooler gas is surrounded by a dust-free space, a phenomenon already observed by Tyndall. Recently, it has found practical application as a means of collecting dust samples from air; for when a gas stream is forced to pass within the dust-free space of the hot body, whatever dust it may contain is deposited on the unheated surface facing the heated body[2]. So far, the method seems to have been tested only on particles visible under the microscope; but as between the limits of diameter of at least 20 μ and about 0·2 μ the efficiency of the method does not depend on the size of the particles[3], it seemed promising to apply it to the collection of the small aggregates composed of radioactive substances. The following account will show that our experiments were successful.

We sent a slow stream of air, carrying radon in equilibrium with its active deposit, through a small thermal precipitator consisting of a wire (0·25 mm. diameter) between two parallel microscopic cover-slips each held 0·1 mm. from the wire. If the wire were at the same temperature as the glass plates, only the usual very slight, and perfectly homogeneous, contamination of the plate by the active deposit could be observed. If, however, the wire were heated to a temperature of 200° C., the active deposit was precipitated on both glass plates, opposite the wire, in the form of a narrow straight line. This we verified by measurement of the activity of the plate in a Geiger-Müller counter, using a lead screen with a slit which was moved over the surface of the glass parallel to the former position of the wire, and by photographing the active deposit on the cover-slip by fixing the latter at a very small distance from a photographic plate. The possibility of preparing radioactive sources not on a wire but on a plate, and nevertheless highly concentrated in a narrow line, may conceivably be of great use in radioactive work.

The efficiency of the precipitation was tested by inserting an electric condenser immediately behind the thermal precipitator. It was found in two experiments that when the precipitator wire was heated, 67 per cent of the deposit formerly collected in the condenser remained in the thermal precipitator. It is probable that after establishing the best conditions of temperature and geometrical arrangement, even a higher percentage of the radioactive particles would be caught; but only a closer study will reveal whether there is a lower limit for the size of particles which can be precipitated thermally.

We hope now to apply the method of thermal precipitation to the collection of artificial radio-elements.

F. A. Paneth.
C. Rosenblum.

Imperial College of
Science and Technology,
London, S.W.7.
April 5.

A Note on the Theory of β-Radioactivity

The ratio between the probability of absorption of a K-electron by a nucleus and the total probability of emission of a positron by the same nucleus can be calculated on the hypothesis put forward by Fierz[1] that the interaction term in the neutrino theory contains the five possible invariants. Let J_K be these invariants, obtained by scalar products from combinations of Dirac's matrices. If one puts $H_\beta = \sum\limits_K C_K J_K$, the probability of the process of β-radioactivity is proportional to $|H_\beta|^2$. Let $\vec{p}_\nu$, $\vec{p}_{el}$, W_{el} be the momentum of the neutrino, that of the electron, and the energy of the latter, these quantities being measured in units of mc and mc^2 (m = mass of the electron; c = velocity of light). If the atomic number Z of the reacting nucleus is small, one obtains for the probability $P(W)dW$ of the emission of an electron (a positron), the energy of which lies between W and $W + dW$:

$$(1)\qquad P(W)dW = k\Big[C_1^2 + C_2^2 + 3C_3^2 + 3C_4^2 + \frac{\vec{p}_\nu \cdot \vec{p}_{el}}{p_\nu \cdot W_{el}}\left(C_1^2 - C_2^2 - C_3^2 + C_4^2\right) \pm \frac{1}{W_{el}}\left(C_1C_2 + 3C_3C_4\right)\Big]\, p_\nu^2 p_{el} W_{el} dW_{el},$$

where k is a constant. The energy p_ν of the neutrino is equal to the difference W_0 between the energies of the initial and the final nucleus, minus the energy W_{el} of the emitted particle. The signs ± in (1) refer to an electron or a positron.

Let us put $C_1^2 + C_2^2 + 3C_3^2 + 3C_4^2 = A$, $C_1C_2 + 3C_3C_4 = B$. The C_i's are real numbers, whence $|B| < A$.

We can calculate the total probability of emission of a positron, the energy of which lies of course between 1 and W_0, and also the probability of absorption of a K-electron, which is obtained from the same relation (1), only with a different energy balance. A similar calculation has already been made for different interactions[2]. After integrating over the angles, one obtains for these probabilities $\int_1^{W_0} P(W_{pos})dW_{pos}$ and P_K respectively; the ratio λ of the latter to the former can be obtained experimentally. This ratio is here equal to

$$\lambda(W_0,Z) = \frac{P_K}{\int_1^{W_0} P(W_{pos})dW_{pos}} = 10^{-4} Z^2 \frac{1 + C}{\zeta_1(W_0) - C\,\zeta_2(W_0)},$$

where the constant C is equal to

$$C = B/A, \quad |C| < 1.$$

The functions $\zeta_1(W_0)$ and $\zeta_2(W_0)$ are the following:

$$\zeta_1(W_0) = \frac{137^2}{240\pi} \times \frac{(4W_0^4 - 18W_0^2 - 16)\sinh\cosh^{-1}W_0 + 30W_0\cosh^{-1}W_0}{(W_0+1)^2},$$

$$\zeta_2(W_0) = \frac{137^3}{240\zeta} \times \frac{(10W_0^3 + 65W_0)\sinh\cosh^{-1}W_0 - (60W^2 + 15)\cosh^{-1}W_0}{(W_0+1)^2}.$$

It should be noticed that for all values of W_0 (that is, $1 < W_0 < \infty$), one has $\zeta_2(W_0) < \zeta_1(W_0)$.

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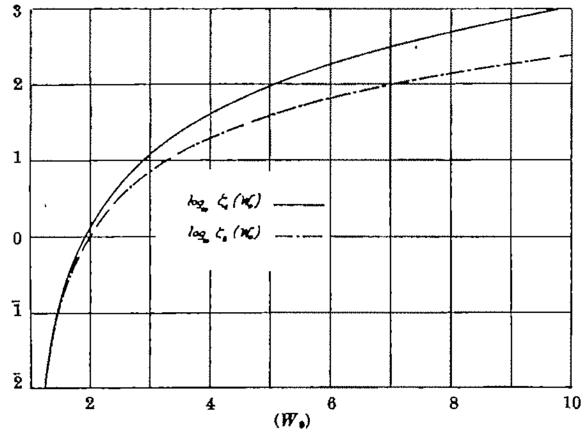
W_0 contains the rest energy and the kinetic energy of the emitted (absorbed) particle.

Table I.

W_0	1 5	2	3	4	5	6	7	10
$\zeta_1(W_0)$	0·1409	1 3062	12·185	41 416	97·652	189·05	324 36	1076 3
$\zeta_2(W_0)$	0 1826	1 0575	7·1836	20·104	40 190	67 392	101·95	248 74

Table 1 gives numerical values of ζ_1 and ζ_2 for W_0 lying between 1·5 and 10 mc^2, and Fig. 1 gives the common logarithm of these functions.



It is of some interest to notice that two experiments would be sufficient to test the above theory, since a single one is enough to determine the constant C:

$$C = \frac{\lambda\zeta_1 - 10^{-4} Z^3}{\lambda\zeta_2 + 10^{-4} Z^3},$$

the experiments being carried out for different values of W_0 and Z, and giving directly the corresponding values of the ratio $\lambda(W_0,Z)$. In the calculation of the ratio λ, the particular value $C = 0$ leads to the hypothesis of Fermi in which J_1 alone (put equal to unity) enters into the interaction term.

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Copenhagen.
March 31.

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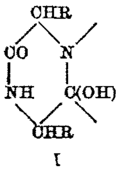
[1] Fierz, M., *Z. Phys*, **104**, 553 (1937).

[2] See Mercier, A., *C.R.*, **204**, 1117, (1937). See also Møller, C., *Phys. Rev.*, **51**, 84 (1937).

Intramolecular Folding of Proteins by Keto-Enol Interchange

IN recent communications[1] to this and other journals, the hypothesis has been developed of a lactam-lactim interchange (I) to account for the linear folding of polypeptide chains in keratin and myosin and what appears to be a similar, generalized, intramolecular folding in the 'globular' proteins. We wish to point out that in certain respects the argument is unchanged if, instead of a lactam-lactim, a keto-enol interchange (II) is postulated.



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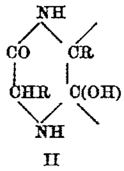

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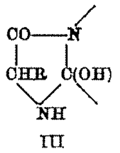

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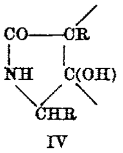

IV

There would appear t
alternative possibility, y

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on the lactam-lactim
respectively, invite cons

Textile Physics Labor
University of Leed

Mathematical Instit
Oxford.
April 2.

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Chem. Weekbl., **33**, 778 (1936).
(1936); **138**, 241 (1936); *Proc.*
F. C., NATURE, **138**, 242 (1936

[2] Jordan Lloyd, D., *Biol. Rev*
and Marriott, R. H., *Trans. Far*
and Pauling, L., *Proc. Nat. Aca*
and Jordan Lloyd, D., NATUR

[3] Huggins, M. L., NATURE,

Anti-Knocks and Pro-
of

IT is well known that
of 0·1–0·2 per cent are c
tion completely, whilst
on the normal combusti
on the chemical theory
to which detonation c
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Gusev and Neuman
maxima occur in the r
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fuel concentrations are 110 per cent
ent with respect to the stoichiometric

ents, conducted in a steel cylinder of
ty, have shown that the initial rate of
pentane air mixtures passes through
when the pentane concentration x is
The accompanying table shows the
ssure ΔP_x at different time intervals t
r spark ignition, for different pentane
, x per cent. The initial temperature
were 20° C. and 4·6 atm.

35	45	55	60	70
5·62	10·25	15 5	17·9	19·75
9 75	16 3	24·0	27·0	28 0
8 5	15·0	21 2	24·7	25·10
5 0	9 5	13 8	29·5	27·25
1 5	3·0	5 64	7·25	10 75

rom these figures that, with x equal to
the velocity of flame propagation in-
at the end of the combustion process.
calculate, on the assumption that the
mixture is compressed adiabatically in
me, that after 55 millisec. the tempera-
atm. will be approximately 360° C. It
n, however, by Aivazov and Neumann[5],
ese conditions a cold flame will be
n induction period of a few milliseconds,
gives rise to a high concentration of

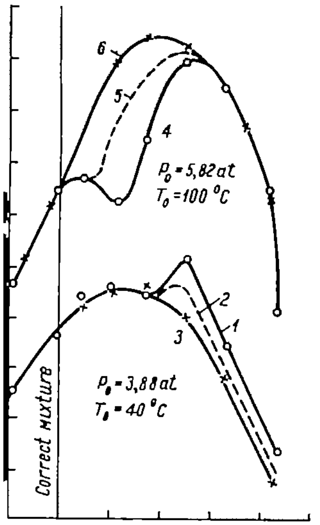

Fig. 1.

h would easily explain the acceleration
tion rate and the onset of detonation.
of the latter is shown on the indicator
experiments by a sharp rise of pressure
by oscillations, and also by the char-
allic knock. With weaker mixtures the
iod of the cold flame is longer, and
bustion of the mixture can take place
iation of a cold flame.

In spite of the relatively low initial speed of propagation of the flame front in the 125 per cent mixture, the time τ for complete combustion is less than that for other concentrations on account of detonation. Thus:

$$x = 100 \quad 110 \quad 115 \quad 125 \quad 143$$
$$\tau = 70 \quad 64 \quad 65 \quad 60 \quad 110$$

The chemical theory of detonation is therefore capable of explaining both maxima on the Curves 1 and 4 of Fig. 1, where the mean velocity is plotted as a function of the pentane concentration. The effect of adding 0·33 per cent and 0·67 per cent lead tetra-ethyl ($Pb(C_2H_5)_4$) is shown in Curves 2 and 3, from which it is clear that whilst this anti-knock is without influence on the velocity of normal burning, it narrows and finally eliminates the region of detonation, so that at a concentration of 0·67 per cent the normal curve $\bar{v} = f(x)$ is obtained with a maximum for x at 110 per cent. The addition of 4·46 per cent isoamylnitrite (Curve 5), on the other hand, increases the detonating tendency of weak mixtures without affecting the shape of the curve for richer mixtures. The detonation region widens still more when 8·3 per cent $C_5H_{11}ONO$ is added (Curve 6) and the curve then contains only one maximum for x at 115 per cent. According to the thermal theory of flame propagation, the maximum should lie at about 110–115 per cent when dissociation of the products is taken into account.

Since lead tetra-ethyl increases and nitrites decrease the induction period of hydrocarbon cold flames, these experiments lend further confirmation to the chemical theory of detonation in motors.

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[1] Callender, *Engin.*, **123**, 147, 182, 210 (1927).

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Rate of Growth of Totally Submerged *Cardium edule*

By good fortune, data on the growth of *Cardium edule* have now been collected covering four summers' growth.

This bivalve is usually found between tide-marks, but it occurs also below low-water mark in this and other localities. The material for the present study was taken from the bottom of a Marine Lake constructed near high-water mark at New Brighton and first filled with water in May 1933[1]. In that year, there occurred a fortuitous settlement of cockles which provided a segregated population of known age. The conditions in the lake are not normal for submerged marine animals in that the water is stagnant, except when renewed by those spring tides which rise hereabouts 28 ft. or more. Each year the lake has been emptied about February for inspection, when the bottom is exposed; collections of cockles have been made yearly, except in February 1934. Significant settlements of young occurred in 1933 and 1936, only rare representatives of other seasons having survived[1].

The growth of the 1933 spat in the second and third summers has already been given[1] and is shown in Fig. 1 at 2 and 3, and that for the fourth summer is now added from a sample of 286 specimens recovered in February 1937. This year, large samples of the 1936 spat were also obtainable, and the size distribution in 1,000 is given in Fig. 1 in millimetre groups at 1 to represent the 0-year class at the end of the first summer's growth. This class is not serial with the others given in Fig. 1, but is probably sufficiently similar to the 1933 spat at the end of the summer of 1933 to give the trend of the mean rate of growth, *RR*. The latter curve is drawn through the co-ordinates for mean size (length) for each year-group and age in summers. It is of characteristic type and shows that decrease in length with age is not markedly accelerated at an age of four summers. It is known that length at later ages falls off sharply, and it is hoped that adequate samples of the same material may be obtained in the future to give definite expression to this.

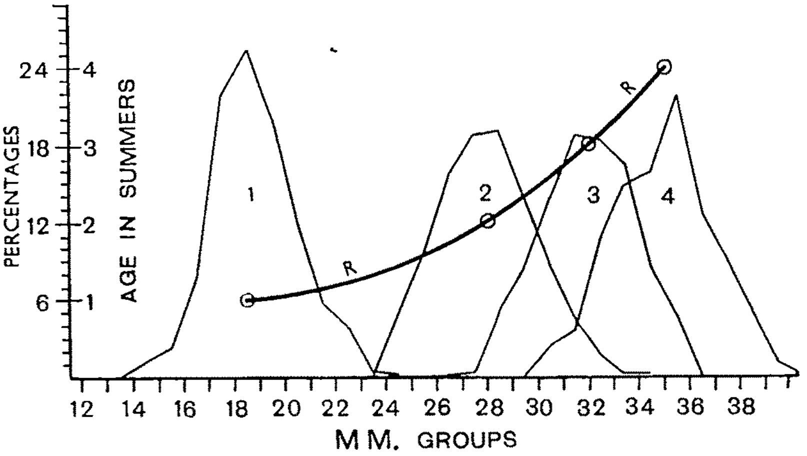

Fig. 1.

LENGTH-DISTRIBUTION IN MILLIMETRE GROUPS OF RANDOM SAMPLES (1, 2, 3 AND 4) OF *O. edulis* FOR, RESPECTIVELY, 1, 2, 3 AND 4 SUMMERS' GROWTH, COLLECTED IN NEW BRIGHTON MARINE LAKE; 1 AND 4 IN FEB. 1937, 2 IN FEB. 1935, 3 IN FEB. 1936. *RR* GIVES THE MEAN RATE OF GROWTH FOR ONE TO FOUR SUMMERS OF GROWTH.

Data for each summer group are as follows:

Age in summers	Year spatted	No. of individuals in sample	Range in size (length) in mm. groups	Approx. modal value in mm.	Approx. increment in modal value in mm.
1	1936	1000	13–25	18·5	—
2	1933	1119	21–34	27·5	9 0
3	do.	1004	21–38	31·5	4 0
4	do.	286	29–40	35 1	3 6

The spat have been found to settle in this locality about the end of June, so that age in summers is not the same as age in calendar years.

There is a notable absence of very small spat in the 1936 brood, which was collected on a 1 mm. sieve. Possibly only the early spatfalls survived or, on the other hand, the late spat were eaten by crabs, fishes or other inhabitants of the lake. Although these bivalves have been under water constantly, their growth is less than that found on the shore in
the south of England[2], and that o
which will be dealt with in the futu
there can be little doubt that grow
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heavy mortality
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J. McC
J. M.
H. C.
F. B.
J. H.

Department of Zc
University of Liv
March 25.

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[1] Bunting, L. E., Esluck, A., Jones, J. W., and Or
137, 705 (1936).

[2] Orton, J. H., *J. Mar. Biol. Assoc.*, 14, 2, 289 (1

Production of Uredia and Telia of *P*
on *Berberis vulgaris*

HITHERTO, in *Puccinia graminis* Pe
and telial stages have regularly oc
gramineous hosts, and the pycnial
and æcial stages on the common bar
vulgaris L.) or on closely-related hosts
from this host relationship has ever
In the course of greenhouse studies, in
plants were infected with pure cultures
races of *P. graminis Tritici* Erkss. a
have recently observed that two cu
distinct tendency to produce uredia a
barberry.

One of these cultures was derived
between races 36 and 9. In the F_1 and
no deviation from the normal host re
observed. An investigation of an F_2 cul
as race 36, was undertaken in Janua
sporidia of this culture readily infecte
produced pustules with relatively fe
scant pycnial nectar. Pycniospores
present in the nectar. Neither the
the nectar of these pustules nor the tra
from pustules of other races to them
to form æcia.

Forty-four days after the inoculat
we observed small uredia on the up
several of the pustules. Further exami
that, in a total of 129 pustules, uredi
in 50, and that 21 of these contain
uredia and telia may occur on the
surface of a pustule, but more freq
upper surface.

The failure of pustules to produce æcia after intermixing of the nectar is not a new phenomenon. It has been observed from time to time in the F_2, F_3 and F_4 progeny of certain crosses, but uredia and telia were never before found associated with this condition.

The other culture that produced uredia and telia on barberry was obtained from a field collection made in 1934, and was identified as race 21. Sporidia from telia developed in the greenhouse in 1936 produced two types of pustules on barberry in about equal numbers. Pustules of the first type were normal in appearance and, on intermixing of the nectar, produced æcia. The pustules of the second type were almost white, with no pycnia, or only rudimentary ones that rarely produced pycniospores. Uredia were recently observed on five pustules of this type on a barberry plant inoculated 43 days previously. Two of these pustules also contained teliospores. Fig. 1 shows an infected barberry leaf bearing a compound pustule, one component of which contains æcia and the other small uredia.

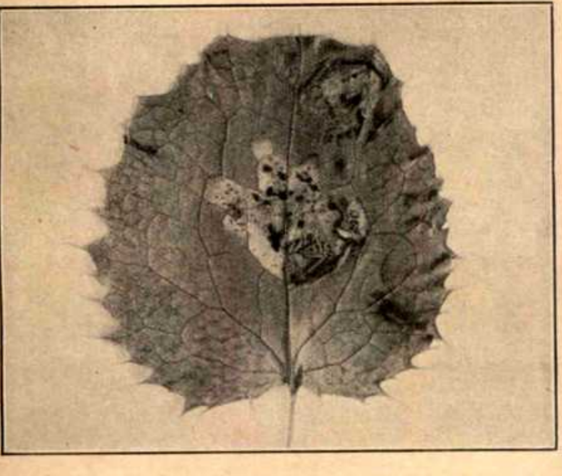

Fig. 1.

LOWER SURFACE OF A BARBERRY LEAF SHOWING A COMPOUND PUSTULE OF *Puccinia graminis Tritici* OF RACE 21. ONE COMPONENT OF THE PUSTULE CONTAINS AECIA, THE OTHER, SMALL UREDIA. (SLIGHTLY ENLARGED.)

The urediospores and teliospores produced on the barberry by both of these races are normal in appearance. The urediospores germinate normally and readily infect wheat seedlings, but are apparently unable to infect barberry leaves. The strains are therefore still heterœcious. The nuclear condition has not been investigated. A fuller report will appear later.

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Flashing of Fireflies in Jamaica

DURING the past summer, the members of the Seventh Botanical Expedition of the Johns Hopkins University witnessed displays of firefly activity in the British West Indies as spectacular in their way as any reported from the Orient.

In front of the expedition's laboratory at Chestervale, in the Blue Mountains of Jamaica, there was a thatch palm which bore below its whorl of leaves an inflorescence a metre in diameter. For about a week in June, and again a month later, this inflorescence was transformed nightly into a sphere of seething flame by the flashes of thousands of fireflies which gathered there. Later, other displays were discovered, particularly on two large acacia trees overhanging the Clyde Valley which harboured such prodigious swarms of fireflies that the nebulous glow was visible half a mile away.

All the fireflies on these trees were of one species, *Photinus pallens*, and the females outnumbered the males in the ratio of 4 : 3. Each firefly flashed regularly about twice a second while walking along the twigs, and entirely independently of any other individual. There was no sign of synchronism or of response between any individuals or between different trees. The flashing was not inhibited by heavy rain, by lightning, or by the beam of a powerful flashlight, but did not occur on moonlight nights. It continued from about 8 p.m. until 3 a.m., and during dull days many of the fireflies remained in the trees all day.

Although these enormous aggregations were particularly brilliant on rainy nights, it is probable that they did not arise as a consequence of the fireflies taking shelter, because displays were also observed on clear nights. Likewise, although some individuals were seen apparently sucking juice from the fresh fruit scars on the palm tendrils, it is probable that food was not the specific cause of the aggregations, since the fireflies collected in several species of trees.

Photinus pallens is conspicuously positive to continuous illumination, and is the only Jamaican Lampyrid firefly which is frequently attracted indoors by lamplight. It was found that when the beam of a flashlight was directed into a bush or on to the grass, specimens of both sexes of *P. pallens* soon begin to fly from all directions, alight in the illuminated area, and flash regularly. Such nuclei, when they came to contain a dozen or so specimens, maintained themselves autonomously by the addition of new individuals from the surrounding area. Accordingly, it seems probable that this photo-positivity is the explanation of the huge swarms which gathered in the palm and acacia trees. Several individuals collected fortuitously in a small area would make sufficient illumination to serve as a focus for the addition of new recruits, like bees joining a swarm, and sufficient individuals remain on the tree during the day to insure its becoming a focus on the following night.

Whatever the cause of the aggregation, it serves an important function in bringing the sexes together for mating, and many coupling pairs were observed on the palm tendrils. The mating, however, appears to be due entirely to accidental contact of the sexes during their peregrinations on the branches. The aggregation habit thus seems to take the place of the accurate systems of flashing signals which serve to bring male and female together in some species of firefly.

I am greatly indebted to the late Prof. D. S. Johnson for laboratory facilities in Jamaica, and to the National Research Council of the U.S.A. for research funds.

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Potassium Permanganate as an Aid to the Production of Asexual Fructifications by *Phytophthora erythroseptica* Pethybr.

WHEN small portions of pure cultures of *Phytophthora erythroseptica* are transferred to water, conidiophores and conidia (zoosporangia) usually develop from the mycelium after a few days, and this behaviour has been found to be stimulated by the addition of a little permanganate solution to the water. Young vigorously growing cultures do not react in this way.

To produce these results the following method is recommended. Portions of the medium (ground Quaker oats agar) in which the fungus has been under cultivation for 6–12 months are placed in drops of tap water on microscopic slides laid on white paper, and permanganate solution (0·01–0·02 per cent) added to the water, until a faint pink colour becomes just perceptible. Cover slips are put on the preparations, and the slides are then placed in Petri dishes lined top and bottom with moist blotting paper, and incubated at 16°–20° C. After 72 hours, sometimes sooner, the production of conidia begins, and their formation reaches its maximum in 84–96 hours. If too much of the reagent is added the medium and hyphæ stain brown, and fructifications may not occur until after 6–7 days. Cultures one month old will give conidia when treated in this way, but older cultures are preferable as germination of some of the oospores in the latter also occurs.

It may be pointed out that this method places this fungus in an exceptionally good position for teaching purposes, as the following facts may all be rapidly demonstrated with it:

(*a*) Inoculation of potato tubers with pure cultures produces typical pink rot in 8–10 days, and the parasite is easily recovered in pure culture from the rotted tubers.

(*b*) Sexual organs are freely produced in culture on ground Quaker oats agar in a comparatively short period.

(*c*) Using old cultures and treating with potassium permanganate as described above, the germination of the oospores, both by long hyphæ and by short ones ending in a conidium, may be observed, as recorded by Pethybridge[1]. In addition, the abundant production of sympodial conidiophores bearing conidia by the old hyphæ can be studied.

(*d*) When the formation of conidia is at its maximum, or abundant, and slides are removed from the incubator to the laboratory bench, germination of the conidia (zoosporangia) by zoospores takes place in about two hours.

I know of no other fungus of this type in which all these points can be studied so easily, and this makes it particularly useful for class work.

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[1] *Sci. Proc. Roy. Dub. Soc.*, **14**, 179–198 (1914).

Specific Ionization by High-speed Particles

THEORETICAL calculation of the interaction between fast electrons and hydrogen atoms (Bethe, Williams[1], etc.) predict an increase of primary ionization when the energy of the incident particle exceeds about one million electron-volts. Wilson chamber experiments have not yet given quantitative results of sufficient precision to ascertain if that increase is real or not.

By a modification of our method[2,3], used for the determination of specific primary ionization of hydrogen by cosmic radiation, we have succeeded in measuring the variation of primary ionization of hydrogen by electrons of energy ranging from $0 \cdot 6 \times 10^6$ eV. up to that of cosmic rays. Contrary to theory, we find that the primary ionization *decreases* for high-energy particles.

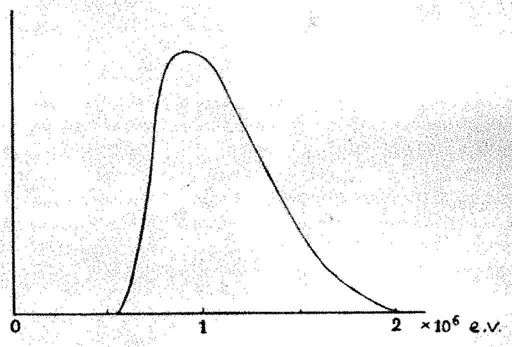

Fig. 1.

The electron source, used near the theoretical minimum ($v/c = 0 \cdot 97$), was a preparation of uranium-X_1 in equilibrium with uranium-X_2 (prepared by the method described by E. Stahel[4]); uranium-X_1 beta rays and secondary electrons were eliminated by means of a magnetic field. The result is a narrow beam of electrons of energy distribution shown in Fig. 1. The beam passes across the diameter of a hydrogen-filled Geiger-Müller counter (diameter about 2 cm.) through very thin walls ($0 \cdot 4$ mgm. cm.$^{-2}$); the slow secondaries emitted in the walls and on the edges of the last slit of the magnetic monochromator amount to less than 4 per cent of the primary rays.

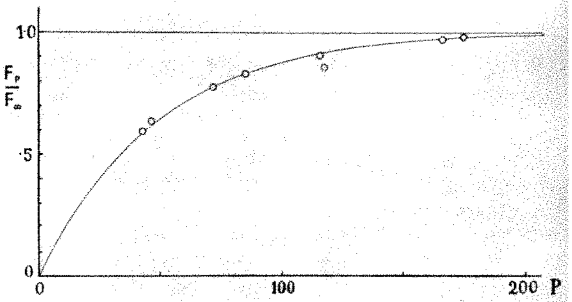

Fig. 2.

The frequency of counter impulses was measured for different pressures of hydrogen, ranging from 40 mm. to 180 mm. of mercury (N.T.P.). To eliminate the effect of residual counts (cosmic and gamma rays), which amount to about 15 per cent of the beta radiation, we automatically register that frequency every 30 minutes, with the shutter of the uranium-X source alternatively open and closed.

Fig. 2 gives an example of a series of measurements; the curve is the result of the calculation, taking the specific ionization as $7 \cdot 8$ cm.$^{-1}$.

The primary ionizations, computed from a series of such measurements, lie between $7 \cdot 5$ cm.$^{-1}$ and $8 \cdot 5$ cm.$^{-1}$. Although we hope to increase the precision of the method, it is already sufficient to show that the ionization near 10^6 eV. is definitely larger than at cosmic rays energy, where it is between 6·0 [2,3] and 6·2 [5].

A detailed account of this investigation will be published in the near future.

An incorrect reference and some ambiguity in a sentence of my previous letter[3] may have given a wrong idea of my opinion about the priority of the method used. I intended to say that Kolhorster's method[8,9] for measuring the *total* specific ionization was not convenient for the measurement of *primary* specific ionization; the principle of our method was suggested by L. Tuwim[6] and tested by us in 1934[7]. The method was applied to cosmic radiations independently by us (April 1936) and by Danforth and Ramsay (June 1936).

Note added in proof: A better series of measurements gives us a value of 8·2 cm.$^{-1}$ for 10^6 eV. energy.

MAX G. E. COSYNS.

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"Fondation Médicale Reine Elisabeth",
Brussels.
March 29.

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[1] Williams, *Science Progress*, 121, 915 (1936).
[2] "Etude des compteurs . . .", *Bull. Tech. A.I. Bruxelles* (1936).
[3] NATURE, 138, 284 (1936).
[4] Stahel, Thesis Zurich (1922).
[5] Danforth and Ramsay, *Phys. Rev.*, 49, 854 (1936).
[6] Tuwim, L., *J. Phys Rad.*, 3, 614–620 (1932).
[7] Cosyns and de Bruyn, *Bull. Acad. Belg*, 20, 371 (1934).
[8] Kolhorster, W., and Tuwim, *Naturwiss.*, 19, 917 (1931).
[9] *idem*, *Z. Phys*, 73, 130 (1931).

Origin of Static Electricity on the Surface of Solid Dielectrics

INVESTIGATIONS, which I have carried out at intervals over the past twenty years, into the origin of the static electrical charges on the surface of cellulose during the manufacture and subsequent manipulation of paper, have shown a property—not peculiar to cellulose but shared by many other solid dielectrics—consideration of which may lead to a clearer conception of the origin of static charges by friction and contact.

When two plates of the same solid dielectric having identically similar surfaces are rubbed against each other, there is no sign of electrical charging by friction. I have found, however, that when two such surfaces of the same dielectric are pressed together into intimate contact, under a pressure of 100–120 lb. per square inch, and then separated, the two surfaces which have been in close contact are charged electrically, one positively and the other negatively. The potentials produced in this way are comparable in strength with those arising under the same conditions by pressure on plates of different dielectrics, although in the latter case the charges are much weaker than those produced by friction between the different dielectrics.

This development of an electric field in the boundary layer between two surfaces of the same dielectric pressed into intimate contact I have found to occur in solid dielectrics of such varying composition and molecular structure as ebonite, dry cellulose, dry gelatine and white mica. So far, it has not been found possible to predict which surface will become positively charged, and which negatively, or why, but I have observed that when fairly large surfaces electrified in this way are examined, it is sometimes found that one surface may show patches having a negative charge surrounded by areas having a positive charge, both corresponding to charges of opposite signs on the coincident areas of the second surface with which the first was in contact.

These phenomena cannot be explained in the light of the theories of Owen[1], Jones[2], Lenard[3] or Nernst[4], on the origin of frictional or contact electricity, but a possible explanation may be found in Freundlich's theory[5] of the production of charges by the rupture of surface adsorption layers.

JAMES STRACHAN.

"The Orchard",
Meopham.
March 22.

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[1] Owen, M., *Phil. Mag.*, 17, 459 (1909).
[2] Jones, W. M., *Phil. Mag.*, 29, 261 (1915).
[3] Lenard, P., *Ann. Phys.*, 47, 463 (1915).
[4] Nernst, W., "Theoretische Chemie", p 878 (11th Edition, 1936).
[5] Freundlich, H., "Colloid and Capillary Chemistry", p 285 (1922).

The Dependence of the Thermal Expansion Coefficients of Silver Haloids on Temperature

EUCKEN and Dannohl[1] observed an increase of the expansion coefficients of the haloids of the alkali metals with temperature. Monocrystals of silver chloride and silver bromide also exhibit a peculiar increase of expansion at high temperatures (near the melting point) several times larger than those observed by Eucken and Dannöhl.

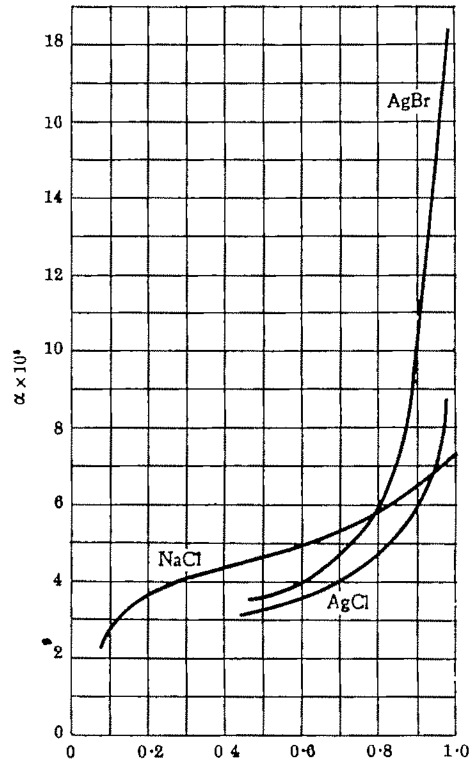

Fig. 1.

In Fig. 1 the expansion coefficients of sodium chloride, silver chloride and silver bromide are plotted as ordinates, while fractions of the absolute melting points T_s are plotted as abscissæ. The dependence increases sharply from sodium to silver and from chlorine to bromine, that is, the change is parallel to the increase of the deformation of the ions.

The character of the change of α with temperature for the group of haloids of potassium, sodium and lithium which crystallize in lattices of the same type is fairly similar. However, it appears from data already given by Eucken and Dannohl that the expansion of compounds which are more easily polarized shows a tendency to increase from 0·6 T_S.

The replacement of the alkali metals by the strongly deforming ion of silver causes the appearance of a large dependence of the expansion coefficient on the temperature, when with increase of the amplitude of the thermal motion the influence of the polarizing forces increases. Silver chloride appears to represent the limiting case, since silver iodide already crystallizes in a different type of lattice.

As a characteristic of the condition of the lattice of these compounds at high temperatures, it is of interest to recall the following jumps in the electrical conductivities at the melting point: sodium chloride, 3,000; silver chloride, 30; and silver bromide, 5.

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Leningrad.

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[1] Eucken, A., and Dannöhl, W., *Z. Elektrochem.*, **40**, 814 (1934).

The Low-temperature Transformation of Heavy Ammonium Chloride

AFTER having studied the low-temperature transformations of the ammonium halides, it was of interest to examine the influence of a substitution of the ordinary hydrogen in the ammonium group by heavy hydrogen. We started with ND_4Cl, obtained in the following way, working in evacuated apparatus. DCl prepared in a vacuum from D_2O (99·97 per cent) and phosphorus pentachloride, was after several distillations finally dissolved in D_2O. ND_3 prepared from D_2O and magnesium nitride (Mg_3N_2) and also several times distilled was dissolved in the DCl solution. This solution was evaporated in a stream of dry pure nitrogen, and then the solid ND_4Cl was dried in a vacuum desiccator over phosphorus pentoxide. No impurities could be detected in the ND_4Cl prepared in this way.

With ordinary ammonium chloride our statical dilatometrical investigations showed[1] at about − 30° a heterogeneous transformation, together with the phenomenon of heterogeneous hysteresis, within a temperature range of 0·3°. The result obtained with heavy ammonium chloride is quite different. The transition is a continuous one; the steepest part of the V,T curve appears in the neighbourhood of about − 24° and hysteresis has disappeared. This change in character of the transition is very remarkable. The shift of the transition to higher temperature was expected, but the change of a heterogeneous transformation into a homogeneous one was surprising, and the disappearance of the phenomenon of hysteresis, significant. In continuing our investigations with the other halides, we hope to reach a fuller understanding of the interesting phenomenon of hysteresis.

A. SMITS.
G. J. MULLER.

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April 8.

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[1] *Z. phys. Chem.*, A, **166**, 97 (1933).

Magnetic Susceptibility of Mercury Vapour

I HAVE measured the susceptibility of mercury vapour by means of a method already described[1].

The atomic susceptibility of mercury has been found to be

$$\chi_a = -(78 \pm 7) \times 10^{-6}.$$

The susceptibility of the Hg++ ion had been measured several times by different investigators, and its most plausible experimental value[2] is

$$\chi_j = -40{\cdot}4 \times 10^{-6}.$$

Thus for the first time we are able to compare χ_a with χ_j and to compute the fraction of the diamagnetic susceptibility given by the two valence electrons of mercury:

$$\chi_e = \chi_a - \chi_j = -38 \times 10^{-6}.$$

We see that the diamagnetism of the two valence electrons of mercury is nearly equal to that of the ion. This result is rather important, because it suggests an explanation of the well-known fact that the diamagnetism of atoms is greatly influenced by the formation of molecules, as was observed, for example, in organic compounds by Pascal.

In the following table we give a comparison of the observed susceptibility of the mercury atom with that calculated by different approximate theoretical methods.

$\chi_a \times 10^6$.

Sommerfeld[3] calculated	Gombas[4] calculated	Slater[5] calculated	Experimental value
40·3	133·3	84·6	78

As may be seen from this table, the calculation carried out by Slater's method gives the most consistent results.

A detailed description of this work will appear in the *Phys. Z. Sow. Union.*

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Sverdlovsk.

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[1] Jaanus, R., and Shur, J. S., *Sow. Phys.*, 7, 19 (1935); 7, 501 (1935)
[2] Kido, K., *Sci. Rep. Tôhoku Univ.*, **22**, 834 (1933).
[3] Sommerfeld, A., *Z. Phys.*, **78**, 283 (1932).
[4] Gombas, P., *Z. Phys.*, **87**, 57 (1933).
[5] Slater, J. C., *Phys Rev.*, **36**, 57 (1930)

Phosphorescence of the Sea

WHEN sailing off the western Scottish coast, I found it possible to predict with certainty phosphorescent nights owing to a nipping sensation on the backs of my fingers after immersion in the sea. This seems to indicate some marine organism. As Dr. R. E. D. Clark's letter in NATURE of April 3 suggests, the phosphorescence is doubtless due "to the agitation of phosphorescent marine organisms".

If a boat-hook is pressed gently downwards into the water on a suitable occasion, there is little observable effect. The slightest jerk, however, that violently disturbs the water, at once produces luminosity but only in the disturbed region. During a very squally night when anchored in Mallaig Bay, I saw a beautiful display. The sea was black but the crest of every small wave that broke was brilliantly illuminated. May the streak effect be due, not so much to the accumulation of organisms in a particular region such as the meeting line of two currents, but rather to the agitation and consequent alarm of the organisms in the particular disturbed region ?

I once described in NATURE[1] the production of the characteristic luminosity so familiar at sea resulting from the sudden distortion of globules of certain viscous materials, and suggested that the organism displays its light—it may be voluntarily or otherwise—by a sudden muscular extension of cells containing such material.

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23 Kirklee Road,
Glasgow, W.2.
April 4.

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[1] NATURE, 115, 944 (1925).

Points from Foregoing Letters

EXPERIMENTS interpreted as evidence for the disintegration of the neutron have been described by Kikuchi, Aoki and Husimi, and the probability of the reaction has been calculated by them in terms of a collision cross-section varying from about 10^{-24} to about 10^{-25} sq. cm. C. W. Gilbert, C. L. Smith and J. H. Fremlin, by two different types of experiment, fail to confirm the disintegration of the neutron by bombardment with heavy hydrogen nuclei (deuterons). They consider that the cross-section for the disintegration of the neutron, if it takes place, is less than 3×10^{-26} sq. cm.

Prof. F. A. Paneth and Dr. C. Rosenblum state that the method of 'thermal precipitation' can be used for the separation, from the gas phase, of the active deposit of radium.

The ratio between the probability of absorption of a K-electron by a nucleus and the total probability of emission of a positron by the same nucleus has been calculated by Dr. A. Mercier on the assumption that the interaction term in the neutrino theory of β-radioactivity contains the five possible invariants to be obtained from Dirac matrices without introducing derivatives. Numerical values are given as functions of the maximum energy of particles emitted.

Drs. W. T. Astbury and D. M. Wrinch, while indicating the keto-enol interchange as an alternative mechanism to the lactam-lactim interchange recently proposed for the intramolecular folding of protein molecules, point out that the former offers a reason for folding in certain places only, given specific sequences of amino-acid residues, in that the hydrogen transference would take place at carbon atoms carrying side-chains.

A table giving the increase in pressure in pentane-air mixtures of various concentrations, at a series of very short time intervals after spark ignition, is submitted by A. V. Belov and Prof. M. B. Neumann. The initial rate of combustion passes through a maximum when the pentane concentration is 110 per cent. Graphs showing the mean velocity as a function of pentane concentration, and the influence of lead tetra-ethyl and of isoamylnitrite are given. The authors state that their experiments support the chemical theory of detonation in motors.

The size (length) distribution of cockles of one, two, three and four summers' growth, from the Marine Lake at New Brighton, has been determined by a group of investigators from the University of Liverpool. The trend of the mean rate of growth deduced from the graphs indicates that even at the age of four summers there is no marked decrease in the rate of growth.

The production of urediospores and teliospores of wheat stem rust (*Puccinia graminis Tritici*) on the common barberry (*Berberis vulgaris*) is reported by Drs. Margaret Newton and T. Johnson. These types of spores normally appear on the gramineous host only. They appeared in selfed cultures of two physiological races of this rust.

The swarming behaviour of fireflies of the species *Photinus pallens* in Jamaica is described by J. B. Buck. The fireflies gather in large numbers, apparently due to the fact that they are attracted by light, so that a few individuals collecting by chance serve, by their flashes, as a focus for the formation of a swarm.

R. McKay states that the addition of a small amount of potassium permanganate speeds up the formation of asexual fructifications (conidia) in the fungus *Phytophthora erythroseptica*. The conidia can thus be induced to develop within three to four days, which makes this fungus a useful material for class work.

Max G. E. Cosyns has measured the specific primary ionization of hydrogen by fast electrons of various energies. The results are in conflict with the theory, which predicts an increase of ionization for energy above one million volts.

Friction between similar surfaces of plates of the same dielectric, such as ebonite, does not give rise to electric charges, but J. Strachan states that when two such plates are pressed into intimate contact and separated, the contacted surfaces are found to be charged, one positively and the other negatively. It is suggested that this observation confirms Freundlich's theory for the origin of frictional and contact electricity by the rupture of surface adsorption layers.

The expansion coefficients of single crystals of sodium chloride, silver chloride and silver bromide have been plotted as a function of their melting-point temperatures by P. G. Strelkov, to show the abnormal increase near their melting points. The author points out that this behaviour is connected with the behaviour of the crystal lattice, as shown also by the jumps in electrical conductivities at the melting points.

Prof. A. Smits and G. J. Muller find that ammonium chloride containing heavy hydrogen in its molecule differs in its behaviour at low temperatures from the normal salt. The volume-temperature curve of the 'heavy' compound shows a homogeneous transition without hysteresis at – 24°, unlike the normal compound which shows a heterogeneous transformation with hysteresis at – 30°.

Research Items

Leg Muscles of Birds

IN a thorough study of the "Muscles of the Pelvic Appendage in Birds", George Elford Hudson has examined representatives of sixteen out of the twenty orders of North American birds (*American Midland Naturalist*, 18, 1; 1937). He has standardized so far as possible the terminology of the muscles with the recognized Basle Nomina Anatomica, and has introduced a method, new for bird anatomy, of illustrating cross-sections of the leg. The hind limb of a bird is worked by a full complement of forty-one muscles, and all these muscles are present in representatives of the order of game birds (Galliformes), suggesting a generalized and primitive condition. In the other orders examined, from one to nine muscles were missing from the full complement, and this indication of specialization was specially marked in *Colymbus* (eight missing), *Dryobates* (7), *Chaetura* (9), and the perching birds (8). On the other hand, *Cathartes* and *Zenaidura* had only one missing muscle. The leg musculature showed distinctive peculiarities for each major taxonomic group, and the author is of opinion that more weight ought to be placed upon the anatomy of soft parts in determining the systematic position and relationships of birds.

The Origin of Insects

IN his presidential address delivered before the Linnean Society of London on May 28, 1936, and published in the *Proceedings* of that Society (Part 4, December 1936), Dr. W. T. Calman discusses the above subject. It is maintained that the earliest insects were probably wingless forms not very different from the existing Thysanura. The idea of any relatively close affinity between insects and crustaceans meets with many obstacles. Some of the features which appear to link together the two groups are undoubtedly the result of convergent or parallel evolution. Furthermore, the fact that embryology has failed to produce any clear evidence of a head-segment, corresponding to that bearing the maxillulæ in Crustacea, discounts Hansen's belief that these organs are homologous with the so-called 'paraglossae' of the thysanuran *Machilis*. The discovery of Collembola from the Middle Devonian of Scotland led Tillyard to place these creatures at the very base of the insect series. The structure of the Collembola seems, however, to be of a specialized character suggesting that they are less primitive than the Thysanura. While it is claimed that the origin of insects is obscure, it is believed that the Symphyla reveal features that indicate what the immediate predecessors of the insects may have been like. An interesting problem raised in this address is the possibility that, in various groups of arthropods, there is a limit of size below which morphological differentiation is unable, as it were, to find adequate scope for expression. The number of segments in the appendages tends to be reduced, setæ are fewer and relatively larger in size, while the appendages themselves are less completely formed as compared with larger species. The primitive thysanuran *Campodea* and the Symphylan *Scolopendrella*, therefore, on these grounds are small enough to discount the absence or incomplete development of some features which would be expected to prevail in primitive forms. (See also NATURE of March 6, p. 399.)

Influence of Temperature Fluctuations on Animals

J. S. MIKULSKI (*Bull. internat. l'Acad. Polonaise*, 11, No. 5; 1936) reports the results of experiments on the influence of alternating temperatures upon the development of *Bufo americanus* and *Ambystoma tigrinum*. The experiments were carried out within the vital range of the animal and the rhythm of the changes of temperature were close to the natural ones. The acceleration in development at constant higher temperatures is offset by the fall in survival value and so they do not represent optimum conditions. Symmetrical alternating temperatures have a different influence as compared with that of constant temperatures in the two animals. The influence is shown by a change in velocity and a change in survival rate. *Ambystoma* exhibits a greater resistance to lower temperatures and the average resistance of *Bufo* is small in the extra-optimal range. The experiments show the necessity of observing the course of temperature fluctuations during the period of development.

Plants Poisonous to Stock

A VERY valuable account of American work upon plants poisonous to stock by J. F. Couch has recently been published (*J. Chem. Educ.*, 14, Jan. 1937). The annual losses of livestock in the United States are estimated to exceed two million dollars, and in Texas during one spring, animals valued at 300,000 dollars died from the effect of one species. It is pointed out that, though poisonous wild species are widespread in the pastures, well-fed animals are usually reasonably safe; when the ranges are over-stocked, the hungry animals turn to the less palatable species of plants, and then the damage is done. Among the poisonous types of plants described are larkspurs, lupins and senecios containing alkaloids; glucoside-containing plants in which the aglycone may be cyanogenetic or phenolic or in which the glucoside is a saponin; solanine-containing plants in which the solanine is at once both alkaloidal and solaninic—it is responsible for the occasional poisoning from sprouting potatoes; plants containing proteins antigenic like the bacterial toxins such as the ricin in the castor oil bean, and the resinoid-containing plants of the Ericaceæ. The chemical nature of these resinoid substances, which are difficult to crystallize, is little understood. It is very interesting to learn that the resinoid andromedotoxin is taken up by the bees from the flowers of some of these Ericaceous plants, and the honey then made may be very poisonous. Another obscure poison is the resinoid galitoxin found in the milkweed, *Asclepias galioides*. This makes this plant one of the most poisonous in the States, three ounces of the fresh plant being sufficient to cause the death of an adult sheep.

White Mould Disease of the Narcissus

THE fungus *Ramularia vallisumbrosæ* causes a white mould disease of narcissus plants, which is particularly severe in Devon and Cornwall. Greyish streaks appear on the leaves, and later bear masses of white, powdery spores. The streaks may occupy considerable areas of the leaves, which are thus unable to manufacture an adequate supply of food. Dr. P. H. Gregory has recently published an account of the disease and its control (*J. Minis. Agric.*, 43, No. 9, 865–69, December 1936). Spores are borne from February until May, and are readily distributed by wind and the splashing of rain, so that the disease can attain epidemic proportions in moist weather. Black sclerotia are formed by the fungus upon withered leaves in summer, and serve to perpetuate the disease. Control methods are mainly along the lines of general sanitation—the removal of leaves from infected plots, and appropriate rotation. There is no evidence that the fungus can contaminate the ground for more than one year, so that a rest of this duration will control the disease. The shoots of susceptible varieties of narcissi should also be sprayed with Bordeaux mixture, when the shoots are 3–6 in. high, in order to eradicate the sporing stage of the fungus. The waxy 'bloom' upon narcissus leaves makes it imperative that a suitable wetting agent be added to the spray fluid, in order that the greatest fungicidal action may be exerted.

Structure of Thin Metallic Films at Low Temperatures

THE properties of thin metallic films deposited at low temperatures are known to be anomalous. Such films possess high electrical resistance and poor optical reflecting powers. When the film is warmed there is an increase in conductivity, which Zahn and Kramer have reported to be discontinuous for films deposited by cathodic sputtering. They conclude that below a certain transition temperature characteristic for each metal, the film is amorphous. Tammann, on the other hand, believes that the difference in properties cannot be thus accounted for. G. Hass (*Naturwiss.*, 25, 232; 1937) describes electron diffraction experiments by which the structure of thin films of silver and antimony, deposited by condensation at low temperatures, has been determined. For silver, well-defined interference rings were obtained even at low temperatures (− 175°), which became sharper as the temperature was raised, thus indicating that the smaller crystals present at − 175° became larger with rise of temperature. This process of crystallization was more important with the thinner films (50 A. thick) than with the thicker ones (700 A.). For antimony, at low temperatures only two broad, diffuse rings were obtained, showing the predominance of a colloidal structure. At room temperature, however, the diagram indicates the existence of fairly large crystal units with thread structure. No transition temperature could be detected in either case, and the films were not amorphous at low temperatures.

Permonophosphoric Acid

ALTHOUGH permonophosphoric acid is a powerful oxidizing agent, converting manganous salts in the cold to permanganate, and is thus perhaps capable of useful application, its preparation by the interaction of phosphorus pentoxide and concentrated hydrogen peroxide is difficult. G. Toennies (*J. Amer. Chem. Soc.*, 59, 555; 1937) has found that the heterogeneous interaction between these two substances in acetonitrile as an inert solvent yields solutions of permonophosphoric acid which are relatively stable even at room temperature. In two experiments, 65·3 and 68·0 per cent of the phosphorus pentoxide were converted into the peracid by the reaction $P_2O_5 + 2H_2O_2 + H_2O = 2H_3PO_5$. The solution, even in the cold, gave the characteristic reaction with manganous salt. Some experiments on the rate of formation and of decomposition of the peracid and the stabilizing effect of low temperature (−12°) are recorded.

Metal Spraying

DEVELOPMENTS in metal spraying were considered by E. C. Rollason at the annual meeting of the Institute of Metals held in London on March 10–11. Twelve years have elapsed since the last paper on this subject was presented to the Institute of Metals. During the interval, radically new designs of apparatus have been evolved using powdered and molten metal as well as wire. Many new applications have been successfully exploited, some of which, such, for example, as in the building up of worn machinery, are becoming of great importance to the engineer. The author concludes that each of the three types of metal spraying equipment has its own characteristic advantages which will allow it to survive competition. Owing to its low costs, the powder process will, in the author's view, prove successful in spraying large surfaces with zinc, especially where the coat is afterwards to be painted. The powder spraying pistol also offers possibilities in connexion with the spraying of brittle metals and alloys of high melting point which cannot be drawn into wire. The molten metal instrument, on the other hand, can produce thick coatings of the lower melting point metals at a reasonable price, especially since the metal can be used in ingot form and neither acetylene nor oxygen is required. The wire pistol will, he believes, hold the field in building up thick deposits on worn articles as well as for producing heat resisting surfaces. Even in the production of zinc coats, the wire pistol offers important advantages in connexion with the spraying of internal surfaces, although the cost is higher than that of the other processes.

Meteor Heights from the Arizona Expedition

A NOTICE by Ernst Öpik of the results of this expedition, which deals in the first report with meteor heights and velocities, has appeared (*Proc. Nat. Acad. Sci.*, 22, 525; 1936). Out of 22,000 meteors recorded during the expedition, 3,540 were observed simultaneously from two stations separated by twenty-two miles. It was found that meteors meeting the earth were vaporized fifteen miles higher than those overtaking it, the higher kinetic energy being predominant in spite of the much less air-mass encountered. Sporadic meteors provided 80 per cent of the whole material, and only 7 per cent was contributed by the well-known major showers. The sporadic meteors were mostly extra-solar with high hyperbolic velocities, nevertheless their heights at the beginning and ending were nearly the same as those deduced for the solar meteors. The suggestion is made that this fact, which apparently contradicts the previous statement that the fast meteors were vaporized higher, can be explained by a difference in composition of the bodies. Solar-system meteors are mostly stone and sporadic meteors iron, and they would differ considerably in the time and heat required for vaporization. This explanation will scarcely satisfy everyone in spite of the fact that there appears to be some independent evidence of this difference in the composition of the meteors. Some light is thrown on the conditions prevailing in the upper atmosphere. One deduction is that a hydrogen atmosphere cannot exist below a height of about 130 km.

The First International Electrodeposition Conference

IN opening the first International Electrodeposition Conference, which was held at British Industries House, London, on March 3–4, Lord Melchett referred to the rapid advance which has been made in recent years in the science and practice of electroplating and other electrodeposition processes, and paid a tribute to the work of the Electrodepositors' Technical Society in furthering these developments and in organizing this first International Conference.

In the four sessions of the Conference, which were presided over by Mr. A. E. Ollard (president of the E.T.S.), Mr. C. Francis Carter, Mr. D. J. Macnaughtan and Mr. S. Field respectively, practically every aspect of electrodeposition was discussed. Four general papers by M. M. Ballay (France), Mr. E. J. Dobbs (Britain), Mr. G. B. Hogaboom (United States) and Dr. R. Springer (Germany) provided surveys of current practice and tendencies in the authors' respective countries. As would be expected in view of the present wide dissemination of ideas and information through the medium of scientific and technical publications, differences in practice between various countries are mainly those arising from differences in public taste and range of demand, or from differences in availability of certain materials. Thus, preference in Great Britain for cadmium plate with a matte surface has limited the use of baths for the direct production of bright cadmium deposits, which are largely operated abroad. Shortage of certain non-ferrous metals in Germany has led to the development of improved methods for electroplating on aluminium; to the more extensive use of anodized aluminium; to the use of insoluble anodes in nickel-plating baths, the composition of which is maintained by additions of nickel carbonate, or to the production of nickel anodes by electrodeposition from such baths on lead strip; and to the elaboration of methods for producing firmly adherent electrodeposits on articles of non-metallic composition such as bakelite and celluloid, which are so successful that they will undoubtedly retain their importance when normal supplies of metal become available.

Among special features of technique, particular reference was made to the 'copper degreasing process' employed mainly in France. M. A. Chabany (France) showed that this process, which consists of cathodic treatment of the basis metal in an alkaline cyanide solution containing copper, so that degreasing is accompanied by copper deposition, needs slight modification when applied to zinc surfaces. Loss of cyanide from the solution during operation is attributed to its oxidation to cyanate.

In the United States, Germany and Great Britain, rapid advances are being made in the development and utilization of 'automatic plant', in which articles of standard shapes and sizes are carried by means of conveyor chains through a succession of tanks in which preliminary cleaning operations, electrodeposition, and certain finishing processes are carried out, each for predetermined times. One automatic nickel-plating plant in Great Britain is using 12,000 amperes and turns out more than a million articles per week. Dr. J. Kronsbein (Britain) described a new type of automatic plant for nickel deposition in which the work bars are transferred from tank to tank by means of electromagnets, with arrangements for varying the time occupied in the transfer; and a novel chromium-plating plant in which the articles to be plated are held on the periphery of a magnetized double-disk wheel which revolves on a horizontal axis and thus carries the work through the plating solution. In Germany and the United States, electrolytic 'galvanizing' of wire is carried out on a large scale: sixty large plants in Germany consume about 300,000 amperes. Electrotinning of steel strip is practised in Germany, and is in course of commercial development in the United States.

The possibility of electrodepositing nickel and then chromium in a single automatic plant has been difficult to realize owing to the necessity for polishing the nickel undercoat before depositing chromium on it. Much attention has therefore been given to the direct deposition of 'bright nickel', and several types of plating bath for this purpose are now in operation. Dr. Schlotter's solution, which contains aromatic sulphonic acids, and baths with other organic addition agents are widely used, but several speakers stressed the value of the nickel-cobalt type of bath, which is claimed to give deposits equal in physical characteristics to an ordinary nickel deposit and to be the only bright nickel solution which can be completely controlled by chemical analysis. Methods for the production of bright deposits of several other metals are in use, and Dr. B. Egeberg and Mr. N. E. Promisel (United States) described the principles of a method which they are developing for evaluating the relative brightness of electrodeposits.

The introduction of simple and reliable tests for adhesion, porosity, thickness, and corrosion resistance of electrodeposits is making it possible to lay down specifications for plating to meet various conditions of service. Several contributors gave examples of such specifications which have been adopted by certain industries in their respective countries, and some speakers directed attention to the importance of specifying the minimum thickness required on 'significant surfaces' instead of or in addition to the average thickness over the whole article. Examples of the extent to which the thickness of silver plate may vary on various parts of the surface of articles of specified shapes were furnished in the survey of silver-plating practice presented by Mr. F. C. Mesle (United States).

Papers dealing with the development and practice of electrodeposition of particular metals were also furnished by Dr. G. Soderberg (United States) for cadmium from cyanide baths; by Mr. R. H. Atkinson (Britain) and by Messrs. E. C Davies and A. R. Powell (Britain) for platinum; by Mr. H. W. J. Pope (Britain) for gold; and by Dr. K. Schumpelt (United States) for the platinum metals—especially rhodium. Electrodeposited platinum and palladium are considerably harder than the corresponding rolled metals, and the hardness of electrodeposited platinum and rhodium is exceeded only by electrodeposited chromium. Owing to its exceptional resistance to attack by most chemical reagents and its fine white lustre, rhodium plating is applied not only to jewellery and as a non-tarnishing coating on silver ware, but also with considerable success to reflectors: it is unaffected by carbon particles sputtered from arc lights.

By means of a specially devised technique, Mr. A. W. Hothersall (Britain) showed that the adhesion of electro-deposits to nickel surfaces may be notably decreased by the presence of an invisible oxide film on the latter, and for securing the highest adhesion he recommended anodic etching of the nickel in sulphuric acid solution, the current being finally reversed for a moment. The special difficulty in securing adhesion of electrodeposits to chromium and its alloys is also due undoubtedly to the presence of an oxide film, and in order to overcome this Mr. G. E. Gardam (Britain) recommended cathodic treatment of the degreased surface in strongly acid nickel sulphate solution at high current density, which causes simultaneous removal of the film and deposition of nickel. It is advantageous to deposit a layer of copper (from the acid bath) on the resulting surface before plating with nickel from the regular nickel bath.

M. P. A. Jacquet (France) has established that whereas on a practically amorphous copper surface, produced by mechanical polishing, electrodeposition of copper begins from randomly distributed nuclei; a surface which has been electrolytically 'smoothed' by his method of anodic treatment in phosphoric acid retains its original crystal grain structure, and this structure is continued when copper is electrodeposited on it from the acid bath. In the initial stages of deposition, the deposit forms preferentially on grains which are favourably orientated with respect to the surface, and the character of its growth is affected by this orientation. Modifications of the phenomena observed when 'aged' baths are used are attributed to the presence of cuprous ions. The various modifications of the crystal structure of electrodeposits which may arise through inclusion in the deposit of substances added to the bath (addition agents) or of insoluble substances formed in the solution adjacent to the cathode surface, were shown in a remarkable series of photomicrographs presented by M. M. Cymboliste (France). Such inclusions are classified with reference to their character, origin and effect on the structure and properties of the electrodeposit; and the effects of varying the conditions of electrolysis are interpreted in terms of the influence of these conditions on the formation of inclusions. Prof. A. Phillips and Mr. W. R. Meyer (United States) reported results of an investigation of the upper limits of current density at which copper deposited from the acid bath on a copper surface ceased to continue the structure of the basis metal. From the cyanide bath no such continuation of structure was observed even at very low current densities. Even minute traces of lead in the acid copper bath were found to affect the character of the copper deposit, tending to make it dense, bright and somewhat brittle; but notable amounts of zinc in the bath scarcely affected the structure.

Papers by Dr. N. A. Isgarischev (U.S.S.R.) and by Prof. A. Glazunov (Czechoslovakia) and Dr. M. Schlötter (Germany) dealt with the mechanism of deposition of metals from complex salt solutions; and contributions from Prof. L. S. Ornstein in collaboration with B. Baars and P. J. Haringhuizen (Holland) were concerned with a comparison of the behaviour of electrodeposited and evaporated metallic films towards corrosive agencies, which had been investigated by means of a specially devised optical method.

Permanence of Oceanic Basins and Continental Masses[*]

IN his presidential address to the Geological Society of London in 1870, Huxley brought into correlation with geological science the scheme of zoological provinces which he had proposed to the Zoological Society two years before. He recognized the fact that the distribution of life, as then known, implied "a vast alteration of the physical geography of the globe", but he nevertheless conformed to the orthodox view of the time regarding the persistence of a general uniformity in the positions of the four great oceans from Devonian or perhaps earlier times.

That the oceanic basins and continental masses had, from the earliest geological times, occupied their positions, with little more than marginal changes, was an idea that originated in its geological bearing with J. D. Dana in 1856. Taken in conjunction with the then prevailing notion, developed by W. Hopkins, that the earth was solid to great depths, the doctrine of permanency persisted for many years unchallenged; it is still held by many geologists in an attenuated form.

After the publication of the "Origin of Species" in 1859, showing, in the words of Darwin, that "each species has proceeded from a single birthplace", the distribution of animals and plants became a critical test of the validity of the doctrine of permanency. Edward Forbes had challenged the idea, but Darwin considered that, when he wrote in 1859, we knew very little about the strange accidents by which living beings secured transport over oceanic barriers; and accordingly he, followed by Lyell in 1868, considered that Dana's views could not justifiably be put aside.

W. T. Blandford, however, speaking as president of the Geological Society, twenty years after Huxley, with far more extensive data at his command, demonstrated that the distribution of animals and plants could not be explained without the previous existence of land surfaces across regions now occupied by oceanic deeps. Although Blandford at that time confined himself to arguments based on biogeography, his previous work in India had led him independently to the same conclusion regarding the southern oceans. It was Blandford who discovered in 1856 the glacial beds at the base of the Gondwana system of 'continental' rocks in India. Later work in the southern continents led to similar discoveries, and ultimately established a correlation between India, Australia, Africa and South America.

So long ago as 1879, Blandford pointed out, in the official "Manual of the Geology of India", that the fossil plants and land animals of the Gondwana system in India were related so definitely to those on the southern continents that land connexions must have existed at certain times, if not continuously, between these areas across the positions now occupied by the

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[*] Summary of the Huxley Memorial Lecture delivered by Sir Thomas Holland, K.C.S.I., F.R.S., on May 4.

Indian and South Atlantic Oceans. This was well before Eduard Suess gave the name Gondwanaland to the supposed pre-Tertiary southern continent.

Work by C. Schuchert published in 1932 on the distribution of Tertiary fossils confirmed the conclusions established by Blandford from living forms. Schuchert similarly required land communications over some of the present oceanic areas, but demanded relatively small land bridges, thinking, as he said, that it would be "easier to sink smaller continental-like masses than larger ones".

Another, wholly different, explanation for the distribution of life has been elaborated in the last twenty-seven years, mainly by the late Alfred Wegener, who maintained that an ancient continental mass, which he named Pangæa, existed in the South Atlantic and Antarctic region and broke up during the Mesozoic period; that fragments of it drifted away to form most of South America, South and Central Africa, Madagascar, India and Australasia, taking with them their records of geological activities during Palæozoic times. This theory is thus assumed to account for the glaciation of lands like India which are in the northern tropics, as well as continents which are still south of the equator; it explains, too, the correspondences between the Gondwana rocks of India and those on the southern continents.

Wegener's hypothesis, according to many geologists, is based on insufficient and often discordant data, whilst mathematicians assert that the mechanics involved in these horizontal movements of continental masses are quite impossible.

Following a suggestion made by R. H. Rastall in 1929, it is now urged that discussion of the purely theoretical implications of this hypothesis should await the accumulation of geological data by work on the lines undertaken by A. L. du Toit in comparing Africa and South America. Du Toit has demonstrated the remarkable duplication of geological features between these two areas, from Lower Palæozoic, age by age, to Upper Mesozoic times. He has also noticed that when the formations vary in the usual way laterally, the variation eastward in Africa and westward in South America is generally greater than that between the corresponding formations on the opposed present shores, although these are now separated by the width of the South Atlantic. Du Toit reasonably concludes that the agreements are too frequently concordant to be regarded as fortuitous, and that the only explanation which best fits the facts is the assumption that these two continents were at one time near one another if they were not actually confluent continental masses.

If it be true that these continental masses have moved horizontally in late geological times away from one another, there is no reason why others should not have done so too, in spite of the circumstance that no completely satisfactory explanation of the mechanics involved can be offered at present. Further work on the lines so ably undertaken by du Toit is now more necessary than mathematical criticism with insufficient quantitative data regarding the physical state of the earth's sub-crust under the continents and oceans.

Magnetic and Optical Properties of Crystals

UNDER this title, Prof. K. S. Krishnan of the Indian Association for the Cultivation of Science (Calcutta) delivered three lectures in the Cavendish Laboratory, Cambridge, on April 26, 29 and 30. In the first lecture he dealt with recent studies of the diamagnetic properties of single crystals, particularly aromatic compounds. The method of deriving the principal susceptibilities of aromatic molecules by combining magnetic measurements with crystal structure determination was described and also the way in which molecular orientation may be predicted on the basis of magnetic measurements alone. A summary of Pauling's method of calculating the principal susceptibilities of any aromatic molecule was given. The experimental method for measuring anisotropy in magnetic susceptibility was demonstrated and also the remarkable property of graphite crystals both as they occur naturally and after exposure to potassium vapour or to oxidizing agents.

The second lecture was devoted to the recent work on paramagnetic crystals. Prof. Krishnan's study of the magnetic properties of $CuSO_4.5H_2O$ has confirmed the predictions concerning the ionic environment made on the basis of theoretical studies and has afforded a remarkable correlation of the magnetic properties with the details of the crystal structure. The influence of the co-ordination on the magnetic anisotropy of the cobalt ion is shown by the comparison of the susceptibilities of $CoSO_4.K_2SO_4.6H_2O$ with those of $Cs_3[CoCl_4]Cl$. The former salt, in which the paramagnetic ion is six co-ordinated, is of great magnetic anisotropy, while the second salt, in which the cobalt is four co-ordinated, has a very small magnetic anisotropy. This result also confirms predictions made on the basis of other physical data. The study of very small magnetic anisotropy of certain manganese salts has made possible the prediction of the entropy of these substances at temperatures near to absolute zero—an important quantity in view of the use to which these salts are put in obtaining very low temperatures by adiabatic magnetization.

The third lecture dealt with the absorption and fluorescent spectra of certain aromatic compounds. Anthracene, naphthacene and chrysene have well-marked pleochroic characters. The absorption spectrum in the ultra-violet region has strong bands for rays vibrating in that principal plane which is most nearly parallel to the plane of the molecules, and weak bands for rays vibrating in that principal plane which is most nearly perpendicular to the planes of the molecules. Naphthacene is a common impurity in anthracene and chrysene, and even when only a few parts per million of the impurity are present a strong fluorescent spectrum is observed. This has the remarkable property of being strongly excited in one plane only, no matter what the relative orientation of the plane of vibration of the incident light. This plane, corresponding to the vibration of the strongly excited spectrum, is coincident with that principal plane which is most nearly parallel to the molecular planes. Some experiments on the photo dissociation of potassium nitrate in ultra-violet light were also described.

University Events

CAMBRIDGE.—The eighth course of Scott Lectures are being given by Prof. W. J. de Haas, of the Kamerlingh Onnes Laboratory, Leyden, in the Cavendish Laboratory at 4.30 p.m. on May 3, 5 and 7. The subject of the course is "Low Temperature Research".

It is recommended that two additional University demonstratorships be established in the Department of Anatomy from October 1.

Dr. H. H. Thomas is proposed as the representative of the University at the International Congress of the History of Science to be held in Prague on September 22–27.

LIVERPOOL.—Dr. Hugh Gordon, lecturer in botany, has been appointed to a lectureship in botany, University of Tasmania, as from June 30.

MANCHESTER.—The completion of the New Arts Library, which will be formally opened by Sir Walter H. Moberly on June 2, releases the whole of the Christie Library for the housing of scientific books.

The University has launched an appeal for £300,000 for development and a further annual income of £10,000. Among the proposed extensions are a new dental school and hospital, presented by Mr. Samuel Turner of Rochdale, and a new laboratory for the school of physico-chemical research directed by Prof. M. Polanyi, which at present is most inadequately housed.

The Rockefeller Foundation has made a grant of £5,000, to be spread over four years, in aid of the biochemical research work being carried out under the direction of Prof. I. M. Heilbron.

Mr. R. W. James, reader in experimental physics, has resigned his post on appointment to the chair of physics in the University of Capetown. Dr. D. Sheehan, lecturer in neuro-anatomy, has resigned on his appointment to the chair of anatomy in the College of Medicine, University of New York.

Among the appointments announced this year are: Dr. Samuel Tolansky to be lecturer in physics; Mr. W. S. Walker and Mr. W. G. Wainwright, to be demonstrators in chemical technology; and Mr. H. B. May, to be assistant lecturer in bacteriology.

OXFORD.—G. R. Girdlestone, New College, has been appointed Nuffield professor of orthopædic surgery while holding the post of clinical director of the Wingfield-Morris Orthopædic Hospital.

Prof. J. A. Gunn, Balliol College, has been appointed to become Nuffield professor of therapeutics, while holding the directorship of the Nuffield Institute for Medical Research, on his ceasing to be professor of pharmacology.

Dr. J. C. Moir has been appointed Nuffield professor of obstetrics and gynæcology as from October 1 next. This professorship carries with it a fellowship at Oriel College.

C. G. T. Morison, Christ Church, has been re-elected University reader in soil science for seven years from October 1 next.

The following have been elected or re-elected to University lectureships in their subjects, for five or three years, as from October 1 next: J. H. C. Whitehead (mathematics), R. L. Hall (economic science), Dr. D. A. Jackson (spectroscopy) and G. D. Amery (history and economics of agriculture).

Science News a Century Ago

The Royal Geographical Society

AT a meeting of the Royal Geographical Society held on May 8, 1837, William Richard Hamilton (1777–1859) the president-elect being in the chair, the Royal Premium for 1836 was presented to Captain R. FitzRoy for his work done while in command of H.M.S. *Beagle*. Addressing FitzRoy, Hamilton said, "one of the first of your discoveries laid open to the commercial and scientific world the harbour of Bahia Blanco, the only one upon the eastern coast of South America, in which a considerable number of line-of-battleships can be at anchor. On the same coast, in the face of numerous difficulties, you explored for the first time, the deep and rapid river of Santa Cruz. You surveyed, at your sole expense, the Falkland Islands. On the western side of South America, you have for the first time laid down the archipelago of islands lying to the south of Chiloe, called Chonos, in lat. 45° S. When your term of service was on the point of expiring, and you were about to proceed on your way home, your zeal for science prompted you to engage a vessel, at your own expense, for completing the survey of the coast of Peru as far as Guayaquil. In circumnavigating the globe, you have for the first time, carried a complete chronometric chain of measurement, by twenty-two chronometers—many of them your own property—from east to west around the globe. You have also enabled Mr. Darwin, the well-known naturalist, to add greatly to our knowledge of the history of those regions."

Darwin was present at the meeting, and in his reply to the chairman's speech, FitzRoy remarked: "Mr. Charles Darwin embarked in the *Beagle* in 1831 as a zealous volunteer in the cause of science. At his own expense, he passed five years aboard the *Beagle*, on travelling in those countries she visited. When it is considered that Mr. Darwin never ceased to be a martyr to sea-sickness, his perseverance may be appreciated. Of the value of his labours, I understand you have been made partially aware; and I believe I am quite correct in saying, that the best judges estimate those labours very highly."

Bulwer's Petrel in Britain

IT was on May 8, 1837, that the first specimen of Bulwer's petrel (*Procellaria bulweri*, Jardine) in the British Isles was picked up dead, on the banks of the River Ure near Tanfield, Yorkshire. Gould describes the record in Part 22 of his "Birds of Europe" and Yarrell on p. 664 of vol. 3 of his "History of British Birds". The specimen is preserved in the York Museum. An inhabitant of the temperate North Pacific and North Atlantic, plentiful off Madeira, the Canaries, Salvages, Sandwich Isles and Japanese isles, this petrel is sooty black all over, with a pointed tail, and reaches $10\frac{1}{2}$ inches in length. There are traces of grey on the throat and head, and brown margins to some of the wing feathers, the irides are deep brown, bill black, legs black and grey, male and female being similarly coloured. The call of the bird, heard at its nesting haunts at night, is a pleasant one, consisting of four high notes and a lower, prolonged one, in marked contrast to the harsh calls of the great shearwaters which also nest on their islands.

The Kingston Valves for Steamships

AT a meeting of the Society of Arts on May 10, 1837, a Gold Isis Medal was awarded to Mr. Ross for an improvement in the adjustment of the object glasses of compound microscopes of high magnifying powers, and the large silver medal was awarded to Mr. Kingston of Woolwich Dockyard, for a safety blow-off pipe for the boilers of marine steam-engines.

When steam was applied to ships, it was necessary to cut holes through the skin of the ship for admitting water to the condensers and for the purpose of blowing-down the boilers. The early plan was to fit a cast-iron pipe through the wooden planking and place a valve or cock on the inboard side. If this valve or cock became defective, it was difficult to repair with the ship afloat. John Kingston, a foreman at Woolwich, therefore devised a form of conical valve with a long spindle of very simple construction, having the great advantage that the pressure of water outside the ship tended to keep it on its seating.

Sir David Brewster on the Absorption of Light

ON May 11 and 25, 1837, a paper by Sir David Brewster was read to the Royal Society entitled "On the Connexion between the Phenomena of the Absorption of Light and the Colours of Thin-Plates". An abstract of the paper said: "The phenomena of the absorption of light by coloured media have been regarded by modern philosophers as inexplicable on the theory of the colours of thin plates, and therefore irreconcilable with the Newtonian hypothesis, that the colours of natural bodies are dependent on the same causes as the colour of thin plates. The discovery by Mr. Horner of a peculiar nacreous substance possessing remarkable optical properties, furnished him [Sir David] with the means of instituting a more accurate comparison between these two classes of phenomena. From the phenomena of thin plates, of polarized tints and of absorption, the existence of a new property of light is deduced, in virtue of which the reflecting force selects out of differently coloured rays of the same refrangibility, rays of a particular colour, allowing the others to pass into the transmitted ray, a principle not provided for in either of the theories of light to which the phenomena of absorption are ultimately referable."

J. A. F. Ozanam (1773–1837)

JEAN ANTOINE FRANÇOIS OZANAM, the eminent medical historian and epidemiologist, who died on May 12, 1837, of tetanus following an accident, was born on July 9, 1773, at Chalamont near Bourg-en-Bresse, the son of a notary. After studying philosophy at Lyons in 1790–91, he passed six years in the French army and took part in the campaign in Italy, where he was present at the most important battles. In 1797 he obtained with some difficulty his discharge from the army, and after an unsuccessful venture in business, took up medicine on the suggestion and encouragement of the celebrated surgeon Marc Antoine Petit. In December 1810, at the comparatively late age of thirty-seven years, he qualified at Milan, where he devoted his attention to the sick and wounded French and Italian soldiers taken prisoners by the Austrians. In 1816 he left Milan for Lyons.

Ozanam's chief work was a history of epidemic, contagious and epizootic diseases in Europe from the earliest times and especially the fourteenth century down to his own day. The first edition was published at Lyons in five volumes in 1817–23, and the second in four volumes at Paris in 1835.

Societies and Academies

London

Royal Society, April 29.

H. H. POOLE and W. R. G. ATKINS: The penetration into the sea of light of various wave-lengths measured by emission or rectifier photo-electric cells. Further measurements of submarine daylight, using emission cells, gave for the vertical extinction coefficient 20 miles from land, $\mu_v = 0{\cdot}11$ for blue and $0{\cdot}19$ for near ultra-violet. The light travelling upwards was about two per cent of that going downwards. Measurements were made with Weston selenium rectifier cells, corrected for the curvature of the illumination current relation, using a modified form of the Campbell Freeth zero-resistance circuit. Infra-red is eliminated in less than 2 m. Red is reduced to 1 per cent at 10 m. The deeper water, 35–50 m., was clearer than that near the surface in the English Channel 10 miles from land. Near the shore the difference between red and green is lessened, but blue is relatively more heavily absorbed and differs more from green.

A. KEYS, B. H. C. MATTHEWS, W. H. FORBES, R. A. MCFARLAND and D. B. DILL: Individual variations in ability to acclimatize to high altitudes. The International High Altitude Expedition made observations at sea-level, 9,000, 12,000, 16,000 and 20,000 ft., of the physiological constitution of ten normal subjects. The capability of acclimatization of the members of the party was graded by a questionnaire as to the deviation in physical and mental performance from their sea-level values, of all members of the party. By this classification, the members of the party were arranged in order at each altitude. A number of physiological properties were observed at sea-level and at each station. No one of these yielded a good correlation with the classification referred to above, but the whole series taken together with suitable empirical coefficients yield a good correlation with the acclimatization classification.

G. A. MILLIKAN: Experiments on muscle hæmoglobin *in vivo*; the instantaneous measurement of muscle metabolism. A photo-electric arrangement is described by means of which the degree of oxygen saturation of the naturally occurring intracellular muscle hæmoglobin in a cat's soleus muscle may be measured instantaneously and recorded continuously. This instrument provides both a chemically specific and time-sensitive method of measuring muscle metabolism, and neither the nerve supply nor the blood supply need be disturbed. Muscle hæmoglobin acts as a short-time oxygen store, helping to tide the muscle over from one contraction to the next. When the muscle contracts, its oxygen demand rises to its maximum value in less than $0{\cdot}2$ sec. from the onset of contraction. There is good general agreement between both resting and active oxygen consumption as measured photo-electrically in the muscle fibre, and in metabolic experiments of the usual kind made on repetitively contracting mammalian skeletal muscle. Resting value: $0{\cdot}07$ mm.^{3} O_2 per gm. per sec During tetanic contraction: $1{\cdot}0$ - $3{\cdot}5$ mm.^{3} O_2 per gm. per sec. Blood flow appears not to be greatly affected in the first few seconds of tetanic contraction These results are in agreement with those of Rein and Kramer, and differ from those of Anrep.

Paris

Academy of Sciences (*C.R.*, 204, 1017–1048, March 31).

G. Bertrand: Obituary notice of Amé Pictet.

Gabriel Bertrand and Lazare Silberstein: New determinations of the amount of boron in plants cultivated on the same soil. The results confirm those previously published. The proportion of boron in the Leguminaceæ is higher than in the Gramineæ.

D. Mangeron: The periodic solutions of a certain class of partial differential equations of higher order.

Jean Delsarte: Certain series connected with Bessel's functions.

Mme. Christiane Pauc: The geometrical study of a group of infinitesimal transformations.

Godofredo Garcia and Alfred Rosenblatt: Regularization of the plane problem of three bodies.

Jean Capelle: The generalization of the method of roulettes and the possible applications to the construction of skew gear.

Svetopolk Pivko: The influence of the finite number of blades of supporting screws.

Lévy Herman: The absorption of oxygen at the limit of the solar spectrum. Experiments leading to the conclusion that the absorption due to oxygen has no practical effect in limiting the solar spectrum.

Jean Perreu: The solubility equation of hydrates.

Marc de Hemptinne, Jean Savard and Paul Capron: The energy of dissociation of the molecule of carbon monoxide.

Félix François and Mlle. Marie Louise Delwaulle: The oxidation of nickel hydrate by sodium persulphate in alkaline solution.

René Moricard and René Bize: The development of the penis produced in the child by the injection of testosterone acetate.

Georges Blanc and M. Baltazard: The long preservation in the dry state of the virus of murin typhus in the excrement of infected fleas.

Amsterdam

Royal Academy (*Proc.*, 40, No. 3, March 1937).

F. K. T. van Iterson: Separation of substances by flotation (2). Scientific principles underlying the practical application of the method.

W. H. Keesom and A. Bijl: Determination of the vapour pressures of liquid nitrogen below one atmosphere and of solid β nitrogen. The boiling point of nitrogen is $77{\cdot}35_7$° K. and the triple point $63{\cdot}15_0$° K.

J. A. Schouten: Differential geometry of the groups of contact transformations (2).

F. M. Jaeger and L. Bijkerk: Investigations on the complex salts of the racemic and optically active cyclohexanediamines with trivalent cobalt and rhodium (3). Tri-cyclohexanediamine salts of trivalent cobalt. Crystallographic data and specific rotations.

E. Mathias, C. A. Crommelin and J. J. Meihuizen: Density curve and the rectilinear diameter of krypton. The critical temperature is 209·39° K. and the critical density 0·9085.

C. S. Meyer: Products of Whittaker functions (2).

J. Popken: An arithmetical property of certain integral functions (2).

C. Visser: Note on linear operators.

W. Beijerinck: Periodicity of flower formation in *Calluna vulgaris* (L.) Hull.

E. A. Hanson: Notes on some physical properties of chlorophyll films. Spreading of monomolecular layers of chlorophyll on water.

H. Baggelaar: Tertiary rocks from the Misool Archipelago (Dutch East Indies).

P. de Wijkerslooth: The metalliferous region of Moresnet-Bleyberg-Stolberg, Dutch Limburg.

H. G. Bungenberg de Jong and G. G. P. Saubert: (1) Phosphatide auto-complex coacervates as ionic systems, and their relation to the protoplasmic membrane (ii). (2) Models for the stimulation of the organ of smell. Application of the results of the preceding communication.

S. Berggren: A direct connexion from the cortex of the cerebellum to the nucleus of Deiters.

Brussels

Royal Academy (*Bull. Classe Sci.*, 22, No. 12, 1936).

L. Godeaux: A canonical surface belonging to the variety of Segre representing pairs of points of two planes.

F. H. van den Dungen: Remarks on the vocabularies of acoustics.

M. Leriche: The Ypresian in the country lying between the Sambre and the Meuse.

P. V. Paquet: The integral form H_n in the invariant theory of the calculus of variations.

P. Burniat: Surfaces of genera one.

S. De Backer: Viscous fluids and waves which can be propagated. Evolution of a monatomic and polyatomic gas.

P. Swings and M. Désirant: Remarks on the formation of the nebulous emissive layers in *Be* stars.

P. Bourgeois and J. F. Cox: Origin of comets.

R. Dugas: The axiom of the initial conditions and 'legality' in quantum mechanics.

P. Van Rysselberghe: Application of affinity to coupled reactions.

L. Marton: Electronic microscopy of biological objects (4).

J. P. Bosquet: The definition of energetic quantities in acoustics.

M. Florkin: The rate of true plasmatic glycæmia in the decapod crustaceans.

T. De Donder and Miss Y. Dupont: New theory of the dynamics of continuous systems (3).

W. H. Benedictus: The generalization of the direct theorem of Jacobi.

Moscow

Academy of Sciences (*C.R.*, 14, No. 2, 1937).

A. D. Alexandrov: The problem of the existence of a convex body, in which the sum of radii of the main curvature is a given positive function satisfying the conditions of *Geschlossenheit*.

V. G. Livenko: Attempt at a general definition of the integral.

W. Romberg: A method for simultaneous approximate determination of specific value and specific function.

V. I. Smirnov: Solution of the problems of limits in the elasticity theory in the case of a circle and a sphere.

F. Dušinskij: The 'concentration extinction' of the fluorescence of dye solutions.

V. Černiajev and M. Vuks: Spectrum of the twilight sky.

B. A. Petruševskij: Discovery of the Palæocene fauna in Tadzhikistan.

D. Tretiakov: Microreflectors in the skin of fishes.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 10

UNIVERSITY OF CAMBRIDGE, at 5.—Prof. A. V. Hill, F.R.S.: "The Heat-Production of Muscle and Nerve: A Critical Survey" (Linacre Lecture).

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Dr. C. B. Warren: "Medical and Physiological Aspects of the Mount Everest Expeditions".

UNIVERSITY OF LONDON ANIMAL WELFARE SOCIETY, at 5.30—(at University College, London).—Dr. N. K. Adam, F.R.S.: "The Destruction of Sea-Birds by Oil Waste".*

Tuesday, May 11

INSTITUTION OF CIVIL ENGINEERS, at 6.—Annual General Meeting.

Thursday, May 13

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY (ROYAL SCHOOL OF MINES), at 5.30.—J. Henderson Smith: "Virus Diseases of Plants" (succeeding lectures on May 20 and 27).*

Friday, May 14

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. N. E. Nörlund: "Astronomical Longitude and Azimuth Determinations" (George Darwin Lecture).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

DEMONSTRATOR IN CHEMISTRY in the Woolwich Polytechnic, London, S E.18—The Secretary (May 13).

ASSISTANT (grade III) at the Aeroplane and Armament Experimental Establishment, Martlesham Heath—The Secretary, Air Ministry, S.2.D (Room 405), Adastral House, Kingsway, W.C.2 (May 14).

ASSISTANT (grade III) in the External Ballistics Department of the Ordnance Committee, Woolwich—The Secretary, Ordnance Committee, Royal Arsenal, Woolwich, S.E.18 (May 14).

LECTURER IN GEOGRAPHY in the Darlington Training College—The Principal (May 14).

LECTURER IN GEOGRAPHY in Bingley Training College—The Education Officer, County Hall, Wakefield, Yorks (May 15).

RESEARCH PHYSICIST for the Printing and Allied Trades Research Association—The Director of Research, 10 Robin Hood Court, London, E.C.4 (May 17).

RESEARCH OFFICER at the Ministry's Veterinary Laboratory, New Haw, Weybridge—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (May 17).

ASSISTANT in the Department of Mathematics in University College, Dundee—The Secretary (May 28).

ASSISTANT LECTURER IN BOTANY in the University of Birmingham—The Secretary (May 29).

LECTURER IN GEOGRAPHY in the College of St. Mark and St. John, Chelsea, S.W.10—The Principal.

LECTURER IN MECHANICAL ENGINEERING in the County Technical College, Worksop—The Principal.

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The National Food Supply

IT will be a source of gratification to those who believe that the problem of the nutrition of their populations is worthy of serious consideration by responsible Governments, to be reminded that in Great Britain the Ministry of Health and the Scottish Office are instigating searching inquiries into the food supply of the nation as a whole and into the distribution of specially desirable foods among different sections of the community. Two years ago, these Government Departments appointed an Advisory Committee on Nutrition which included some senior civil servants from various Ministries and Departments, and some prominent scientific workers in the field of nutrition such as Prof. E. P. Cathcart, of the University of Glasgow, Sir Frederick Gowland Hopkins, of the University of Cambridge, Prof. E. Mellanby, secretary of the Medical Research Council, and Sir John Orr, director of the Rowett Research Institution, Aberdeen. Its terms of reference were: "to inquire into the facts, quantitative and qualitative, in relation to the diet of the people, and to report as to any changes therein which appear desirable in the light of modern advances in the knowledge of nutrition".

The Committee has now issued its first report*. It has had before it estimates of the total food consumed in recent years by the population of the United Kingdom, and was thus able to compare the quantities of food available with the nutritional requirements suggested in the report by the Technical Commission of the League of Nations Health Organisation, which is reprinted as an appendix to the present report. This comparison does not pretend to give an exact picture of the existing state of affairs; nevertheless its results are of considerable interest. It is calculated that the national food supply, after allowing a margin of 10 per cent for wastage, contains more than sufficient calories to meet the energy requirements of the population on the basis of the report of the League Commission. It is the opinion of the Advisory Committee, therefore, that all except a small fraction of the population are getting as many calories as they require. There is no deficiency of fat in the national food supply, though there is some deficiency in the diet of the very poorest. The total amount of protein available for the population is sufficient to supply its needs, but seeing that the proportion of animal protein in the diet increases as the standard of living rises with income, it is considered probable that there is some shortage of animal protein in the diets of the poorest section of the community.

The greatest discrepancy between the estimates of national consumption and the recommendations of the League Commission relates to liquid milk. The requirements on the basis of the League Commission's report are estimated to be equivalent to an allowance of seven-eighths of a pint daily per head of the population, whereas the present actual consumption in the United Kingdom is less than half this amount. Even if the consumption of condensed and dried milk is taken into account, the total quantity works out at only 60 per cent of the Commission's recommendation.

This deficiency is regarded with special concern and is referred to again and again in the present report. The Advisory Committee published in 1936 a memorandum on the nutritive value of milk which is republished as an appendix to this report. In it the opinion is expressed that the desirable amount of milk for children is from one to two pints a day, for expectant and nursing mothers about two pints a day and for other adult members of the community half a pint. The Committee deplores the fact that there is a deficiency of milk in the diet of large sections of the population at a time when there is a substantial surplus of liquid milk produced in the United Kingdom. The hope is expressed that the State will endeavour to ensure that a sufficient supply of safe milk will in the future be brought within the purchasing power of the poorest. It is considered that there is no other single measure which would do more to improve the health, development and resistance to disease of the rising generation than a largely increased consumption of safe milk by mothers, children and adolescents. While whole milk is a more complete food than other dairy products, the Committee would like to see skimmed milk and buttermilk more readily available for human consumption than they are at present.

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* Ministry of Health. Advisory Committee on Nutrition. First Report. Pp. 52. (London: H.M. Stationery Office, 1937.) 1s. 0d. net.

With regard to other foods specially recommended by the League Commission, it has been possible in one or two instances to make comparisons between its recommendations and the actual consumption in the United Kingdom. The present average consumption of eggs is estimated to be 2·9 per head per week, while it is calculated that 3·9 per head per week would be necessary to satisfy the Commission's recommendation. The average weekly consumption of potatoes is in the region of 56 ounces per head; the Committee would like to see a larger consumption, to replace some of the sugar and highly milled cereal of the diet. It is pointed out that while sugar may be a useful source of energy, it possesses no other food value and, when taken in large amounts, it dulls the appetite for more valuable foods and may thus have an unfavourable effect on nutrition.

The recommendations which the Advisory Committee have made are based on experimental and medical data, which have already indicated the importance of good nutrition for the maintenance of health. It is admitted, however, that a great deal more information is necessary before a final verdict can be passed on the effect of good diets on the health of a community. The Committee has already proposed and instigated additional inquiries which should enable further practical suggestions to be made for improving the nutrition of the masses. It wishes, for example, to obtain a more reliable estimate than has hitherto been possible of the distribution of the population in income groups; it has invited Government Departments to undertake dietary surveys on a comprehensive scale and has recommended specifically that exact studies of the diets of several hundred families should be carried out in England, Scotland and Wales; it has also recorded its view that efforts should be continued to establish a reliable group of tests for the assessment of the state of nutrition of individual human beings.

Viscount Astor directed attention in the House of Lords on May 5 to the Advisory Committee's report, and obtained a statement given on behalf of the Government by Viscount Gage. Lord Gage said that the Government accepted the conclusions of the Committee, but thought that much more information is desirable; and the Government is prepared to collect it. A threefold inquiry is proposed. The Ministry of Labour will make an inquiry in connexion with the cost of living index figure. For this it is hoped to secure the weekly budgets of 10,000 families taken over four separate weeks in various parts of Great Britain. These results will be checked by another inquiry, called a qualitative dietary survey, of a much more detailed character. This is already in progress, and will eventually embrace 500 families, of which 200 may be from Scotland. Then, from the last census figures, a definite proportion, say, one in 500 or one in 1,000, of the family census schedules will be taken. Those are expected to show, roughly, after certain allowances are made for altered conditions, the distribution of the population according to occupation. These statistics will be compared with the information in the possession of the Ministry of Labour with regard to the wage rates current in such occupations. It is hoped that the statisticians will be able, on this basis, to correlate the results of these various inquiries and present a working analysis of how the incomes of the various classes of the community are divided with special reference to food.

What is not clear at the present moment is whether the Government only accepts the conclusions that the diet of the country is improving and that more data about this should be obtained, in which case a political gesture has been made to get over an embarrassing situation; or whether the main conclusions and recommendations have been accepted. If the Government has accepted these and intends to carry them out, then the new science of nutrition is about to be applied for the welfare of the people, and we are on the eve of what will be the greatest social reform of this century.

The Ice Age in Detail

The Quaternary Ice Age
By W. B. Wright. Second edition. Pp. xxv + 478 + 23 plates. (London: Macmillan and Co., Ltd., 1937.) 25*s*. net.

WHEN the first edition of the "Quaternary Ice Age" was published in 1914, it took its place at once as the standard English text-book on the subject Since then our ideas concerning the Glacial Period have undergone a profound change, for the monoglacial theory, after a comparatively brief tenure, has had to give place to the older view of successive ice-advances, alternating with milder, or even warm, interglacial episodes. A new and revised edition of this well-known book has, therefore, been looked forward to for some long time.

To review all the evidence that brought about such a change in ideas was indeed a formidable task, for mere revision of a text-book published in 1914 would obviously be inadequate. Nothing less than a largely rewritten edition would meet the case; and on the whole the author has accomplished this difficult task in an admirable manner. Of the 24 chapters of the second edition, only a few are reprinted in their original form; most have been expanded and brought up to date, and some are new. A considerable increase in size of the volume is the result; many new illustrations and the useful bibliographies now added to each chapter will be a great help to students.

The general chapters on glaciers and ice sheets, glacial deposits, theories of the Ice Age, the mammals of the time and earth movements during and since the Glacial Period remain much as in the earlier edition, but there are minor revisions. More attention has been given to the phenomena of glacial retreat, so clearly demonstrable in north-western Europe, and to the wind-borne loess, now believed to be intimately connected with the phenomena of ice-advance. But much rewriting has been necessary, because we now realize the inevitable effects on the contemporary fauna and lora of successive glaciations and interglacial phases—particularly as they affected the history of early man. As a result of this realization, geology and prehistoric archæology have become overlapped to such an extent that the glacialist, o be on safe ground, must be well versed in the study of prehistoric man, if not actually a specialist in that branch. A large mass of literature had, herefore, to be summarized in the preparation of this new edition, and the author has succeeded fairly well in his brave attempt.

The treatment of the details of the geology and archæology of the east of England gives the impression of being insecure and rather below the high standard of the rest of the work. A strange omission is that of the story of events in the valley of the Lower Thames (although a new chapter has been added on the river gravels of the south of England) from the deposits of which we have recently gained our most substantial knowledge of human occupation in relation to late glacial history (*vide* W. B. R. King and K. P. Oakley's useful summary and J. P. T. Burchell's work). Also, a few pages might have been spared for a review of the remarkable disturbances of soft strata, which, although they have given rise to much speculation and argument, have thrown valuable light on glacier-motion and the behaviour of englacial and subglacial material. These omissions, however, are but slight blemishes in a work which, taken as a whole, is a masterly summary of existing knowledge in a subject admittedly of wide range and crowded with detail. Mention only can be made, for example, of admirable chapters on the older and newer drifts of the British Isles, the glaciation of northern Europe, the Alps, and North America, and on raised beaches and submerged forests.

At the end of the volume are accounts of the author's isokinetic theory of oscillations of sea-level and of the post-glacial changes of climate in Europe. As the author regarded this theory as his most original contribution in the first edition of the book, it is perhaps only fair to quote his own words in the second edition: "...the demonstration that isostatic movement alone", that is, the reaction of the earth-crust to loading by and unloading from the ice-masses, "was an inadequate explanation of the quaternary oscillations of shore-line, but that it became completely adequate when coupled with eustatic change of ocean-level due to the return of the water bound up in the ice-sheets. This theory, which was then [in 1914] quite novel, has received ample confirmation from recent researches, and, being now completely established, is given the name Isokinetic, from the fact that shore-lines are cut when the two motions are equal and in the same sense".

A word of appreciation is due to the publishers for the obvious care taken in producing this handsome volume.

An Advance in Kantian Scholarship

Kant's Metaphysic of Experience:
a Commentary on the First Half of the "Kritik der reinen Vernunft". By Prof. H. J. Paton. (Library of Philosophy.) Vol. 1. Pp. 585. Vol. 2. Pp. 510. (London: George Allen and Unwin, Ltd., 1936.) 2 vols., 30*s*. net.

EVER since the philosophy of Immanuel Kant was given to the world, in the years 1781–90, there seems to have been a tacit understanding among his readers and commentators that this philosophy would not do as it stood; and thus there has grown up a curious but almost universal custom of reading Kant not for the sake of what he said, but for the sake of what the reader presumes that he ought to have meant. Idealist philosophers, including even the German neo-Kantians after Cohen, have rejected as 'dead' all elements in his philosophy except those which became a basis for the work of his idealist successors, and the first large-scale commentary on Kant that was produced in Great Britain was informed by the same assumption. More recent scholars have claimed to discover, with the aid of textual criticism, that the "Critique of Pure Reason" is a patchwork of fragments, written at different dates within a period of eleven years, embodying widely different and even contradictory views, and at last hastily assembled in the space of three months. On this view, Kant has no consistent philosophy of his own; his greatness rests merely upon the enormous width of his interests and the illuminating nature of many of his suggestions, but he involves himself in far more difficulties than he elucidates.

Prof. Paton's book represents the long-overdue reaction against these cavalier methods. Starting with the fact that the "Critique of Pure Reason", whatever its materials may have been, was obviously planned and executed as a whole, he examines and expounds in detail the text of the first two sections of it, the "Aesthetic" and the "Analytic", and discovers that it embodies a continuous and close-knit argument resting on certain assumptions which, whether true or not, are at any rate coherent, reasonable, and in no way idealistic. In these respects Prof. Paton's interpretation has the considerable merit of crediting Kant with having done very much what Kant himself always said he had done.

Two points in the author's interpretation of Kant call for special mention. The first is concerned with the doctrine of the thing in itself. To the scientific world, Kant has been known chiefly by what he has in common with Comte and Spencer. The sphere of possible knowledge, he says, is confined within the limits of experience, and the world which we know in experience is merely phenomenal. Behind the phenomenon lies the thing in itself, but that is and must always remain unknown. It is true that Kant also held doctrines of an absolute time and an absolute Euclidian space, and certain opinions about the nature of mathematical thinking, which have got him into trouble with mathematicians and physicists; but these are details, and the essence of his doctrine lies in distinguishing between phenomena and the thing in itself, and confining all possible knowledge to phenomena. Against this the philosophers have argued that, if the thing in itself is really unknown, Kant cannot even know that it exists, and is inconsistent in claiming to do so; that in the long run he is actually driven to admit that he is not certain of its existence, and that he ought to have denied it altogether and become a true idealist.

Prof Paton shows in the work under notice that these criticisms are beside the mark. When Kant denies that we can know the thing in itself, he does not deny that we can form an idea of it as being something in general; what he denies is that we can have insight (*einsehen*) into its nature. Nor does he ever entertain a doubt of its existence; the passages which have been held to express such a doubt have been misinterpreted. Kant thinks it is quite certain that, behind the phenomena of Nature, there is something the existence of which we can recognize in a general sense, but the character of which we cannot conceive. This doctrine may be erroneous, but it is neither inconsistent nor *prima facie* unreasonable. That it is really Kant's doctrine was established by Adickes, to whose praise Prof. Paton consecrates a footnote; it has also been recognized by Dr. Ewing in his "Idealism", and it may be hoped that the recognition may become general.

The other point which requires special mention is Prof. Paton's treatment of Kant's doctrine of the schematism of the categories. The doctrine has been generally ignored, or treated as a piece of pedantry; but in fact it is indispensable to the coherence of Kant's argument. If the scientific worker, whose presuppositions Kant claims to be elucidating, is to recognize in Kant's categories his own working principles, which are simply the minimum assumptions necessary in order to make sense of a world in space and time, then Kant himself must take explicit account of space and time, and see to it that any more abstract principles of his own, which he may be able to extract from an analysis of pure logical forms, shall be given a spatio-temporal form, that is, 'schematized', before he can set them forth as valid for scientific thought. Prof. Paton's understanding of this, and his demonstration that Kant also understood it, constitute not the least of the merits of this book.

Kant's philosophy does not lend itself to quick study and epigrammatic judgment; but those who are prepared to study it seriously and in detail, as it demands, will do well to take Prof. Paton as their guide. His commentary is indispensable to those who wish to obtain a clear and balanced view of the fundamental principles of one of the greatest philosophies of modern times.

Comparative Biochemistry

An Introduction to Comparative Biochemistry By Dr. Ernest Baldwin. Pp. xviii+112. (Cambridge: At the University Press, 1937.) 5*s*. net.

UNTIL recently, the criteria of zoological and botanical relationships were, in the main, qualities of external or internal structure, or of functional behaviour. The possibly more intimate and certainly less obvious resemblances and differences between different animal types, in the chemical make-up of their tissues and body fluids and in their metabolic habits, have only recently begun to come within the sphere of established knowledge. It is as a direct result of the new methods which have been developed in biochemistry, particularly as an outcome of increased accuracy in dealing analytically with very small quantities of material, that information has accumulated in the last few years regarding these matters, throwing a flood of light on the ways in which the physical and chemical problems presented to different types of living organisms at various stages in their evolutionary history have been overcome.

In this book an outline of recent advances in this relatively untrodden field—an outline that is never far from the available experimental findings—is presented in an admirably succinct way by Dr. Baldwin. Beginning with a consideration of the osmotic difficulties of sea- and fresh-water fauna and how these are met, the author proceeds to the devices used by land animals for conservation of water, and the biological significance of the different ways in which nitrogen is excreted in different groups of land and sea animals, particularly in relationship to the ornithine cycle and purine metabolism. A section is devoted to the strange distribution of the two phosphagens. Recent work on the biochemistry of the supply of oxygen to the tissues in relation to respiratory pigments is summarized, and is followed by a brief descriptive account of some pyrrol, indol and carotene pigments. This last chapter on pigments seems a trifle abrupt, and less well woven than the earlier chapters into the general evolutionary story.

It is doubtful whether the word uræmia (p. 32 *et seq.*), normally used clinically to describe a definitely pathological condition which may occur irrespective of the level of urea in the blood, is the wisest one to use to describe a physiological condition in which there is a high content of urea in the blood and tissues. It is not quite clear why, if urea were produced in the cleidoic egg, it should disturb osmotic relationships (p. 47), since, apart from the wall of the urinary bladder and the gills of elasmobranchs, most tissues seem to be freely permeable to this substance. It would have been interesting to have had the author's views on the relationship of the recent findings of W. L. Davies, that trimethylamine oxide occurs in appreciable quantities in the urine and milk of dairy cows after they have eaten various beet by-products, with the statement (in the section beginning on p. 43) that it is only in the excreta of marine teleosts that this substance occurs. Does the normal diet of these animals contain large quantities of betaine or related compounds? Is the occurrence of trimethylamine oxide in the excreta more a reflection of the type of compound in the ingesta than of any fundamental metabolic peculiarity?

In case there is virtue in the fact that the reviewer read through this book from cover to cover with the greatest pleasure in a single sitting, let it be put on record. Dr. Baldwin's book may be confidently recommended as a delightfully yet firmly written introduction to this infant science. Sir Frederick Hopkins contributes a characteristic foreword.

H. D. K.

A Modern Climatology

Handbuch der Klimatologie
Herausgegeben von W. Koppen und R. Geiger. In 5 Bänden. (1) Band 1, Teil B: Die klimatologischen Elemente und ihre Abhangigkeit von terrestrischen Einflüssen, von Prof. Dr. V. Conrad; Band 1, Teil C: Das geographische Systeme der Klimate, von Prof. Dr. A. Köppen; Band 1: Titel, Vorwort, Inhalt, alphabetisches Sachregister. Pp. x + xii + B556 + C44 + 12. 90 gold marks.

(2) Band 2, Teil J: The Climates of North America. Part 1: Mexico, United States, Alaska. By Prof. Robert DeC. Ward and Prof. Charles F. Brooks. Pp. x + 326. 60 gold marks.
(Berlin: Gebrüder Borntraeger, 1936).

(1) The encyclopædic handbook of climatology by Köppen and Geiger makes a considerable advance by the issue of two new volumes. The first of these, containing vol. 1, Section B and Section C, is a volume of about 600 pages. In Section B Prof. V. Conrad, of Vienna, gives an outline of the climatological elements and their dependence on terrestrial influences. He has taken a wide view of the domain of climatology, and we might perhaps regard much of the matter which he has included as falling rather within the domain of physics of the atmosphere. In view of the thoroughness of the treatment we have no cause to regret the author's choice of topics. In five sections he treats in turn solar and terrestrial radiation, the constitution of the atmosphere and its impurities, the measurement and representation of temperature, wind and air flow, and the hydrometeors. We find throughout the whole book careful discussion of methods of observation and of methods of representation of the observations. Thus the question of how best to obtain a reasonable mean temperature for the day from observations at standard times is considered with some care. The influence of the location and aspect of the observing station on the meteorological conditions is stressed, particularly with regard to temperature and rainfall.

For almost every meteorological element we find tables, charts or diagrams, showing the distribution over the globe, the variation with height, or the diurnal or annual variation. Data from many parts of the world are shown in the text or diagrams. The mean winds of the globe are described, and an outline of the scheme suggested by V. Bjerknes for the general circulation of the atmosphere is added. Special local winds, land and sea breezes, and hill and valley winds are described. The longest section is that dealing with the water vapour in the atmosphere. All aspects of the subject are mentioned. Evaporation is discussed with reference to the theories which have been put forward in such overwhelming numbers. But here the reviewer noted that the work of O. G. Sutton, which he would regard as one of the most valuable of all recent contributions to this most difficult subject, receives no mention. Some idea of the thoroughness with which the author has done his work may be gathered, however, from the fact that he has even succeeded in collecting some data relating to the diurnal variation of rainfall, a subject which few writers have cared to embark upon. References to original papers are plentiful, and form one of the most useful features of the book.

In Section C, Köppen gives in about forty pages an account of the well-known classification bearing his name, which is based on considerations of temperature and rainfall. Köppen distinguishes eleven main types of climate, but there is obviously an almost infinite gradation of possible subdivisions. Fig. 4 shows the annual distribution of temperature and rainfall in each of the main types, and in view of the importance of this diagram it is regrettable that it is on so small a scale. The short account is, however, a useful summary of the bases of Köppen's classification of climates.

The whole volume is one of the most useful additions to the list of reference books of the working meteorologist. It is naturally a severely technical work, and cannot be regarded as light reading by even the most technically minded. But it will have its place in every library of meteorological books.

(2) The second of the two new volumes, vol. 2, Section J, describes the climates of Mexico, the United States and Alaska. Much of the work of collecting and discussing the observations was done under the partial guidance of the late R. de Courcy Ward. He shared with Prof. C. F. Brooks and Mr. A. J. Connor the duties of author, but many American meteorologists contributed to the work of compiling the book. It begins with a general introductory description of the physical features of North America and their bearing on the climates of the continent. We are here reminded that the fact that the continent narrows southward instead of northward has the consequence that, instead of a Sahara, North America has the Gulf of Mexico.

The volume is in three sections, dealing respectively with Mexico, the United States and Alaska. Each of the three sections ends with a series of tables, giving for a large selection of stations monthly and annual means of temperature, pressure, wind directions, relative humidity, days with snow, hail, thunderstorms, strong wind, or fog, to name but a selection of the contents. The text discusses these observations, charts and diagrams being freely used where desirable. Most of the charts cover the whole of the continent, including Canada, though the climatology of Canada is to form the subject of the next volume, which is due to appear shortly. The authors have carried out their difficult task with care and good judgment. Of particular interest are the chapters in the section on Mexico dealing with climate and vegetation, and climate and population, and in the section on the United States dealing with climate and health and climate and crops. The volume will be valuable to all who are interested in the meteorology, climatology, or economics of the North American continent.

The general editors of this monumental climatology, Köppen and Geiger, are to be congratulated on the way in which the work not only progresses, but also maintains the high standard which marked its early stages. One cannot help a feeling of envy of the American colleagues, who will have an excellent and up-to-date climatology of their country at their elbows, while wondering why no one has yet seen fit to produce an equally complete modern climatology of the British Isles.

D. B.

Analytical Chemistry

Textbook of Quantitative Inorganic Analysis
By Prof. I. M. Kolthoff and Dr. E. B. Sandell.
Pp xv+749. (New York: The Macmillan Co., 1936.) 20*s*. net.

IN this work, the production of well-known teachers and investigators of analytical subjects, we have one of the best productions on the subject of quantitative inorganic analysis available to students. It sets out from the position that analytical chemistry is a fundamental branch of the science, a statement which the reviewer accepts fully.

The presentation of the subject is such that many who have passed beyond the stage of the advanced student and have reached the heights of research will find it profitable to read the volume. The theory of *p*H values, solubility product and the electroanalytical process is given sufficiently fully for practical purposes. A chapter on errors in analysis will repay careful study, and we may recommend in particular that part of the chapter dealing with significant figures obtained in the course of an analysis. The section on volumetric analysis is introduced by a very useful discussion of the theory of the various branches of this class of analytical operations. It includes a fairly full account of potentiometric titrations, and of various types of indicators, many of which, for example, erioglaucine *A* and phenanthroline, are here given the attention they deserve.

A short section of the book is devoted to physicochemical methods, and that part which deals with colorimetry and spectrophotometry should prove valuable to all who have to use colorimeters in their work. The use of so-called unspecific properties (density, refractive index, etc.) for the analysis of mixtures is dealt with rather too briefly, as is indeed the rest of the chapter, which gives an outline of some other physico-chemical properties useful in investigation. While the methods here described for the analysis of brass and steel are useful and practical, it is a matter of opinion whether the space devoted to these matters might not possibly have been better utilized for fuller discussion of some of the physicochemical methods. We agree that the description of the analysis of silicate rocks is valuable to the student because of its wide and general application, but the description of the examination of these two alloys seems to the reviewer somewhat restricted for a work which is so philosophic in its general outlook.

The subject matter is well arranged and has adequate references to original papers and special works on analysis, while the descriptions of the more important gravimetric and volumetric processes are sufficient. For teaching purposes, three different sizes of type have been employed, and this, together with the problems set at the end of the chapters, will be found particularly advantageous in using the book.

This work can be recommended with confidence as providing the foundations of a sound training in theoretical and practical quantitative analytical chemistry. We have not discovered any errors, and misprints, if any, must be very few indeed. We agree heartily with the views on the scope and purpose of the study of analytical chemistry propounded in the preface. J. J. F.

Laboratory Manual for Chemical and Bacterial Analysis of Water and Sewage

By Prof. Frank R. Theroux, Edward F. Eldridge and Prof. W. LeRoy Mallman. Second edition, revised and enlarged. Pp. x+228. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 15*s*.

THIS book is essentially a utilitarian product, greatly appreciated as proved by two editions appearing within nineteen months: the added bacteriological section further enhances its value.

The first part is chemical, subdivided into three sections, water, sewage and polluted water; these arbitrary divisions cause some duplication. The instructions are efficient, concise, well arranged and furnished with calculated examples from selected data. This part describes the preparation of the necessary solutions and reagents and concludes with chemical notes on analytical methods. Here the preparation of the caustic soda solution seems wasteful, while the diluting water for the B.O.D. (biological oxygen demand) misses the point by aeration after adding alkali.

Part 2 gives an efficient account of the bacteriological examination of water and sewage; also the composition of the required media; these follow on the lines of the American Public Health Association methods—hence *B. Welchii* is omitted. The number of media enumerated is excellent. However, the absence of Noble's official cyanide citrate medium for the Coli-ærogenes group is noted. The colon index method is used for routine comparative purposes; the Phelps and M.P.N. (most probable number) methods are given.

Calculations with numerous illustrative examples are prominent throughout. Unfortunately, small errors occur; p. 118, the atomic weight of iodine is a unit larger than usual; the equation is unbalanced; p. 119, the alkali equivalent is 0·1 per cent too high.

The organic determinations are, by a strange irony, the least satisfactory part of our present methods, due to unrealized errors and artefacts. The shepherding care here devoted to the nitric nitrogen in the Kjeldahl process deserves emulation even in more pretentious works; it would confer inestimable benefits upon all concerned and is fundamentally necessary to progress. J. W. HAIGH JOHNSON.

Die Tsetsefliegen:

ihre Erkennungsmerkmale, Lebensweise und Bekämpfung; ein Leitfaden für die Praxis. Von Dr. F. Zumpt. Pp. iv+149+15 plates. (Jena: Gustav Fischer, 1936.) 9 gold marks.

DR. F. ZUMPT, of the Institute of Tropical Diseases at Hamburg, has provided in the above work a concise and up-to-date manual on the tsetse flies. Within the compass of about 140 pages he has described the essential features of their structure, taxonomy, habits and the means for attempting their control.

The first section is devoted to general features of their morphology: this is followed by a short account of their methods of feeding and of reproduction. A longer section is given to taxonomy, wherein the characters employed for determining the various species are dealt with, together with accounts of their habits and geographical distribution. A short general statement of tsetse ecology follows, together with a more detailed discussion of ecological methods of study. The concluding part is concerned with the problem of combating these insects, both by purely local methods, such as trapping, and by the more comprehensive schemes of destroying or altering their natural environment. At the end of the work is a very complete bibliography (up to 1936) comprising about 400 references to separate publications.

While this manual gives a good presentation of the subject as a whole, its most useful part will probably be found in the account of the taxonomy and specific characters of these insects. A. D. I.

Forest Insects:

a Textbook for the Use of Students in Forest Schools, Colleges and Universities, and for Forest Workers. By Prof. R. W. Doane, Prof. E. C. Van Dyke, Prof. W. J. Chamberlin and H. E. Burke. (American Forestry Series.) Pp. xii+463. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 25*s*.

THE realization of the national importance of forestry, which has overtaken the North American continent in recent years, has manifested itself in various ways. Forest protection and reafforestation, in particular, have come to the front. Under the term protection come not only the combating of forest fires but also of the many biological enemies of living trees. Among these latter, insects are the most important.

Practical people in forests and parks, as well as teachers and students in academic institutions, need properly documented information to which they can refer. The present book aims at filling requirements of this kind. In its first four chapters general principles are dealt with in a brief and elementary fashion. Nearly seven eighths of the book are given to accounts of forest insects themselves. The essential information about each species is provided, while the bibliographies at the ends of the chapters guide the reader to sources giving fuller details.

The book is well arranged and clearly illustrated, and should admirably fulfil its purpose as a manual for North American use.

Méthode des caractéristiques pour l'intégration des équations aux dérivées partielles linéaires hyperboliques

Par Mlle. Hélène Freda. (Mémorial des Sciences mathématiques, Fasc. 84.) Pp. vii+82. (Paris: Gauthier-Villars, 1937.) 15 francs.

WITH great skill and clarity, Mlle. Freda has presented an account of the origin, development and applications of one of the most powerful methods of mathematical analysis. Starting with Cauchy's problem and Riemann's original method, she traces the extensions due to Picard, Volterra, d'Adhémar, Tedone, Coulon and Hadamard, with modifications and additions due to herself. There are references to mechanical and physical applications, and to the history of the subject. Prof. V. Volterra contributes an appreciative preface. H. T. H. P.

Water-Power in the United States

By Dr. Brysson Cunningham

II

Grand Coulee Dam

THE second of the great power projects in the United States to be described is the Columbia Basin Project, Washington. It includes the construction of a dam which, when completed, will be the second highest in the world; the formation of an artificial reservoir with an area of 82,000 acres or 128 square miles; the installation of a power plant which will ultimately exceed the capacity of any other now in existence, and an important irrigation canal system over adjacent territory.

The Columbia River, rising in the Canadian Rockies and crossing into the State of Washington near its north-east corner, has the greatest run-off but one in the country. It flows for 750 miles through the State into the Pacific Ocean, falling 1,300 ft. in its course, and is the largest river in the United States in point of potential power susceptible of economic development. It is obviously, therefore, a very suitable subject for exploitation in the interests of industry and agriculture.

The impounding dam is at the mouth of the Grand Coulee (Fig. 1), a natural basin formed by an earlier diversion of the river channel, probably during the glacial epoch, about 22 miles north of Almira and 92 miles by road west of Spokane. The work of dam construction was commenced in December 1933, and is expected to be completed by the end of the current year. As originally designed, the height of the dam was fixed at 300 ft., with a crest length of 3,400 ft., which would have erved for a power development of 520,000 horse-ower. It was the intention thereafter to supermpose a high dam upon this low dam, when funds became available for a combined irrigation and power development scheme. Constructional difficulties, however, arose from slides in the canyon walls above the site, and a consideration of the objectionable bonding of two structures, with the uneconomical accommodation for hydraulic machinery to cope with low-head and high-head conditions, led to the substitution, at the outset, of a dam of the concrete straight-gravity type, rising about 550 ft. above the lowest point of the foundation bed and capable of raising the river-water surface-level by 355 ft. This dam,

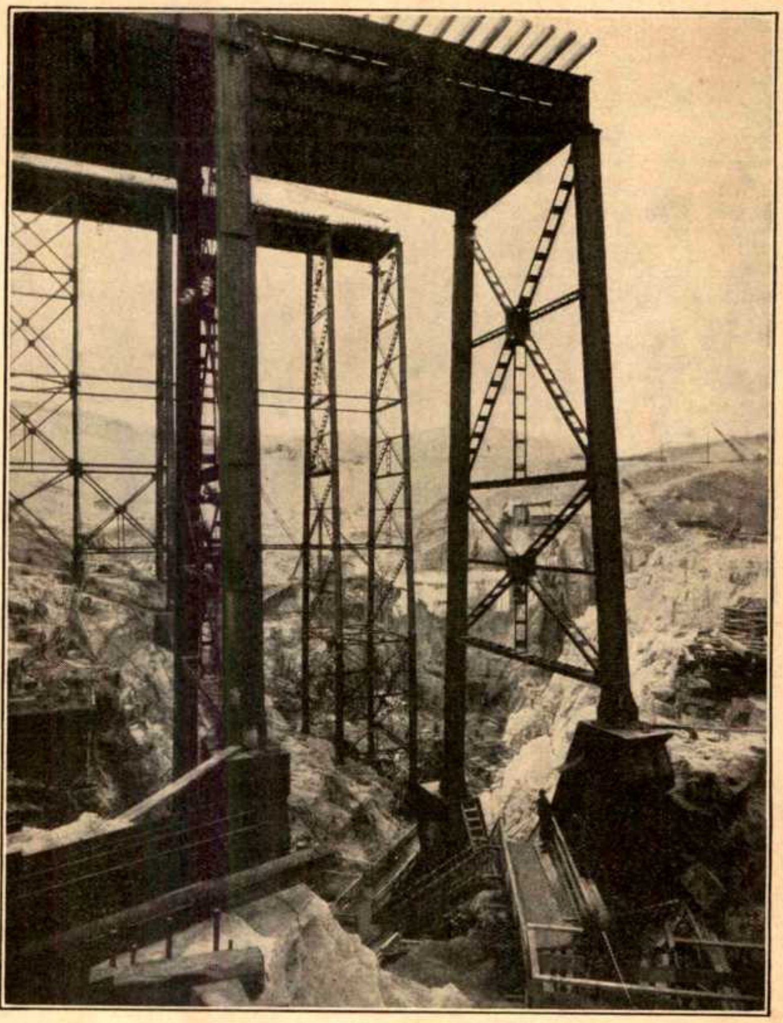

Fig. 1.

View of excavation in progress (December 1936) at Grand Coulee installation. The concreting of the dam just commenced.

superimposed on the natural granite, will have a crest length of about 4,200 ft., with a 1,650 ft. overflow spillway in the river channel portion, affording a flow capacity of a million cusecs. The structure is of enormous size, containing, with the powerhouse and other appurtenant works, no less than 11,250,000 cubic yards of concrete masonry, weighing more than twenty million tons—roughly, three times the volume and weight of the Boulder Dam.

The reservoir formed by the dam will extend for a distance of 151 miles from the Grand Coulee to the Canadian border, and up the Spokane River for 32 miles. The width averages a little more than 4,000 ft. The Columbia River, it may be added, is five times as large as the Colorado River, on which the Boulder Dam is located. The volume of water to be impounded in the Columbia River reservoir is sufficient to supply nearly 2,000 gallons for every inhabitant on the earth. In contrast with the Colorado River, the Columbia River water is practically free from silt.

The installed capacity of the Grand Coulee power plant will be 2,700,000 horse-power—half as much again as that of the Boulder Dam plant and six times as much as that of Niagara Falls. The continuous power output will be 1,240,000 horse-power. There are to be two power houses, one on each side of the dam, containing eighteen 150,000 horse-power vertical hydraulic turbine and eighteen main generating units of 120,000 kVA. capacity each, 60 cycles. There will also be three 7,500 kVA. service units. Water will reach the turbines through eighteen penstock culverts, 18 ft. in diameter, and the machines will operate under an average head of 335 ft. (maximum 360 ft.; minimum 265 ft.). It is expected that the plant will be ready to commence partial operation in 1942.

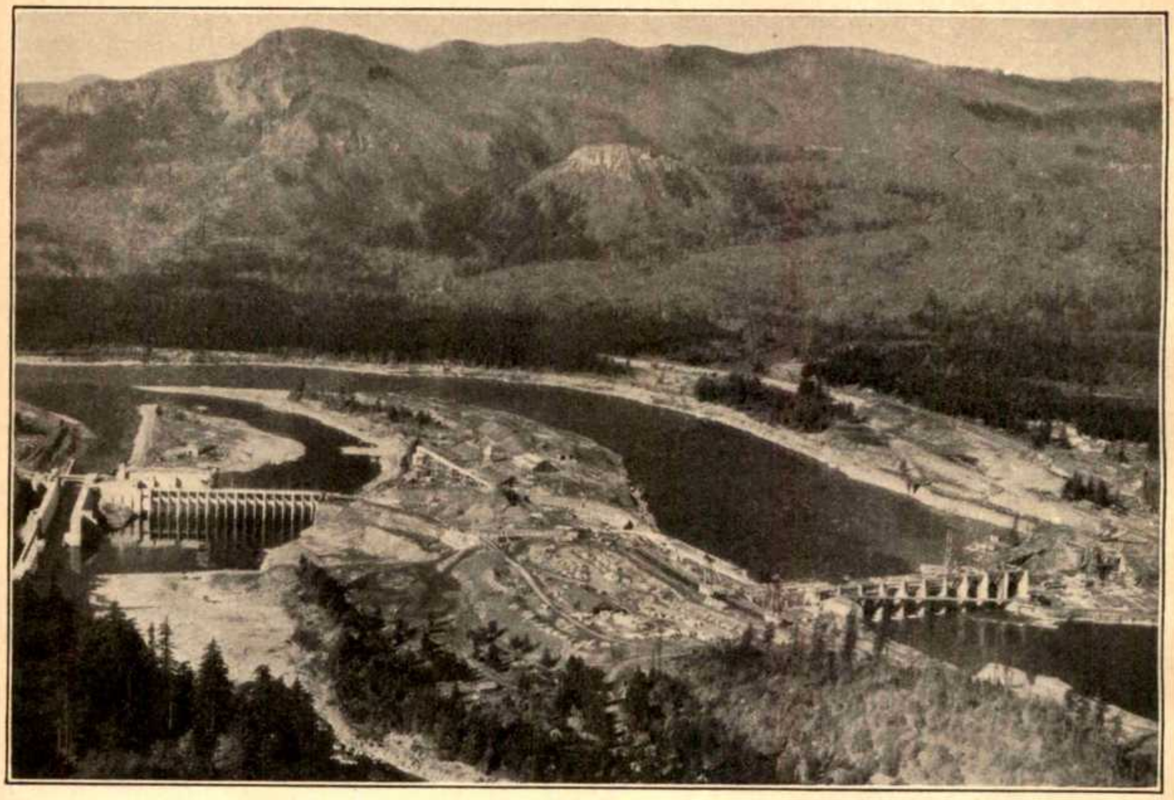

Fig. 2.

GENERAL VIEW OF THE BONNEVILLE INSTALLATION; UPSTREAM SIDE OF POWER HOUSE AND LOCK, WITH SITE OF MAIN DAM.

The reservoir is to be provided with an installation of twelve pumps, of 1,600 cusecs capacity each, driven by a 65,000 horse-power motor against a normal head of 295 ft., discharging through 13 ft. diameter outlets, about 700 ft. long, in a canal which leads to the reservoir.

The flow of the Columbia River is on an average 109,000 cusecs. The greatest recorded maximum is 492,000 cusecs, but it is believed that a peak of 725,000 cusecs was reached at Grand Coulee during the flood of 1894. The minimum discharge, after completion of the dam and the introduction of regulation, will be about 35,000 cusecs.

Irrigation is possible over an area of about 1,200,000 acres in the Columbia Basin, of which 980,000 acres will be by gravity and the remainder by supplemental pumping. The district lies on the east side of the Columbia River, between Soap Lake on the north and Pasco at the extreme southern end, with a maximum width of 60 miles. The land has been declared to be "the best undeveloped irrigation area on the continent".

The estimated ultimate cost of the entire undertaking is 377,000,000 dollars (£75,400,000) of which 179 million dollars is assignable to the dam and power plant and the balance to the irrigation system. The initial development at the Grand Coulee Dam is estimated to cost 60 million dollars.

II

BONNEVILLE DAM

The Columbia River furnishes other sites than the foregoing for the economical exploitation of water-power, including Rock Island and Bonneville. The former of these has already been developed by private enterprise ; the development of the latter, Bonneville, is now in hand by the U. S. War Department Corps of Engineers under an authorization of Congress on August 30, 1935. The main features of the Bonneville undertaking are a dam, a power house, a ship lock and fishways. The total cost, inclusive of an initial installation of two (out of ten) power units of 60,000 horsepower each, will amount to 45 million dollars (£9,000,000).

The Bonneville site (Fig. 2) is about 143 miles from the coast of the Pacific and the river is tidal for that distance. At this point, the river flows in a westerly direction in two channels, separated by Bradford Island. The dam is being constructed in the north or main, channel, while the power house and navigation lock are located on the south channel. The bedrock under the principal structures is a sedimentary deposit of volcanic ash, largely intermixed with pebbles and rock fragments of all sizes, and is locally known as Eagle Creek formation. There is a mushroom-shaped intrusion of andesitic lava of high quality which forms the foundation for the lock and the power house.

The dam is a concrete gravity structure at the base, supporting reinforced concrete piers for eighteen vertical lift steel gates. The gate openings are each 50 ft. wide and the piers 10 ft. thick, making the length of the dam proper, 1,090 ft. The width at the base is 200 ft. and the height above lowest foundation, about 170 ft. A service roadway is to be carried across the piers, so that the completed dam will have the appearance of a concrete multiple-arch bridge. The dam is designed to pass a flood of 1,600,000 cusecs—37 per cent in excess of the volume of the flood of 1894.

The ultimate capacity of the power installation will be ten 43,200 kw. units, 3 phase, 60 cycles, and one 4,000 kw. station service unit. Each of the main turbines will be of 60,000 horse-power, with a head of 45 ft. and a flow of about 2,200 cusecs.

The ship lock is designed to receive ocean-going vessels, so that by deepening the channel below Bonneville (the natural depth of which at low water ranges from 7 ft. to 50 ft.) such vessels may ascend from Vancouver to The Dalles, about 50 miles above Bonneville. The lock will have clear dimensions of 76 ft. in width by 500 ft. in length, and a depth of 24 ft. over the lower sills at low water.

The information on which the foregoing article is based has been supplied by the Bureau of Reclamation, Department of the Interior, Washington, so far as the Grand Coulee installation is concerned, and by the Corps of Engineers, U. S. Army, Washington, in relation to the Bonneville project, to both of which bodies, acknowledgments are also made for the photographic illustrations.

Medical Research in 1936

IN addition to the usual summary of the present position of many aspects of medical research, the report of the Medical Research Council[*] discloses that steps have been taken during the past year to develop the Council's policy of establishing senior clinical posts for whole-time work in research and higher teaching, such as will give a satisfactory career in later life to young men who devote themselves to the scientific study of clinical problems. The Council already supports, in whole or in part, three clinical research units in London, at University College Hospital, Guy's Hospital and the National Hospital for Diseases of the Nervous System. Reference is made to the establishment of a department of clinical research at Cambridge, under the regius professor of physic, in which research students are supported by the Elmore Fund, and to Lord Nuffield's gift to the University of Oxford for the development of research and post-graduate teaching in medical science.

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[*] Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1935–1936. (Cmd. 5378.) Pp. 172 (London : H.M. Stationery Office, 1937.) 3s. net

The Council has given special attention to another aspect of the problem, namely, the training of young clinicians with academic and research appointments in view: for this purpose it has instituted six post-graduate studentships and four research fellowships in clinical science and experimental pathology. The students receive a grant for personal maintenance while undertaking approved courses of study in Great Britain, which may include modern languages as well as advanced physiological, pathological and special clinical work under recognized teachers. The fellowships are for candidates who have already had some experience in the use of research methods, and are intended as probationary appointments for research in clinical science and experimental pathology under suitable direction in Great Britain.

The Council has also always considered problems of health and disease in relation to tropical conditions within its sphere: in fact, one of the chief reasons why it was originally placed under the direction of the Privy Council was that it should be free from territorial limitations. With the prospects becoming more favourable of being able to institute a wider programme of work in the tropics, the Council has appointed a Tropical Medical Research Committee, which contains representatives of the Colonial Office and of the Liverpool and London Schools of Tropical Medicine. The Committee having advised that the most effective means open to the Council of promoting investigations in this subject is the establishment of a small staff of highly qualified workers giving their whole time to research under the best possible conditions, the Council has awarded two junior and two senior fellowships with the view of training suitable candidates in research in tropical medicine. The Council's further intention is to establish, as suitable investigators become available under this scheme, permanent and pensionable appointments for research work in tropical medicine including senior posts: members of this staff will work partly in the tropics and partly in institutions at home. The terms of service will be as favourable as those applying to other Government appointments for men of similar professional standing.

There have been three changes in the constitution of the Council during the year: the Marquess of Linlithgow, Prof. E. D. Adrian and Mr. W. S. Morrison have retired and been succeeded by Lord Balfour of Burleigh, who becomes the new chairman of the Council, Prof. J. Mellanby and Mr. R. K. Law. Reference is made in the report to the award of the Nobel Prize in Medicine for 1936 to Sir Henry Dale, conjointly with Prof. O. Loewi of Graz, in recognition of their work on the nature of the chemical mechanism involved in the transmission of nerve impulses, and to the loss suffered by the National Institute for Medical Research by the death of Captain S. R. Douglas: Sir Patrick Laidlaw has been appointed to succeed Captain Douglas as deputy director of the Institute and head of the Department of Experimental Pathology and Bacteriology.

The scientific researches carried out by members of the scientific staff of the Council and by other workers supported by grants-in-aid cover the whole field of medical research: it is possible to refer to only a few of the more outstanding advances during the past year in this review.

Investigations have been continued on the properties of different viruses: in the case of influenza, it has been shown that the virus obtained in various outbreaks of the disease in widely distant parts of the world is identical with that originally isolated in Great Britain. Conclusive proof has also been obtained of the identity of the experimental disease in ferrets with influenza in man; an infection originally obtained from human sources and since passed repeatedly from ferret to ferret, has been retransmitted by accident to a human being. Progress has been made in the study of methods for the immunization of man against this disease by use of vaccines; but nothing suitable for application in more than an experimental way has yet been achieved.

A new method of determining the size of the particles of different viruses has been used to check results obtained by differential filtration. The rotor of a Sharples centrifuge, closed at the lower end, is lined with a thin layer of a weak agar gel, which is allowed to set during rotation: the suspension to be separated forms a layer only a small fraction of a millimetre in depth on the surface of the agar when the rotor is spinning, so that the particles become entangled in the gel and are protected from re-suspension when the rotor is decelerated. The correspondence between the figures given by filtration and centrifugation has been found in all cases to be a good one.

A characteristic of the known pathogenic viruses has been the failure, hitherto, to grow them in artificial culture media free from organized cellular material which they can infect. A group of free-living non pathogenic organisms, of about the size of vaccinia virus, has now been discovered living in London sewage; they grow readily on ordinary bacteriological media, in which they can be maintained indefinitely in pure culture. The suggestion that propagation of viruses is possible only under conditions of intra-cellular parasitism, since the system of enzymes and surfaces necessary for self-reproductive life could not exist within a sphere of such small diameter as that of a virus, is therefore inapplicable to viruses of the size of the vaccinia group—about 150 millimicrons. The existence of these free-living organisms raises the hope that means may yet be found for growing some of the pathogenic viruses in artificial culture.

Analysis of some recent studies of nutrition in Great Britain has shown the relative constancy in the distribution of calories between protein, fat and carbohydrate eaten by people in different towns: in particular, the percentage of protein eaten is constant, at 10–11 per cent in St. Andrews, Cardiff and Reading. In spite of this, the types of foodstuffs eaten are widely different: in fact, the constant percentage intake of protein and the similar calorie intake of people living far apart, are obtained independently of the type of foodstuff eaten and seem to represent the result of some kind of instinct. As regards the daily calorie intake, a recent investigation of the diet of more than a hundred women students showed the daily intake to be 2,035 calories per person. This intake is considerably less than the usual standard of 3,000 calories, which has itself been considered by some workers to be too low. The analysis of these diets led to the conclusion that few can be considered really poor: on the other hand, many of them, particularly with reference to their content of 'protective' foodstuffs such as milk, green vegetables and fruit, leave much to be desired. The remedy is the education of the average housewife in the relative nutritive value of different foodstuffs.

Epidemic diseases still remain one of the greatest enemies of mankind, although some have been partially or even completely conquered. Problems relating to the spread of epidemics have been studied by field investigations of epidemics naturally occurring among human beings; but there are still many problems which have resisted field investigation because the difficulties of collecting statistical evidence prevent the assessment of the importance of inter-related factors. The experimental study of the spread of epidemics in a population of mice, as carried out for many years at the London School of Hygiene and Tropical Medicine, has provided answers to certain of these problems. Thus it appears that in large herds living under conditions favourable to the spread of epidemic disease, and receiving regular additions of healthy animals, the disease will persist indefinitely. The form of the mortality curve and the size of the herd are determined mainly by the rate of immigration. In epidemics initiated by virulent organisms, the rate of mortality during the early days of herd life is high, reaching a low level between the fortieth and sixtieth days of cage life. The expectation of life from the twentieth to the thirtieth day rises continuously but never reaches that of normal healthy mice. It is considered that both selection and natural immunization play a part in the increased average resistance displayed by surviving animals, the latter being the more important.

Another important subject which is discussed in the report is the problem of the prevention and treatment of puerperal (or childbed) fever. Summing up the present position, the report states that modern investigation suggests two lines of prevention, with a reserve line of treatment if the first two lines of defence are broken down. First, childbirth should be so conducted that access of pathogenic organisms to the birth-canal is rigorously excluded, especially streptococci from the throats of medical attendants, friends or the patient herself. Secondly, the diet should be of such a nature as to raise the resistance to infection to the highest possible level; this means an ample consumption of milk, green vegetables and other protective foods. Finally, if infection does occur, there is evidence that the new chemotherapeutic compounds, 4-sulphonamido-2-4 diaminoazobenzol and *p*-aminobenzene sulphonamide, will reduce both the mortality and the incidence of complications.

Obituary Notices

Prof. W. M. Wheeler

IN the death of Prof. William Morton Wheeler, the United States loses an outstanding personality in the biological world and a man whose reputation spread far beyond the confines of his native country. The first intimation of his death received in England was a telegram from Dr. T. Barbour of Harvard University to Prof. J. Stanley Gardiner, on April 21. He died suddenly in Harvard Square, Cambridge, Mass., on the evening of April 19, after having only very recently returned from a journey in Mexico.

Born at Milwaukee (Wisconsin) on March 19, 1865, Wheeler graduated from the German-American Normal College in that city in 1884. In June 1885, he became a teacher of German and philosophy in the High School, Milwaukee, under George W. Peckham, a well-known student of spiders and social insects. In 1887 Wheeler became custodian of the public museum in his native city, and gave up this post in 1890 on being made a fellow of Clark University, under G. O. Whitman. He graduated Ph.D. there in 1892 and, in the same year, became instructor in embryology at the University of Chicago: in 1897 he was assistant professor. While at Chicago, Wheeler went on study leave to Europe (1893–94), working under Boveri at Wurzburg, and at Liège; he also occupied the Smithsonian table at the Naples Zoological Station. In 1899 he became professor of zoology at the University of Texas; in 1903 he was made curator of invertebrate zoology in the American Museum of Natural History, New York, and from 1908 until 1935 he was professor of entomology at Harvard University. In addition to the last-named post, he was dean of the Bussey Institution of that University from 1915 until 1929.

Much of Wheeler's early researches were in the domain of general zoology—especially morphology and embryology. Mention may be made of his work on the development of the urino-genital system of the lamprey (*Zool. Jahrb.*, **13**, *Anat.*; 1899): his contribution on the peculiar Annelid ***Myzostoma*** (*Naples Mitt.*, **12**; 1896) and his large treatises on insect embryology (*J. Morph.*, **3**; 1889: **8**; 1893) besides several articles written in German and contributed to the *Zoologischer Anzeiger*. Wheeler's work on insect embryology, it may be added, is still important to-day. This kind of occupation, however, failed to stisfy him: "My association with Peckham, Whitman and Patten," he wrote, "had converted me into a hard-boiled morphologist." Henceforth he devoted himself to the insect world and developed his predominant interest in ant life. On this subject alone he must have published more than a hundred and fifty papers, covering most aspects of their economy. On the systematic side he has left a great output of high-class work, but it was the living creatures which attracted him most and especially the peculiar relations of ants to other insects and to the plant world. In addition to his great text-book on ants (1910), in the Columbia Biological Series, the treatise of more than 1,000 pages on the ants of the Belgian Congo (1921–1922) is a monument to his industry and to the other workers who collaborated with him. Wheeler's lectures given at the Lowell Institute, Boston, in 1922 formed the basis of his book "Social Life among the Insects" (1923). This work was greatly amplified in the elaborately documented "Social Insects, their Origin and Evolution" (Paris, 1926; London and New York, 1928). In 1928 there were also published his books "Emergent Evolution and the Development of Societies" and "Foibles of Insects and Men". In 1931 there appeared the book "Demons of the Dust: A study in Behaviour"—an attractively written study of parallelism in evolution as revealed by two widely divergent insect types. His last book was "Colony Founding among Ants", published in 1933, but I believe that he left material for at least one other book at the time of his death. He was active to the very end, and some of his latest papers only came to hand a few weeks ago.

All who knew Wheeler—and his friends are scattered in many lands—will feel a sense of personal loss, for he inspired genuine affection and regard. Many will recall his keen sense of humour as revealed in his published addresses and other writings, or in telling a good story. During his teaching career, at the Bussey Institution, each year brought its quota of students who came to work under him. Many who have now made distinguished careers owe their start to Wheeler's counsel and guidance. His interest was mainly in the research man rather than the undergraduate. Having discussed a programme of work with a student, the latter was usually left to his own devices, for Wheeler rarely visited his students in the laboratory. All who brought their difficulties to him, however, found him both helpful and sympathetic. Wheeler possessed the faculty of inspiring confidence in his men and succeeded in stimulating their best efforts.

Wheeler was a man of simple tastes and with the mind of a scholar. Besides a knowledge of the classics, he was thoroughly familiar with several European languages. His favourite reading for a number of years past covered many aspects of philosophy, psychology and sociology, written in several tongues. With this background, ripened by extensive travel and first-hand observation in the tropics and other lands, he brought to bear a penetrating insight into his interpretation of the evolution and behaviour of social insects. As expositions of such phenomena his writings are unsurpassed.

Wheeler belonged to most of the chief scientific societies of America. He held the degrees of Sc.D. of Harvard and Chicago Universities and of LL.D. of the University of California. He was an honorary member of the Entomological Societies of France and Belgium and was one of the twelve honorary fellows of the Royal Entomological Society of London. His first visit to Europe was in 1893 and he last visited England in 1935, when he attended the British Association meeting of that year. He married Miss Dora Bay Emerson of Rockford, Illinois, in 1898, who survives him together with a son and a daughter.

A. D. IMMS.

Prof. L. Mangin

LOUIS MANGIN, former director of the Muséum national d'Histoire naturelle in Paris, died at Orly on January 27 last. Born at Paris on September 8, 1852, Mangin was of Lorraine origin. He first studied botany under Le Monnier at Nancy and then with van Tieghem at Paris. He became professor of natural sciences at the Lycée of Nancy when twenty-one years of age, and at Louis-le-Grand when twenty-nine. His first researches showed the influence of his teachers and were concerned with plant anatomy and physiology; his thesis for his doctorate was on the adventitious roots of Monocotyledons. In collaboration with Gaston Bonnier he undertook research on respiration, transpiration and carbon assimilation, with results which are of interest in the historical developments of these subjects. This was followed by investigations on the physiology of Basidiomycetes, pioneer work which has not been much added to in the fifty years which have since elapsed.

Mangin then turned his attention to the structure of cell membranes, and by his methods of microchemical analyses and differential staining laid the foundation of modern histological research; that on the membranes of Mucorineæ and Peronosporaceæ is still the basis of text-book descriptions.

From the physiology of fungi and the structure of membranes it seemed logical to pass to the study of fungal infections, and this Mangin did with such effect that he is rightly regarded as one of the founders of French phytopathology. His best-known investigations are those on the diseases of wheat, chestnut, vine (with Viala) and fruit trees; he also studied rots of timber.

In 1904, Mangin was appointed professor of the classification and natural families of Cryptogams at the Museum national d'Histoire naturelle in succession to Dehérain, who had held the chair since 1880, but as professor of vegetable physiology. Here his enthusiasm and administrative ability resulted in his being surrounded by a group of active workers—but in conditions which were surprisingly bad. He continued his investigations and became interested in phytoplankton. One aspect of his work which has not received the recognition due to it, was the attempt to add precision to the description of moulds. In 1920, he was elected by his colleagues to succeed Edmund Perrier as director of the Museum. His administrative duties, particularly heavy on account of the effects of the War, left him little opportunity for research, but he devoted what time he could spare to the study of phytoplankton. By the time he retired in 1931 he had extended the activities and raised the prestige of the Museum; but perhaps his greatest service was the building of the magnificent new Botanical Gallery at a cost of twenty million francs, of which the Rockefeller Institution gave five millions.

Louis Mangin showed his character in his work; when one met him he appeared somewhat reserved but alert and practical, though ever ready to extend to younger men courtesy of a kind suggestive of an older generation. J. R.

WE regret to announce the following deaths:

L. B. L. Belinfante, secretary of the Geological Society of London in 1916–30, and editor of the *Quarterly Journal* in 1890–1930, on April 10.

Dr. A. P. Wills, professor of mathematical physics in Columbia University since 1910, on April 17, aged sixty-four years.

News and Views

Royal Society: New Fellows

AT the meeting of the Royal Society held on May 6, the following fellows were elected: Dr. J. D. Bernal, lecturer in crystallography, University of Cambridge; Prof. A. C. Chibnall, assistant professor of biochemistry, Imperial College of Science and Technology; Prof. G. R. Clemo, professor of chemistry, Armstrong College, University of Durham; Dr. A. N. Drury, lecturer in pathology, University of Cambridge; Prof. H. Munro Fox, professor of zoology, University of Birmingham; Prof. W. E. Garner, professor of physical chemistry, University of Bristol; Dr. S. Goldstein, lecturer in mathematics, University of Cambridge; Dr. Percival Hartley, director of biological standards, National Institute for Medical Research; Prof. H. L. Hawkins, professor of geology, University of Reading; The Rev. J. E. Holloway, lecturer in botany, University of Otago; Dr. W. Hume-Rothery, Warren research fellow of the Royal Society; Dr. T. G. Mason, Cotton Research Station, Trinidad; J. Reid Moir, archæologist; Dr. M. L. E. Oliphant, assistant director of research, Cavendish Laboratory, Cambridge; Dr. C. F. A. Pantin, lecturer in zoology, University of Cambridge; Dr. D. R. Pye, deputy director of scientific research, Air Ministry; Dr. E. C. Stoner, reader in physics, University of Leeds.

Coronation Honours

THE following names of scientific workers and others associated with scientific work appear in the list of Coronation honours conferred by H.M. the King: *Barons:* The Right Hon. Christopher Addison, first Minister of Health, 1919–21, and Minister of Agriculture and Fisheries, 1930–31; Sir John Cadman, chairman, Anglo-Iranian Oil Company and Iraq Petroleum Company. *G.C.M.G.:* Sir Frederick Leith-Ross, chief economic adviser to His Majesty's Government. *K.C.B.:* E. J. Forsdyke, director and principal librarian, British Museum; Prof. E. Mellanby, secretary of the Medical Research Council. *K.C.M.G.:* Sir David Chadwick, secretary of the Imperial Economic Committee and of the Executive Council of the Imperial Agricultural Bureaux; Prof. A. P. W. Thomas, emeritus professor of botany, zoology and geology, Auckland University College, New Zealand. *Baronet:* Sir David Milne-Watson, president of the National Gas Council and Governor of the Gas Light and Coke Company. *Knights:* Prof. R. W. Chapman, professor of engineering, University of Adelaide, South Australia; Brigadier H. J. Couchman, surveyor-general of India; Dr. Allen Mawer, provost of University College, London, and director of the Survey of English Place Names; Colonel A. Olver, expert adviser in animal husbandry to the Imperial Council of Agricultural Research; Dr. R. H. Pickard, director of the British Cotton Industry Research Association; Dr. D'Arcy W. Thompson, professor of natural history, University of St. Andrews. *C.H.:* Prof. C. T. R. Wilson, for services to experimental physics.

C.B.: Major-General H. M. Perry, honorary surgeon to the King, director and professor of pathology, Royal Army Medical College; Dr. D. R. Pye, director of scientific research, Air Ministry; B. Rackham, keeper, Department of Ceramics, Victoria and Albert Museum. *C.M.G.:* A. J. Findlay, director of agriculture, Zanzibar; C. F. M. Swynnerton, director of tsetse research, Tanganyika Territory. *C.I.E.:* J. F. Blakiston, director-general of archæology in India; Colonel J. Taylor, director, Central Research Institute, Kasauli; Lieut.-Colonel C. Newcomb, chemical examiner to the Government of Madras, and principal, Medical College, Madras; F. Ware, officiating expert adviser in animal husbandry to the Imperial Council of Agricultural Research.

C.B.E.: Prof. A. L. Bowley, emeritus professor of statistics in the University of London; Prof. E. L. Collis, emeritus professor of preventive medicine in the University of Wales, a member of the Miners' Welfare Committee; G. S. Colman, member of the Pastoral Research Council, Commonwealth of Australia; Dr. A. D. Crow, director of ballistics research, Research Department, Royal Arsenal, Woolwich; Colonel J. Heatly-Spencer, honorary physician to the King, professor of tropical medicine, Royal Army Medical College, and consulting physician to the Army.

O.B.E.: W. P. Brewis, chairman of the Newcastle Society of Antiquaries, member of the Council of the Roman Society; H. J. Burrell, for contributions to natural history in the Commonwealth of Australia; R. Daubney, chief veterinary research officer, Kenya; H. N. Linstead, secretary and registrar of the Pharmaceutical Society of Great Britain; A. Main, chief inspector of agriculture, Department of Agriculture for Scotland; A. Morley, lately staff inspector, Board of Education; Prof. A. J. Perkins, formerly director of agriculture in the State of South Australia; F. S. Richards, deputy surveyor-general to the Egyptian Government; H. W. Simmonds, entomologist, Fiji; Dr. J. M. Stagg, senior technical officer, Meteorological Office, Air Ministry; D. Stewart, deputy conservator of forests, United Provinces; J. G. Stewart, chief inspector of agricultural education, Ministry of Agriculture and Fisheries. *M.B.E.:* W. L. Watt, agricultural officer, Kenya; L. F. Wacher, agricultural officer, Basutoland. *I.S.O.:* A. H. Cockayne, director-general, Department of Agriculture, Dominion of New Zealand; A. More, deputy Government chemist.

Prof. W. L. Bragg, O.B.E., F.R.S.

PROF. W. L. BRAGG, who has been appointed director of the National Physical Laboratory, has held the Langworthy chair of physics in the University of Manchester since 1919. Beginning his research work at Cambridge in 1912, about the time when v. Laue had announced his discovery of the diffraction of X-rays by crystals, Prof. Bragg was attracted to this field of work. One of his early papers explained, in terms of the 'reflection' principle, the nature of the patterns observed in the Laue photographs. Along with his father, Sir William Bragg, he developed the X-ray spectrometer. The determination of the structures of the simpler crystals followed, until in 1915, their work was recognized by the joint award of the Nobel Prize for Physics. After his appointment at Manchester, Prof. Bragg quickly established a school of workers engaged in investigations of the solid state of matter. His own particular interest has been in the orderly arrangement of atoms in crystals and in relations between atomic arrangement and the properties of a crystalline substance. The field is a very wide one, and is of interest, not only to the physicist, but also to the chemist who is seeking to understand the nature of the forces which bind atoms together and to the industrial research worker who wants information about the structure of his working materials.

FOLLOWING the first period, in which the simpler crystal structures were investigated by X-ray methods, the determination of the structures of more complex crystals was made possible, principally through the development of methods of analysis using the intensities as well as the directions of reflection of the X-rays. In this phase of the work, Prof. Bragg and his co-workers have determined a range of complex structures of minerals, particularly silicates and zeolites. During the last few years, Prof. Bragg and his team of research workers have been particularly interested in an experimental and theoretical study of the atomic arrangements in alloys and in the effect of heat treatment on these structures. Prof. Bragg's laboratory in Manchester has been one of the principal centres in Great Britain for the investigation of the structure of crystals, and students from all parts of the world have visited the laboratory, either for training in this field of research or for the privilege of working under Prof. Bragg's supervision.

Prof. A. O. Rankine, O.B.E., F.R.S.

IT is announced that Prof. A. O. Rankine, professor of physics in the Imperial College of Science and Technology since 1919, will resign that position at the end of the present academic year in order to join the staff of the Anglo-Iranian Oil Company as chief physicist. Prof. Rankine has for some years acted as geophysical adviser to the Company and in his new position he will take charge of all physical investigations carried out by the Company. The appointment is another interesting and significant example of the migration from the academic to the industrial world of a distinguished man of science, and is evidence of the ever-growing importance of science and scientific research in modern industrial development. It may be remembered that Sir John Cadman, the chairman of the Anglo-Iranian Oil Company, was himself at one time a professor in the University of Birmingham. During his chairmanship of the Company, since 1927, notable work in the development of the relatively new science of geophysics has been carried out since 1924 by the Company, which introduced geophysical surveying in the country formerly known as Persia and now to be called Iran In the development of geophysical science, Prof. Rankine has played a notable part, and will no doubt find in his new sphere increased scope and opportunity for further advances.

Awards in Anthropology

THE Wellcome Gold Medal for research in anthropology for 1936 has been awarded by the Council of the Royal Anthropological Institute to Dr. Charles Kingsley Meek for an essay entitled "Law and Authority in a Nigerian Tribe". In accordance with the terms of award laid down when the medal was instituted by the late Sir Henry Wellcome, the subject of research is the application of the science of anthropology to the problems of administration among backward peoples. Dr. Meek was formerly an officer of the Nigerian administrative service, and has for long been known as the foremost authority on the native tribes of Northern Nigeria. He is the author of a number of works in which the ethnography of the territory has received detailed treatment. The Council of the Institute has also awarded the Rivers Memorial Medal to Dr. Edward Evan Evans-Pritchard. This medal is awarded in recognition of recent meritorious field work. On this occasion, the Council has had before it the results of Dr. Evans-Pritchard's work in the Anglo-Egyptian Sudan and in Kenya since 1926. Dr. Evans-Pritchard, who was educated at Exeter College, Oxford, and studied anthropology at the London School of Economics, was appointed in 1926 by the Sudan Government to carry on the ethnographical survey of the tribes of the Anglo-Egyptian Sudan which had been initiated by Prof. C. G. Seligman, and later for a time was professor of anthropology in the University of Cairo. He has also acted as honorary secretary of the Royal Anthropological Institute. From time to time, the earlier results of his researches have been published in *Sudan Notes and Queries* and in the *Journal of the Anthropological Institute*. His further studies have appeared recently in a work on witchcraft among the Azande, which has been pronounced by those most competent to judge to be one of the outstanding works of recent years in anthropology. Dr. Evans-Pritchard is now engaged in preparing a further work on the religion and social organization of the Azande.

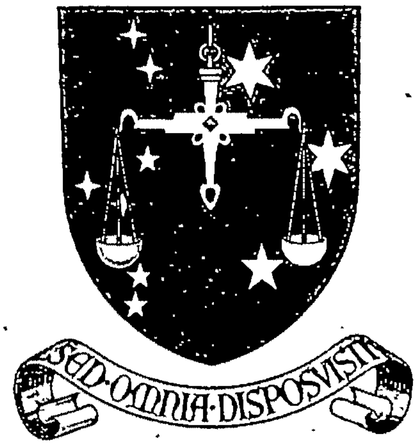
Wool Research in Australia

THE decision of the Australian Government last year, at the instance of pastoralists, to impose a levy on wool production, has been followed by the appointment of a Wool Board, with six members representing the industry and one the Commonwealth Government. The levy may be up to 6*d*. per bale, and the funds are to be used for (i) scientific research and (ii) publicity for the benefit of all sides of the wool industry. The Board has recently determined upon its expenditure under the first heading during the next financial year, and its decisions should result in marked stimulation of scientific work, particularly of that being carried on under the auspices of the Council for Scientific and Industrial Research. £2,750 has been granted for extensions to the Council's Nutrition Laboratory in Adelaide; £1,600 for sheep blowfly investigations at Canberra and Sydney; £900 for provision of additional accommodation at the McMaster Laboratory in Sydney; £730 per annum for three years for parasitological field work; £100 capital and £370 per annum for three years for further study of external parasites of sheep; £500 for the Council's field station at St. Mary's, some twenty miles from Sydney; £484 for three years for increased staff for fertility studies; and minor amounts for further investigations into toxæmic jaundice, foot-rot and ophthalmia in sheep.

IN addition to these grants, the Australian Wool Board has agreed to support a project for establishing in South Queensland a field station for large-scale investigations of sheep problems, including tests of methods for mitigating the blowfly pest. The Queensland Government has granted the Commonwealth Council a thirty years lease, at a peppercorn rental, of an area of 40,000 acres in the Cunnamulla district. Towards the capital expenditure on buildings, fencing, etc., that will be necessary, the Board has allotted £10,000 in the first year and £7,500 in the second. The establishment of this station is cordially approved by wool-growers throughout Australia, and it should serve as an effective additional link between the practical growers and the research workers in the city laboratories.

Arms for the British Association

THE British Association has received a grant of armorial bearings from the College of Arms, the necessary fees being met by gifts from an anonymous donor and from ex-presidents of the Association.



The shield is described as azure ten stars, two of six, four of five, and four of four points argent, representing the constellation of Libra; over all a balance or. The motto, *Sed omnia disposuisti*, is taken from "Wisdom of Solomon", ii, 20 (But Thou hast ordered all things in measure and number and weight).

University of Sheffield and Sir Robert Hadfield

IN NATURE of October 10, 1936 (p. 610), reference was made to the appeal for £250,000 being made by the University of Sheffield for urgently needed extensions and for endowments. The first list of subscriptions was headed by a gift of £10,000 from Sir Robert Hadfield, to whom the University was already indebted for valuable donations and much support. It is now announced that Sir Robert has increased his donation to £20,000, this being the largest individual gift so far received in answer to the appeal. The announcement was made in the course of his address at the annual meeting last month of Messrs. Hadfields, Ltd., and Sir Robert added that he was moved to add to his original donation by the noteworthy address delivered early last March by General Smuts on "The University in Civic Training", when he was installed as Chancellor of the University of Cape Town. General Smuts believes that the university is the hope of civilization, the one place where fact is exalted above sectional loyalties and ideologies. Sir Robert has given substantial proofs that he, likewise, has faith in the university as an institution of vital significance for the future of humanity. It is to be hoped that his great benefactions to the University of Sheffield will stimulate other industrialists to play their part in supporting more liberally, if not universities in general, at least the particular university to which they must look for development and progress in their own field. Sir Robert Hadfield, it may be noted, celebrated the fiftieth anniversary of his election to the Institution of Civil Engineers on March 1, when he received a congratulatory address from the president, and on March 23 was elected an honorary member of the Institution, for his "long and conspicuous service in the advancement of metallurgical science".

Decorative Lighting for the Coronation

SINCE the last coronation, twenty-six years ago, great improvements have taken place in the art of decorative lighting. In 1911, metal filament and arc lamps were used. Since then the invention of gas-filled lamps and the development of electric-discharge lamps have greatly cheapened the cost and improved the flexibility of the illumination. The illuminations will show many new aspects of London, and practically all the principal provincial cities will have very effective displays. In London alone there will be nearly two hundred floodlighting installations, and in the provinces, statistics obtained from six hundred local authorities show that the mean additional load per town will be approximately 60 kilowatts. This does not take into account the numerous smaller schemes of strip-lighting and illuminated devices with which shops and business premises will be decorated. For the first time, the fountains in Trafalgar Square are being illuminated by means of eight submersible reflectors taking 500-watt gas-filled lamps. In addition to all four sides of 'Big Ben', the terrace of the Houses of Parliament is being floodlighted for the first time. Two novelties are, 30-ft. high electric 'bonfires' with flame effects on the roof of the Shell Mex House, and colour changing equipment for illuminating 30-ft. high jets of water from fire floats stationed outside the new London Fire Brigade headquarters. A very large sodium floodlighting installation used at Dunfermline Abbey and Edinburgh Castle give an outstanding and beautiful display of decorative lighting.

The German Airship Disaster

THE latest and largest German airship, *Hindenburg*, was destroyed by fire while landing at Lakehurst, New Jersey, U.S.A., on the evening of May 6. This was the terminal point of her first voyage of the year from Frankfort-on-Main. She carried 39 passengers and 61 crew, approximately half of whom were killed or afterwards died of injuries. The airship had been cruising about for an hour during a heavy storm, which was judged to be too severe for safe landing, and was just coming in at about 300 feet above the ground, dropping her nose mooring lines for the landing crew on the flying field. Reports state that a burst of flame was seen at the stern. In a few moments the whole ship was enveloped in fire. This was evidently due to the ignition of the hydrogen in the gas bags, as the report mentions the exceptional brilliance of the fire. No details are yet available upon which any useful theories as to the cause of the fire can be based, but the fact that the ship had been cruising around the field in a heavy thunderstorm lends colour to the suggestion that she was electrically charged, and raises the possibility of sparks having occurred when the landing ropes earthed her. It is known that special precautions against this were embodied in her design, and therefore this theory assumes some additional accident. Whatever was the original cause of the accident, it is certain, as was the case with the British airship *R* 101, that the ignition of the highly inflammable hydrogen was responsible for the completeness of the disaster.

The Electrical Industry of the World

THE twenty-ninth report of the Imperial Economic Committee (London: H.M. Stationery Office. 2*s*. 6*d*. net) gives a survey of the trade in electrical machinery and apparatus. The latest information given relates to the year 1935. Perhaps the most significant feature during the last five years is the leading part that radio receiving sets have been occupying. At the end of 1935 there were 56 million sets of this type of apparatus in use, the increase having nearly doubled in five years. There were 22·5 million sets installed in the United States, and this works out to 178 per 1,000 of the population. The consumption of electrical energy used in radio receiving was 1,540 million kilowatt hours per annum. The corresponding figures for Great Britain, which was second in the world's list, was 7·4 million sets, and the third was Germany with 7·2 million. On the other hand, the increase in the world's telephones was comparatively small. This is ascribed primarily to an actual decrease in the United States and Canada. But these two countries still lead in this form of communication. It is worthy of note that there is a greater number of telephones per head of population in agricultural countries like Denmark, New Zealand and Australia, than there is in industrial countries such as Great Britain, Germany and France. Probably this is due to the greater facilities of communication by other methods in the latter countries. Russia has come to the front as an electrical manufacturing country. This is shown by the fact that the value of its imports, which rose gradually from 3·62 million pounds in 1929 to 9·15 million pounds in 1932, has fallen rapidly to only £789,000 in 1935. The outstanding example of self-sufficiency is the United States, the imports of which in 1935 were valued at only £427,000.

Present State of British Bird Ringing

THE 1936 report on bird ringing in the British Isles (*British Birds*, April 1937) supports what the 1935 report indicated, namely, that future progress lies not in increasing the sum total, but rather in increasing the proportion of adult birds over nestlings, and scarcer species, marked. Although the total of 48,663 birds ringed is below the number for previous years, the total of trapped adult birds, 19,235, is a record, while that for nestlings (where mortality is naturally high) of 29,428 is a decline on the previous years. Dr. H. J. Moon again heads the list of ringers with 5,280 birds ringed, including 1,332 lapwings, 975 song thrushes, 849 blackbirds and 587 starlings; Mr. G. Charteris marked 3,524 birds, 1,166 of which were chaffinches, and Mr. E. Cohen marked 3,024 birds, including 865 shearwaters. There is an increasing number of birds ringed by schools and societies, and the two bird observatories. The Oxford Ornithological Society marked 2,639 birds, Bootham School 1,656, Rugby School 1,050, the Midlothian Ornithological Club 813, the British Empire Naturalists' Association 158, the Zoological Society 511 and Leighton Park School 403. Totals of ringed birds are not quite so significant as the numbers of birds of rarer species marked. Among the ringings of the Oxford Ornithological Society, for example, were 67 kingfishers, Skokholm Bird Observatory marked 27 white wagtails and 20 Greenland wheatears, Mr. A. Maynall marked 409 nightingales, Mr. C. Wontner Smith marked 201 rooks, Rugby School marked 169 rooks and 62 carrion-crows, Leighton Park School marked 21 fork-tailed petrels, Dartington Hall School 12 cirl buntings, the Isle of May Bird Observatory a barred warbler, two bluethroats and a Continental coal tit. Of the national total, the most numerous species ringed were: 3,191 lapwings, 2,155 Manx shearwaters, 1,530 Sandwich terns, 1,271 common terns and 1,131 herring-gulls.

The National Institute of Agricultural Botany

THE seventeenth report of the National Institute of Agricultural Botany, Cambridge, is now available, and copies may be obtained on application to the Institute (Huntingdon Road, Cambridge). The work of the Institute is directed to supplying the farmer with unbiased information as to the seeds he sows, and the report deals with methods by which this information was obtained in 1936. New varieties of all farm crops are tested by the Institute as soon as they appear, the trials being conducted on a field-scale at six permanent stations in England, and in some cases at additional centres on a farmer's own land. In all cases, the varieties are grown just as they would be by the farmer himself. Every feature of the varieties is noted and the results are often extremely enlightening. For example, of all the new varieties of winter wheat that have been tested in the last ten years, only one has proved to be worthy of general recommendation by the Institute. This is the Dutch variety 'Juliana', which has in the past two years' trials given slightly better results than 'Wilhelmina'. The position with other crops is very similar, and it is clear that farmers will be well advised, before deciding to grow a new variety, to apply to the agricultural organizer for their county, or direct to the Institute, for information as to the merits of the variety in question.

"The Hero"

LORD RAGLAN writes in reference to the review of his book "The Hero" appearing in NATURE (March 27, p. 532): "Your reviewer . . . suggests that in the absence of documentary evidence I would feel constrained to deny the existence of Nelson and Napoleon. My contention is that in the absence of documentary evidence we should none of us have heard of Nelson and Napoleon." In reply, the reviewer says that, in effect, Lord Raglan appears to agree. In so far as Nelson and Napoleon are characters in the folk drama, they stand on the same footing as Robin Hood, Maid Marian and the rest. These two names, however, were not an effort of invention, but were chosen as those of the popular hero and bogey of the day. Their survival in this form is an effect of folk memory and not of documentary evidence, and their appearance in a ritual does not preclude their real existence, however incongruous their dramatic action. In this instance, the inference happens to be supported by documentary evidence. The conclusion to the contrary, however, that is, that without documentary evidence we should not know of their existence, is shown not necessarily to hold good. Approved documentary evidence is the only source of certain knowledge, and to this extent Lord Raglan is above criticism; but the archæologist maintains, on the other hand, that a legend may embody facts which may in certain conditions afford a clue to interpretation, when his evidence points in a certain direction. The story of the Minotaur may be ritualistic; but the setting of the Minoan civilization is the fact to which it gave Sir Arthur Evans the clue. It may be true that, strictly speaking, in the absence of documentary evidence we have no certain knowledge of Minos; but we have all heard and believe in the existence of the head of the great empire, for whom his name is the generic term.

Russian Railway Transport

AT the International Exhibition of Art and Technique in Modern Life which is to be opened in Paris this month, Soviet railway transport will be well represented, the principal exhibit being a working model of the new locomotive *SO* 17–635 which recently completed a successful test journey of 13,000 miles hauling a goods train of 1,200 tons. This engine is an outstanding development of the steam locomotive and, in its way, a pioneer, having been designed for the conditions of Middle Asia and the Far East where, owing to the scarcity of water, the provision of adequate supplies may represent as much as 40 per cent of the total cost of construction. The engine has a special tender equipped with radiators for condensing the exhaust steam, and tanks for collecting the condensate. After being passed first through an oil separator, the exhaust steam enters a turbine which drives the fans for cooling the steam when it reaches the radiators. In this way, with an initial supply of 10 tons of water, it is claimed that the engine can make a run of 627 miles without replenishment. The trial trip was organized for the purpose of testing the behaviour of this locomotive in severe winter conditions, with different kinds of coal, and on the steep gradients which are numerous in the mountainous districts. Travelling from Moscow to Vladivostok and back, it passed over eleven main lines of the U.S.S.R., and the long run, it is stated, was completed without a hitch. Further Soviet exhibits at the Paris Exhibition will include working models of other steam and electric locomotives and of new types of railway coaches specially adapted to Russian and trans-Siberian conditions of travel. The growth of railway transport in those regions is indicated by recent official figures, which show that in 1935 the total length of the railways in the U.S.S.R. was 52,500 miles and that last year they carried 990·8 million passengers and 484·2 million tons of freight.

Research in Tropical Medicine

THREE junior fellowships are offered immediately by the Medical Research Council for award to qualified medical men wishing to receive training with the view of careers in research work in tropical medicine. The fellowships will be tenable for three years. The stipend will be at the rates of £300, £400 and £500 per annum in the successive years, with an additional allowance during service abroad and necessary expenses. In three years' time, at least one senior fellowship will be available for candidates who have held the junior fellowships mentioned above. This will be awarded for a further period of three years, carrying stipend at the rate of £600–£750 per annum, with an additional allowance during service abroad and expenses. The time will be spent mainly in research work in the tropics. The Council is also prepared to consider immediate applications for senior fellowships from candidates who have had adequate experience in research work, whether already specially trained in tropical medicine or not. The Council further intends to establish in due course permanent and pensionable appointments for research work in tropical medicine, including senior posts. Members of this research staff will work partly in the tropics, and partly in institutions at home to which they will be severally attached. Further information can be obtained from the Secretary, Tropical Medical Research Committee, 38 Old Queen Street, London, S.W.1, with whom applications should be lodged not later than June 15.

Royal Geographical Society Awards

THE King has approved the award of the Royal Medals of the Royal Geographical Society as follows: The Founder's Medal to Colonel C. G. Lewis, for his surveys on the Miri Mission, 1911–12, in Iraq and Syria, 1918–19, and on the Afghan and Turco-Iraq Boundary Commissions; for the air survey of the Irrawaddy Delta, 1924; and for his promotion and encouragement of the exploration and survey of the Himalaya; The Patron's Medal to Mr. Lincoln Ellsworth, for his work in developing the technique of aerial navigation in the Polar regions, culminating in his successful flight across the Antarctic in 1935–36. The following awards have been made by the Council: The Murchison Grant to Mr. Ronald Kaulback, for his surveys in South-eastern Tibet; the Back Grant to Mr. L. R. Wager, for his work in mountain physiography; the Cuthbert Peek Grant to Mr. V. E. Fuchs, to assist him in his expedition to Lake Rukwa, East Africa; the Gill Memorial to Mr. George B. Barbour, for his work on the geology and geography of China.

Institution of Electrical Engineers Premium Awards

THE Institution of Electrical Engineers has made the following award of premiums for papers read during the Session 1936–37, or accepted for publication: Institution Premium to Dr. E. A. Speight and O. W. Gill; Ayrton Premium to Dr. D. Robertson; Fahie Premium to Col. A. S. Angwin and Mr. R. A. Mack; Kelvin Premium to Dr. T. E. Allibone, D. B. McKenzie and F. R. Perry; Paris Exhibition (1881) Premium to J. A. Sumner; Overseas Premium to Dr. A. L. Green, Dr. G. Builder and Dr. O. O. Pulley; Extra Premiums to Dr. P. Dunsheath, L. H. Harris, E. H. Jolley and F. O. Morrell; H. Trencham and K. J. R. Wilkinson; Mr. W. R. Debenham; Dr. W. Jackson, Mr. H. A. Thomas; Wireless Section Premiums to Dr. Benjamin, C. W. Cosgrove, and G. W. Warren (Duddell Premium); Commander F. G. Loring, W. L. McPherson and W. H. McAllister, T. L. Eckersley; Meter and Instrument Section Premiums to W. F. Randall; Dr. E. Hughes; Dr. C. Dannatt; Prof. J. T. MacGregor-Morris and Mr. V. A. Hughes; Transmission Section Premiums to H. G. Taylor (Sebastian de Ferranti Premium); J. Eccles.

Radio Communication Conference at Bucharest

THE Fourth Reunion of the Comité Consultatif International des Radiocommunications (C.C.I.R.) will take place in Bucharest on May 21–June 8. The previous meeting was held in Lisbon in 1934 (see NATURE Sept. 29, p. 490), and in the intervening three years the various national committees have investigated miscellaneous technical problems in connexion with radio communication. The matters under discussion at the present time include the study of the propagation of waves, direction finding, the measurement and means of suppression of the various types of interfering noise experienced in radio reception, and the improvement of transmitters, particularly from the point of view of frequency stability and the consequent reduction of inter-station interference. Other matters which will be discussed at Bucharest, and upon which it is evidently desirable to secure the greatest measure of international agreement, concern the allocation of wave-bands to the various types of radio-communication services, and the nomenclature employed in designating these wave-bands and the corresponding frequency ranges. It is anticipated that some twenty nations will participate in the Bucharest conference, and the British delegation will include representatives of the Post Office, National Physical Laboratory, British Broadcasting Corporation and the various manufacturing and operating companies.

Magnetic Disturbances and Auroras

Writing with reference to the notes on this subject in Nature of May 8, p. 790, Father J. P. Rowland states: "I greatly regret that by inadvertence I misread in my notes a horizontal force range in minutes of arc, before converting into gammas, as a declination range, and so gave the extreme declination range as 93′, whereas it should be 62′ as given in my letter to *The Times*. The extreme range in horizontal force, exceeding 620γ is correct. There was another notable magnetic disturbance from May 4^d 17^h to 5^d 18^h U.T. with ranges in declination and horizontal force of 28′ and 234γ respectively, probably associated with an elongated group of sunspots which crossed the central meridian on April 29."

Comets

Mr. L. E. Cunningham at Harvard has detected the periodic comet Grigg-Skjellerup. Its position on April 30^d 1^h 30^s U.T. was R.A. 6^h 59^m 0^s, N. Decl. 7° 53′ 27″, mag. 13. In the "B.A.A. Handbook" for 1937 the elements and also an ephemeris are given, perturbations being taken into account. Comparison with this ephemeris indicates that perihelion will be reached on May 23.0 U.T., which is about half a day later than the predicted time. Dr. M. Davidson has used observations from February 4 to April 1, forming normal positions, and finds that Comet 1937*b* (Whipple) is moving in an elliptic orbit with eccentricity 0·999619. The period is very long—about 300,000 years.

Announcements

At the request of the Council of the Royal Society of Edinburgh and in terms of the Bruce-Preller Lecture Fund, Prof. H. S. Taylor, of the Department of Physical Chemistry, Princeton University, will deliver an address on "Heavy Hydrogen in Scientific Research", at the ordinary meeting of the Society to be held on June 7.

Dr. W. T. K. Braunholtz has been appointed secretary of the Institution of Gas Engineers in succession to Mr. J. R. W. Alexander, who has been appointed general manager of the Associated Gas and Water Undertakings, Ltd., and of the East Surrey Gas Co.

Johnstone and Florence Stoney studentships of the value of £250 each for research in Australia have been awarded by the British Federation of University Women to Miss Mary Elizabeth King and to Miss Joyce Laing, who are both proposing to work on aspects of pathology. A similar studentship will be offered for the year 1938–39.

The annual congress of the Royal Institute of Public Health in conjunction with the Institute of Hygiene will be held at Margate on May 25–29 under the presidency of Lord Horder. Further information can be obtained from the Secretary, A. Seymour Harding, 28 Portland Place, London, W.1.

The French Academy of Medicine has awarded the Albert I of Monaco prize of 100,000 francs to Drs. Paul Bouin and Ancel for their work on the sex hormones and the interstitial glands in man.

Prof. Levaditi, of the Paris Pasteur Institute and member of the Academy of Medicine, has been nominated scientific director of the French League against the Venereal Peril.

The National Geographic Society announces by its News Bulletin that arrangements are being made to broadcast on June 8 a description of the total solar eclipse of June 9 next from either Canton or Enderby Island in the Central Pacific. The transmission will probably be from an anchored vessel, and will begin from time to time several weeks previous to the eclipse with a description of the preparations.

Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, London, W.1, have issued a Catalogue (No. 531, 1937) of books on early medicine and surgery. The gem of the collection is a fine copy of the very rare first edition of William Harvey's "Exercitatio Anatomica De Motu Cordis", printed in Frankfort in 1628. Among other rare and interesting works listed may be mentioned Robert Wyer's "Antidotharius", containing recipes for plasters, salves, ointments, etc., J. Duchesne's "The Practise Of Chymicall and Hermeticall Physicke", William Turner's "Herbal", and a copy of the second edition of Jenner's "An Inquiry into the Causes and Effects of the Variolæ Vaccinæ".

Erratum.—In the course of the summary of the Huxley Memorial Lecture delivered by Sir Thomas Holland printed in Nature of May 8, p. 809, reference is made to the work of "W. T. Blandford". The name should, of course, have been "W. T. Blanford"; and we regret having overlooked the mistake made in the typed summary supplied to us and followed by our printers.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 845.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Rate of 'Organification' of Phosphorus in Animal Tissues

RADIOACTIVE isotopes as indicators in biological problems were first used by Hevesy[1]. Recent progress in the production of artificial radioactive substances makes this field of research one of the most promising, and ^{32}P, the radioactive isotope of phosphorus with a decay period of 14 days, has already been used as an indicator in animal and plant metabolism[2].

Prof. E. O. Lawrence, of the University of California, kindly gave one of us some pieces of metal from the Berkeley cyclotron. During a chemical analysis of them, we separated a fairly large amount of ^{32}P which we used in an investigation of some problems of the intermediary metabolism in rats. The following is a preliminary report on the distribution and the rate of 'organification' of injected sodium phosphate.

TABLE 1. LIPIDIC PHOSPHORUS

Tissue	Per gram of moist tissue		Specific activity
	Weight of P (mgm.)	Activity (R.U.)	
Liver	1·083	19·2 ± 0·6	(18·6) 17·8 (15·7)
Intestine	0·905	12·9 ± 0·5	(16·0) 14·4 (12·6)
Kidney	1·237	16·3 ± 1·9	(17·7) 13·2 (8·2)
Parenchyma	1·073	9·2 ± 0·7	(10·3) 8·5 (7·1)
Muscle	0·480	1·4 ± 0·1	(3·4) 2·9 (2·3)
Brain and medulla	1·822	0·9 ± 0·4	(1·7) 0·5 (−0·2)

A young rat was fed on a diet containing only fats and proteins and practically free from phosphorus and calcium, and was injected daily for four days with sodium phosphate containing ^{32}P; afterwards it was bled.

The tissues were successively extracted with hot alcohol and alcohol plus ether. The extracts purified with chloroform were mineralized with nitric and sulphuric acids, and the phosphorus determined according to Neumann-Gregersen. We call this fraction *lipidic phosphorus*. The residue of the alcohol-ether extraction is treated with cold trichloroacetic acid; in a fraction of the extract we precipitate directly ammonium phosphomolybdate (*mineral phosphorus*) and the second fraction is again mineralized in order to determine the *acid-soluble phosphorus*. In the mineralized residue of the two successive extractions we determine the *acid-insoluble phosphorus*.

The radioactivity of phosphorus belonging to each fraction was measured with an ionization chamber in arbitrary units (R.U.). Absorption of the β-rays by the precipitates, and also natural decay were taken into account. For the sake of brevity we omit the data referring to mineral phosphorus and to acid-soluble phosphorus. The main conclusions from these fractions are:

(*a*) That the specific activity of phosphorus, that is, the ratio between activity and weight of phosphorus, is about the same in all tissues examined, except in brain and medulla where it is distinctly lower.

(*b*) That there may be, judging from a comparison of the activities in the fractions of the acid-soluble phosphorus and the mineral phosphorus, some low organic compounds which are synthesized in muscle intestine and liver, from inorganic phosphorus.

Tables 1 and 2 show the weight of phosphorus, per gram of moist tissue, its radioactivity and its specific activity, for lipidic phosphorus and acid-insoluble phosphorus respectively. We give also the probable error of the radioactive measurements and the extreme limits of specific activity supposing the true error to be three times the probable error.

TABLE 2 ACID-INSOLUBLE PHOSPHORUS.

Tissue	Per gram of moist tissue		Specific activity
	Weight of P (mgm.)	Activity (R.U.)	
Liver	2·015	34·1 ± 0·7	(17·8) 16·9 (16·0)
Intestine	1·353	15·5 ± 0·5	(12·7) 11·5 (10·4)
Kidney	0·902	7·8 ± 1·0	(12·2) 8·7 (5·2)
Parenchyma	1·610	14·2 ± 0·7	(10·0) 8·8 (7·5)
Muscle	0·520	3·8 ± 0·2	(8·4) 7·3 (6·2)
Brain and medulla	0·892	1·2 ± 0·6	(3·1) 1·3 (−0·4)

Lipidic phosphorus (Table 1). Both activity and specific activity show a maximum for the phospholipids in the liver, intestine and kidney; they have medium values in the other parenchymous organs (spleen, pancreas, adrenals, testes, lungs, heart) and lower values in muscle and brain and medulla.

These results confirm the assumption of a fairly active metabolism of phospholipids in liver and intestinal mucosa which has been put forward by one of us[3] and Sinclair[4], and suggest an extension of the assumption also to the kidney. Moreover, they show that the participation of the phospholipids to intermediate metabolism is not limited to a substitution of fatty acid radicals in the molecule of phospholipids, but results, at least partially, in a complete synthesis starting from inorganic phosphorus, even if this is simply injected.

The differences which we have found depend evidently upon large differences in the rate of synthesis of phospholipids in different organs and therefore afford some hints on the problem of the function of phospholipids in cell economy.

Acid-insoluble phosphorus (Table 2). Though this fraction contains different phosphorated compounds, it is probable that the greater part consists of nucleoproteins, which are the most complicated products entering into the structure of living beings.

Due to the different content of nucleoprotein phosphorus of different tissues, one notes different activities per gram of fresh tissue; specific activity is relatively high in the liver and perhaps in the intestine, while it is roughly the same in muscle, parenchyma and kidney. Brain and medulla show a very low specific activity; that is, the rate of synthesis of nucleoproteins is minimal in nervous tissue, as we have seen for the phospholipids synthesis.

We thank the Radiation Laboratory of the University of California for the gift which made this investigation possible.

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University, Palermo.

April 10.

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[1] Hevesy, G., *Biochem. J.*, 17, 439 (1923).

[2] Hevesy, G., and others, NATURE, 136, 754 (1935); 137, 66 (1936); 139, 149 (1937). Chiewitz, O., and Hevesy, G., *Dansk. Vidensk. Selsk.* (*Biol. med.*), 13, 9 (1937).

[3] Artom, C., *Arch. Fisiol.*, 33, 57 (1933); *Arch. intern. Physiol.*, 36, 101 (1933). Artom, C., and Peretti, G., *Arch. intern. Physiol.*, 36, 351 (1933); 42, 61 (1935–36).

[4] Sinclair, R. G., *J. Biol. Chem.*, 92, 245 (1931); 95, 393 (1932); 98, 103 (1932); 111, 275 and 515 (1935).

Reflection of Atmospherics at an Ionized Layer

WE have been studying the wave-form of the electromagnetic pulse radiated from a lightning flash known as an 'atmospheric'. Incidental to the observations which we have made, evidence has been obtained of the reflection of atmospherics at an ionized layer.

The atmospherics are received on a vertical aerial, which is connected through an aperiodic amplifier to a cathode ray tube. The spot on the screen of this tube is photographed on a film fixed to the external surface of a cylindrical drum, which rotates at a uniform peripheral speed of 900 cm./sec.

Some hundreds of wave-forms have been observed, and more than twenty of these show pulses, which appear to have been reflected from an ionized layer at a height above the earth of 78–82 km. Three photographs of wave-forms showing this feature are reproduced in Fig. 1 (*a*), (*b*), (*g*). The intervals of time elapsing between the arrival of the first pulse along the ground and the reflected pulses can be measured for from five to eight reflections at the ionosphere. Assuming the law of optical reflection at the ionosphere and at the ground, and that the ground and sky waves are propagated with the velocity of light, c cm./sec., these intervals of time, t sec., enable both the distance of the flash, d km., and the height, h km., of the reflecting ionized layer to be calculated from the relation

$$ct = 2\,n(h^2 + d^2/4\,n^2)^{1/2} - d,$$

where n is the number of reflections at the ionized layer. In the accompanying table (p. 838) the values of h and d, which satisfy a least square fit for the observed times, t, are tabulated. The fit is sensitive to a change of 1 km. in the value of the height and 10 km. in the distance, and the accuracy of the fit is indicated under $\overline{\Delta t}$, which is the mean difference in microseconds between the calculated and observed times. The height obtained, assuming the law of optical reflection, is not, of course, the actual height of the reflecting layer, but is the 'equivalent' height.

Independent evidence of the distance from the receiving aerial of the lightning is entered in the last column. Only for the first case is the distance in this column more than a rough estimate, and in that case observers at Flinders Island, distant 380 km., and at the Eddystone light, distant 450 km., reported lightning at the time of the observation. An observation with the cathode ray direction-finder taken simultaneously with the photograph of Fig. 1 (*a*) confirmed this direction. In the second case the distance is estimated from the deflection of a cathode ray direction-finder. In the last four cases visual observations of the lightning were made, and assuming that it came from clouds 6 km. above the ground, the distances given can be calculated.

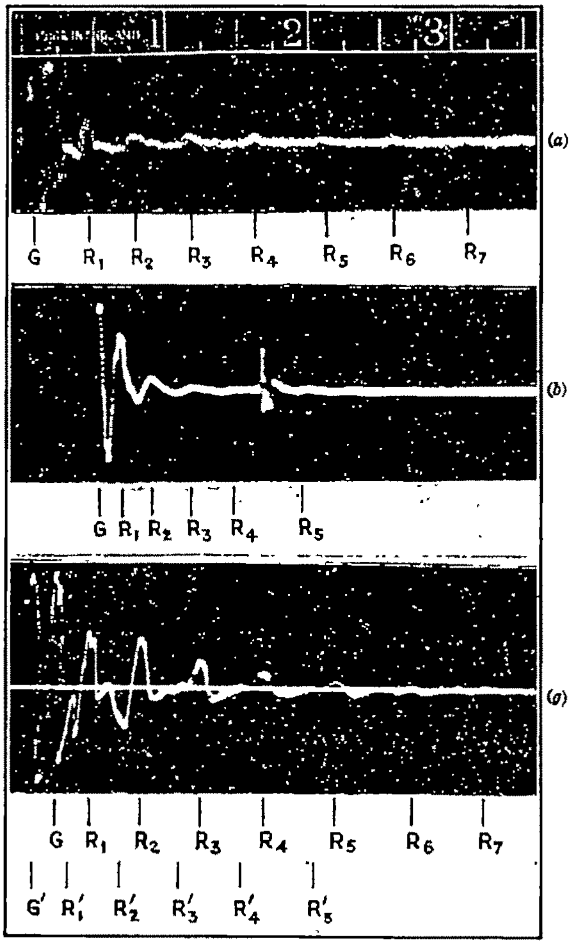

Fig. 1.

ATMOSPHERIC OSCILLOGRAMS FROM LIGHTNING DISTANT 175–500 KM. G IS THE GROUND WAVE AND R_1, R_2, . . . R_7 ARE THE REFLECTED WAVES. IN (*g*), TWO SETS OF REFLECTIONS G . . . R_7 AND G' . . . R'_5 APPEAR. ON THE TIME SCALE, 1 = 0·001 SEC.

The evidence for reflection rests on the close fit of the calculated with the observed times of the pulses, and upon the first case where there is independent evidence that the value of d so calculated is correct. Finally, the observations show that an atmospheric pulse has a fundamental frequency of the order of 10^4 cycles/sec. For a wave of this frequency, reflection will occur when the ionization reaches a value of the order of 1 electron per cm.^{3}, and this ionization no doubt exists at a lower height than the 90 km., which is given as an average value for the 'equivalent' height of the E layer.

Obs.	Time	Reflections	Height	Distance	$\overline{\Delta t}$	Estimated d
a	17 00	8	78 km.	410 km	10 μ sec.	420 km.
b	15 45	5	79 ,,	510 ,,	40 ,,	300–500 ,,
c	17 15	6	82 ,,	1310 ,,	50 ,,	Unknown
d	01 15	7	80 ,,	175 ,,	20 ,,	150 km
e	01 30	7	80·5 ,,	300 ,,	20 ,,	>250 ,,
f	01 45	6	79 ,,	300 ,,	10 ,,	>250 ,,
g	01 52	7	79 ,,	250 ,,	30 ,,	200 ,,

The observations *d*, *e*, *f* and *g* were taken on the early morning of February 20, 1937

These observations, taken at the University of Melbourne between November 1, 1936, and February 1937, have been made as part of the programme of work of the Radio Research Board of Australia.

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March 19.

Resonance in the Interaction of Radio Waves.

IN my recent account of a revised theory of the interaction of radio waves[1], mention was made of the following new deductions :

(a) In regard to the amount of modulation which a wave W can impress on another wave W', a notable degree of resonance may occur when the frequency of W passes through the value of the local gyro-frequency.

(b) A gyro-wave (that is, one having a frequency within a few per cent of this gyro-frequency) can produce observable interaction with suitable medium and long waves when it is radiated by its source at the rate of one or two kilowatts.

(c) The following conditions are favourable to the occurrence of gyro-interaction (that is, interaction caused by a gyro-wave) : The received wave W is reflected from a region of the ionosphere which lies within about 200 km. from a gyro-station, and has a wave-length which ranges approximately from 2,000 to 500 metres as the distance between the radiator and receiver of W' ranges from 400 km. to 1,200 km.

It was accordingly predicted that, among other broadcasting stations, Lille (247·3 metres) might be found to produce observable interaction with other waves.

This prediction has been confirmed and the deductions stated above have been amply supported by observations made by myself and many collaborators in different parts of Great Britain, Ireland, France and Belgium, during the period March 1–14.

Through the courtesy of Sir Noel Ashbridge of the B.B.C., Prof. René Mesny of Paris, Mr. T. J. Monaghan of Dublin, and other authorities, substantially the following scheme of experimental radiations took place: On separate nights, during 30 minutes between 0005 and 0045 G.M.T., the three gyro-stations Dublin (222·6 m.), London National (261 m.), and Lille, radiated respectively the morse letters Q, B and K on tones of 125 and 1,000 cycles/sec. and with a modulation depth of about 75 per cent. On one of these nights, for comparison of the effects produced, London Regional (342 m.) radiated the morse letter M on tones, modulation depths and powers similar to those of London National and in the intervals between the latter's B's. Corresponding respectively to the above three gyro-stations, the following three groups of complementary stations radiated at full power waves which, with the unintended exception of Hilversum I, were modulated only at five-minute intervals and then with characteristic morse letters having modulation depths of 2, 5 and 2 per cent respectively :

Athlone (531 m.) ;
Hilversum I (1875), Radio Paris (1648), Brussels I (484) ;
Hilversum I, Luxembourg (1293), Beromunster (540), Strasbourg (349).

It is not possible in this brief note to give more than a summary account of the results obtained, but a more detailed account will be published elsewhere.

The experiments with Dublin and Athlone failed to reveal any gyro-interaction, as might be expected with Dublin's power of 0·5 kW. and under normal conditions in the E-layer.

Lille impressed strong modulations on the waves from Hilversum I, Luxembourg and Beromunster when its radiated power was 60 kW., and occasionally weaker modulations when its power was 10 kW. On one of the latter occasions the interaction with the wave from Beromunster which was received at Leicester was strong enough to justify the conclusion that a power of 5 kW. would have caused observable interaction. Infrequently the wave from Strasbourg was also found to be modulated by Lille, and then weakly. Nearly all the ionospheric regions of reflection of the waves having the strongest impressed modulations are within 200 km. from Lille.

London National, radiating at 30 kW., impressed strong modulations on Hilversum I, Radio Paris and (less frequently) Brussels I. The depth of modulation at a low frequency was often about 3 per cent and at times considerably exceeded that of the received characteristic signal, which had been given a depth of 5 per cent. Several observers also heard an impressed modulation when the power of London National was only 5 kW. On one such occasion, Mr. E. W. B. Gill and I estimated that an impressed modulation with about half the intensity of that observed by us would still have been perceptible ; from this it may be concluded that a radiated power of about 2 kW. would have sufficed to cause observable interaction. Nearly all the ionospheric regions from which the most strongly affected waves were reflected lie within 200 km. of London.

The simultaneous radiations from London National and London Regional took place on the night of March 11–12. It was then found that, with equal radiated powers, the B's impressed by London National were usually stronger than the M's impressed by London Regional ; that often the B's were easily audible when all the M's were absent ; and that occasionally the B's were weaker than the M's. Having regard to probable deviations from complete symmetry in the radiation from each of the two stations, it may be concluded that with a given power London National causes stronger interaction than London Regional. Since their waves are respectively 11 and 45 per cent longer than the local gyro wave-length 235 metres, this result strongly supports the conclusion that resonance exists.

In the experiments with Lille, London National and London Regional, it was usually found that the intensity of the impressed modulation decreased as the modulation frequency increased. This is in accordance with the theory. But on several occasions the intensity with a modulation frequency of 1,000 cycles/sec. was observed to be much stronger than that with a lower frequency: an interesting anomaly in the theory in its present state.

A more complete account of the theory will be given in the issue of the *Philosophical Magazine* of May.

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April 3.

NATURE, 139, 68 (Jan 9, 1937).

Cosmic Rays and the Magnetic Moment of the Sun

IT is generally assumed that the constant intensity of cosmic radiation at sea-level beyond a certain latitude is accounted for by the 'clocking effect' of the atmosphere, which absorbs all particles of energy below the limit of that latitude resulting from the action of the earth's magnetic field. An important consequence of this assumption is that the latitude at which the intensity becomes constant should be displaced towards the geomagnetic poles as the altitude above sea-level increases, since then the thickness of the absorbing air layer decreases and therefore also the energy absorbed. Compton's mountain experiments[1] already throw doubt on the existence of this displacement, and this doubt is strengthened by Cosyns's stratospheric measurements[2] which, while admittedly inconclusive, indicate that the intensity remains constant north of 49° even at the highest altitudes reached.

There are clearly two possible interpretations of this remarkable result. Either the spectrum of primary cosmic radiation has a sharp threshold at the energy corresponding to the geomagnetic threshold at that latitude where the intensity becomes constant, or else, as suggested by Janossy[3], particles of this energy (and less) are prevented from reaching the earth by the action of the sun's permanent magnetic field, although the moon might also be suspected.

The theory of the allowed cone of cosmic radiation[4] gives for the geomagnetic threshold at 50° about 200 millistormers (mS.) for particles coming horizontally and 300 mS. for particles coming from all directions. The number r_e measuring the energy of a particle in stormers is connected with the ratio of momentum to charge (mv/e) by Stormer's well-known relation

$$r_e = \sqrt{\frac{mv}{eM_e}}\, R_e, \qquad (1)$$

where M_e is the earth's magnetic moment and R_e the earth's radius. Introducing a parameter r_s similar to r_e, but referred now to the sun's magnetic dipole moment M_s and to the distance from the sun to the earth, D, by the relation

$$r_s = \sqrt{\frac{mv}{eM_s}}\, D, \qquad (2)$$

the same theory shows that, if the ecliptic lies along the solar magnetic equator, r_s must be less than 0·414. Eliminating mv/e from (1) and (2), we obtain:

$$M_s = M_e \left(\frac{D}{R_e}\right)^2 \left(\frac{r_e}{r_s}\right)^2; \qquad (3)$$

which, upon inserting the known magnetic moment of the earth and the known ratio D/R_e, gives $M_s = 10^{34}$ E.M.U. If the angle between the sun's magnetic moment and its axis of rotation is small, this value is only slightly changed. It corresponds to a field intensity at the sun's equator of 30 gauss, in good agreement with the results obtained by Hale and his collaborators[5] from a study of the Zeeman effect of solar lines.

It may be readily shown that, while the sun's magnetic field may thus prevent cosmic particles of energy around ·200 mS. (2×10^9 eV. if electrons, $1·6 \times 10^9$ eV. if protons) from ever reaching the earth, if they come from distances large compared with the diameter of its orbit, it does not hinder low-energy particles of suitable angular momentum shot off the sun from reaching the earth, provided either that such particles leave the sun at very high latitude or that its magnetic moment is inclined at a high angle (around 45°) with respect to the ecliptic. This introduces a difficulty in connexion with Birkeland's and Stormer's theory of the aurora polaris, particularly if the particles responsible for the aurora originate in the sunspot belt.

If the interpretation suggested here is correct, there are several consequences which may be accessible to experiment, of which we shall name only two. First there should be a seasonal variation of the intensity of cosmic radiation of lowest energy of the order of magnitude of the eccentricity of the earth's orbit, with maximum in summer and minimum in winter, arising from the fact that as the earth rotates around the sun the distance between them varies periodically. Secondly, there should be a diurnal variation as a function of solar time with phase which is now being calculated. It arises because the sun's field at the earth is still capable of deflecting particles of energy up to 435 mS. approximately, and therefore there is at the earth both a solar allowed cone and a terrestrial allowed cone, the common region of which varies periodically as the earth rotates around its axis. The magnitude of this fluctuation may be roughly estimated at between 0·1 and 0·2 per cent.

It may be added that the possibility of ascribing the blocking of cosmic particles to a magnetic action of the moon seems excluded on the ground that it would have to possess a magnetic moment about ten thousand times that of the earth; this would give rise to large variations of intensity depending on the position of the moon which have not been found.

M. S. VALLARTA.

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Cambridge, Mass.
March 22.

[1] Compton, A. H., *Phys. Rev.*, **43**, 398 (1933).

[2] Cosyns, M., NATURE, **137**, 616 (1936).

[3] Janossy, L., *Z. Phys.*, **104**, 430 (1937).

[4] Lemaître, G., and Vallarta, M. S., *Phys. Rev.*, **50**, 493 (1936). For the specification of the energy in stormers, see *Phys. Rev.*, **49**, 720 (1936), and for the equivalence between stormers and electron-volts, see *Phys. Rev.*, **43**, 90 (1933).

[5] Hale, G. E., Seares, F. H., van Maanen, A., Ellerman, F., *Astrophys. J.*, **47**, 206 (1918).

Molecules in Interstellar Space?

IN a recent note in NATURE[1], and more in detail elsewhere[2], Dr. T. Dunham, jun., has described his discovery of more interstellar lines due to K (λ 7699·03), Ca (λ 4227), Ti+ (λ 3242·6 and others) and a number of other lines the origin of which has not yet been traced (λ 3957·7, λ 4300·3, λ 4232·6). We have to add to these Merrill's interstellar lines[3] (λ 5780, λ 6284).

Dunham's work and his discussion of the occurrence of Ti+-lines forms a landmark in the story of interstellar investigations, as it throws clear light on the mechanism of excitation, and removes a good deal of misconception arising out of the former idea that only Ca+-lines, and the sodium *D*-lines occur in interstellar space.

Dunham's discovery that only such Ti+-lines which arise from absorption in the lowest orbit of Ti+ ($3d^2$. $4s$. $^4F_{3/2}$) occur as interstellar lines and that no Ti+ atom in the next excited state Ti+ ($3d^2$. $4s$. $^4F_{5/2}$, excitation potential 0·012 volt) occur in interstellar space, shows that the reaction between matter and radiation in interstellar space is of a kind which cannot be described in terms of any interspace temperature. The temperature in interspace is very nearly absolute zero, and ionization is produced only by the photochemical action of quanta meeting atoms or ions after long intervals of time in space. The recombination between ions and electrons also take place at very long intervals. The result is that only such states of atoms and ions occur in interstellar space as have infinitely long life.

The argument raises the question: Why should not molecules also occur in interstellar space? In fact, the above arguments, if forced to their logical conclusion, lead us to the view that we should have molecules in interstellar space. Merrill in fact notes that the lines λ 5780·4, and λ 6284·0 discovered by him are diffuse, and in course of a conversation told me that they might be molecular in origin. In fact, the line λ 6283·0 appears decidedly to be due to *molecular sodium*, Na_2, due to the transition (Na_2: $^2S\,^2S\ A\ ^1\Sigma \rightarrow {}^2S.{}^2P\ B\ ^1\Sigma$, $n'' = 0$, $n' = 8$). This band is obtained in absorption in molecular sodium, and according to the Franck-Condon principle, the transition is strong as r'' (internuclear distance at the lowest state) is $3{\cdot}07 \times 10^{-8}$ cm., and r' (internuclear distance at the excited state) is $3{\cdot}66 \times 10^{-8}$ cm., so the transition $n'' = 0$ to $n' = 8$ is the most probable. According to the arguments presented here, no other line (or band) of Na_2 is likely to occur among the interstellar lines.

Merrill's other line (λ 5780) may be provisionally identified with a line of NaK ($n'' = 0$, $n' = 5$), though in this case the identification is less sure.

The molecule which is likely to be most abundant in interstellar space is H_2, but as it gives absorption lines only in the Lyman region, there is no possibility of our being able to prove its existence, but lines due to hydrides may be found amongst interstellar lines.

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April 6.

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[2] *Pub. Ast. Soc. Pac.*, 49, 26 (1937).

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A Possible Function of the Osphradium in the Gastropoda

DESPITE the universal occurrence of the osphradium in the mantle cavity of marine Gastropoda and the large size to which it may attain, the current views as to its function are unsatisfactory. It has been considered (*a*) an organ for testing the water which enters the mantle cavity (Bernard[1]), and (*b*) as a chemo-receptor concerned with the detection of food in water (Henschel[2], Brock[3]).

But the sea is a very constant medium, apart from regions near the shore or the mouths of rivers, and the osphradium is present in Gastropoda which live in the open sea under conditions where the water is never contaminated or diluted. There is certainly no correlation between the presence, or size, of the osphradium and the possible need for 'water testing'. The second theory can at best have only a limited application, namely to predacious carnivores or carrion feeders such as *Nassa* and *Buccinum* (studied by Henschel[2] and Brock[3] respectively). It cannot apply to browsing herbivores, for example, *Pterocera* (Yonge[4]) or *Littorina*, deposit feeders such as *Aporrhais* which seek for food with the proboscis (Yonge[5]), or plankton feeders such as *Vermetus* (Yonge[4]) or *Crepidula* (Orton[6]). Yet in all these, with the exception of *Crepidula* where it is reduced, the osphradium is well developed. Moreover, there is nothing in the evidence produced by Henschel or by Brock inconsistent with the possibility that the siphon is the chemo-receptor in carnivorous species. This possibility is being investigated by us.

An alternative theory as to the function of the osphradium has been developed by us as the outcome of work on the ciliary currents in the mantle cavity of *Aporrhais* (Yonge[5]), followed by comparative work on a variety of common marine Prosobranchs and Opisthobranchs. It is suggested that the osphradium is concerned with the *estimation of the amount of sediment* carried into the mantle cavity by the water currents created by the lateral cilia on the gills. Our reasons may be summarized as follows:

(1) Material carried into the mantle cavity is divided into three portions. The heaviest material is removed by way of the inhalent aperture by cilia lining the mantle in this region. The finest material is carried between and over the gill filaments and entangled in the mucus from the hypobranchial gland before being expelled via the exhalent aperture. Medium-sized particles are accumulated invariably *along the line of the osphradium*, before being carried across the floor of the mantle cavity to the exhalent aperture.

(2) The osphradium, besides possessing sense cells (well described by Bernard[1] and by Stork[7]), also possesses very many mucous glands. The secretion of these masses gathers together the material which accumulates on the osphradium. Previous workers have made no suggestion as to the function of these glands.

(3) There is a general correlation between the development of the osphradium and the degree of sediment to which the animal is exposed. For example, it is broad in mud- and sand-dwelling Prosobranchs, such as *Buccinum*, *Nassa*, *Pterocera*, etc.; linear in passive burrowers such as *Aporrhais* and plankton feeders such as *Vermetus*; reduced in *Crepidula*, which is a plankton feeder normally raised

above the bottom. In *Patella*, where secondary gills have appeared, the osphradia are vestigial because material is not normally carried into the reduced mantle cavity, while in the Opisthobranchs, *Scaphander* and *Aplysia*, it is reduced probably in correlation with rejection of sediment by cilia on the edge of grooves on the parapodia which conduct the water currents into the mantle cavity.

It is therefore suggested that the sense cells in the osphradium form a tactile organ which responds to contact stimuli, the impulse being conveyed by way of the osphradial nerve to the visceral ganglia. Blocking of the mantle cavity with sediment is a supreme danger to Gastropoda, and the importance of such a receptor is clear. The invariable association between ctenidum and osphradium is explained on this view, because the former creates the current, in which the quantity of sediment is estimated by the latter. The universal presence of the osphradium, irrespective of the habitat and of the food, is also explained. It is hoped later to follow up this biological study with an experimental analysis of the receptive capacities of the osphradium.

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April 7.

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Lunar Periodicity in *Homo sapiens* L.

THE belief in a connexion between sexual periodicity and the moon is very ancient[1]. In particular, it is commonly thought that there is some connexion between the moon and menstruation. De Lee[2] stated, without giving any evidence, that the majority of women menstruate during the new moon, thus associating the periodicity with the *synodical* lunar month of 29·55 days. Arrhenius[3] concluded from data of nearly 12,000 menstruations that there is a slight *tropical* lunar rhythm of 27·32 days, and that the average duration of the menstrual cycle is just under 27 days.

We have reinvestigated these questions with data of more than 10,000 menstruations. We find a great variation in the duration of the cycle, both in one individual and between different individuals. The average duration in our cases during 1928–30 was 29 days, but there was a clear inverse correlation between age and the duration of the cycle. Thus the cycle became shorter by a day with every five or six years increase in age, the oldest group (born before 1891) giving an average of 26·9 days, and the youngest (born after 1905) of 30·2 days. If, therefore, the average cycle of one age-group is equal in length to any lunar cycle, then this equality will not be present in any other age-group. Similarly, if the average for a whole population corresponds with a lunar cycle, the correspondence is unlikely to be present in another population having a different age-distribution. Since Arrhenius's average for the menstrual cycle was derived from data which mostly gave the time interval in whole weeks, while in ours the individual averages err by not more than ± 0·1 day, his conclusion can no longer be accepted.

An exhaustive examination of the number of our cases starting to menstruate on each day of each kind of lunar month has been made, involving statistical and graphical tests. *No correlation* of any kind was found. Arrhenius's data were known by him to be inaccurate, and they showed a systematic error, inherent in their mode of collection, which itself could give the appearance of a lunar periodicity. Our data are far more accurate and do not contain this source of error. We therefore conclude that there is no causal relation between the moon and menstruation, and that the well-known *approximate* coincidence in the duration of the cycles is fortuitous.

A full account of this investigation, embodying a number of other conclusions, will appear in October in the *Journal of Obstetrics and Gynaecology of the British Empire.*

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Action of Radium Rays on the Growth of Cells *in Vitro*

NUMEROUS experiments on gamma irradiation of cells cultivated *in vitro* have demonstrated their high radio-resistance to doses designed to produce a lethal effect. Sub-lethal doses have the effect of producing changes in the mitotic activity of the culture, while the lethal dose has so far only been observed as a delayed effect.

In continuation of our earlier experiments[1] we tried to work out a suitable dosage and method of application which would enable us to produce in the irradiated culture *itself* graded effects of radium from very slight inhibition of growth to death of the whole colony.

This was achieved in the following way. The source of rays consisted of a plate 1 sq. cm. in area, containing 5·9 mgm. of radium element with a filter of 0·05 mm. monel metal. With this filtration and with the use of a mica plate of 0·15 mm. thickness for the culture, 12 per cent of the soft and 58 per cent of the hard β-rays were available, in addition to the α-rays. By means of a simple centralizer, it was possible to conduct all the experiments under identical irradiation intensities. The radiations were applied to pure cultures of chick's mesenchyme cells cultivated in the hanging drop according to Carrel's method.

In contrast with most investigations hitherto published, irradiations were carried out in a refrigerator at +6° C. By this method of irradiation in the cold, we succeeded in investigating the various effects of radium treatment on the irradiated culture itself.

In all cases where more marked effects are to be produced by prolonged exposure, it is absolutely essential to suspend active cell life during the whole period of irradiation. With the usual method of treatment in the warm, the cells continue to migrate and divide during irradiation and the culture proceeds to develop; however, if the activity of a culture is suspended by cold, it accumulates the total effect of the rays, without manifest change. When a culture irradiated in the cold is transferred to the incubator, it develops to a degree exactly corresponding to the dose of rays applied. We are thus enabled to establish a numerical relation between the amount of growth inhibition and the dose of rays applied.

The cultures are irradiated immediately after explantation and are then transferred to the incubator. A parallel non-irradiated control culture is set up under identical conditions.

In our experiments, the cell cultures react to dosages ranging from 0·3 mgh. to 206·5 mgh. (3 minutes to 35 hours exposure) as observed in a period of 3 × 24 hours. The effects can be divided into three groups:

(1) Growth inhibition without complete stoppage of growth within the period of observation. The doses employed ranged from 0·3 mgh. to 70·8 mgh.

(2) Marked inhibition of growth with subsequent cell degeneration and stoppage of growth of the culture within the period of observation. Doses: 70·8–177 mgh.

(3) Immediate death of the irradiated culture. Doses 188·8–206·5 mgh.

With doses of less than 47 mgh. the retardation of growth in the irradiated cultures is observed after a latent period of 24 hours. With doses greater than 47 mgh. this latent period is no longer apparent.

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Radioactivity induced by Fast Neutrons according to the (*n*, 2*n*) Reaction

IN a letter to NATURE[1], we reported some time ago that we had obtained evidence for the expulsion of two neutrons from the nucleus when copper and zinc were bombarded with the fast neutrons from a (Li + ^{2}H) source. In the case of copper, our assumption was confirmed by the experiments of Bothe and Gentner[2], who obtained the same radioactive copper nucleus by irradiating this element with gamma rays, this giving rise to the expulsion of a neutron. According to the latter process the same investigators produced some new radioactive bodies. We attempted to get the same active isotopes with the fast neutrons from our (Li + H^2) source according to the process (*n*, 2*n*), the results being as follows.

Molybdenum. A strong activity is observed with a period of 21 minutes. Bothe and Gentner found a period of 17 minutes, whilst a 25-minute period is observed with slow neutrons[3]. With slow neutrons (Be + ^{2}H + paraffin; intensity equivalent to 3 grams Ra + Be) we also find a 25-minute period, which indicates that these activities are not identical.

Silver. A sheet of silver with a filter of 0·4 mm. silver and 0·2 mm. cadmium in front of it was irradiated. In accordance with Bothe and Gentner, we found a period of 24 minutes. The 2·4-minute period is also present.

Bromine. The activity induced in bromine shows two periods, one of 18 minutes and one of about 5 minutes. The former has been observed also by Bothe and Gentner. For the short period they give 3·5 minutes however.

Antimony. A strong activity with a period of 17 ± 1 minutes is observed, whilst Bothe and Gentner give 13 minutes.

Tantalum. A sheet of pure metallic tantalum was irradiated several times for half an hour. Only a very poor activity was obtained. We could not establish the period. Bothe and Gentner found a 14-minute period.

Tellurium. A strong activity with a 60-minute period is observed. The same period was found by Bothe and Gentner.

It may be mentioned that our apparatus works at a tension of 250 kV., whilst almost pure deuterium is used. Hence the creation of gamma rays is excluded.

Continuing our experiments, we observed some more examples of this type of reaction and found some new radioactive isotopes:

Selenium becomes strongly active when bombarded with fast neutrons. The period is 56 minutes. With slow neutrons (source as mentioned above) we find a period of 22 minutes, whilst Fermi and his co-workers[4] give 35 minutes.

Cadmium bombarded with fast neutrons yields two periods, one of 200 minutes and one of about 20 minutes. These activities may be due to ^{109}Cd and ^{115}Cd. A very low activity with a period of 70–200 minutes has already been observed when cadmium is bombarded with slow neutrons.

Mercury gives a period of 43 ± 1 minutes when bombarded with fast neutrons. With slow neutrons this period was not observed. A chemical separation was attempted by R. W. P. de Vries. It was ascertained that the active nucleus is an isotope of mercury.

Thallium. With fast neutrons we obtained a period of 4·1 minutes. As a period of 4 minutes has been observed already with slow neutrons[5], we may ascribe this activity to ^{204}Tl.

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Absorption Spectra, Optical Activity and Isotopic Exchange

WE have made a systematic examination[1] of the absorption spectra of cobaltammines which undergo isotopic exchange of hydrogen atoms in constituent NH_3 or NH_2 radicals, and more especially of those which are mixtures of optical isomers. Cobaltammines almost invariably give rise to two broad absorption bands[2] in the visible (I) and near ultra-violet (II) spectrum. Substitution of ^{2}H for ^{1}H produces an effect upon band (I) illustrated in Fig. 1; it is generally more pronounced the larger the number of exchangeable hydrogen atoms in the molecular ion. Absorption band (II) is scarcely affected, but differences occur in the farther ultra-violet. The full line is representative of protium-containing cobaltammines, the broken line of corresponding deuterium compounds.

The form of the curves of rotatory dispersion obtained by Mathieu[3] for protium-containing cobaltammines dissolved in water suggests that the regions of absorption responsible for optical activity are precisely those which we have found sensitive to protium-deuterium exchange; notably the long wavelength side of band (I). Accordingly we have compared the rotatory powers of the protium and deuterium isomers of cobalt tri-ethylenediamine ion, the number of complex ions in the path of the beam being identical in each case; that is, $[Co(H_2N.CH_2.CH_2.NH_2)_3]^{3+}$, hereinafter called [H], dissolved in H_2O, and $[Co(D_2N.CH_2.CH_2.ND_2)_3]^{3+}$ hereinafter called [D], dissolved in D_2O. The observed rotations are tabulated; the solutions, approximately 0·035 molal, of lævo- [H] and lævo- [D] were rather more concentrated than those of dextro- [H] and dextro- [D].

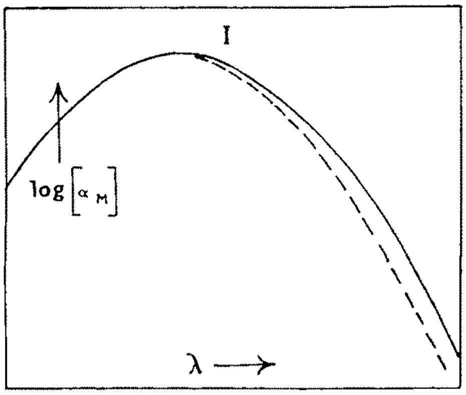

Fig. 1.

Wave Length	Lævo		Dextro	
(A.)	H_2O	D_2O	H_2O	D_2O
5893	−3·29°	−3·09°	2·86°	2·68°
5770	−4·18°	−3·90°	3·56°	3·31°
5461	−9·57°	−8·86°	8·03°	7·43°

As would be anticipated from the displacement of the absorption edge of band (I), the rotation of [D] is smaller than of [H] at all three wave-lengths; the percentage difference in rotation increases as the absorption maximum at 4665 A. is approached. A complete investigation of rotatory dispersion is contemplated. That the phenomenon is due to the exchange of ^{2}H for ^{1}H and not to other conceivable causes is proved by the following observations. Similar differences of rotation are ***initially*** observed when [H] and [D] salts are dissolved in pure formamide, but the rotation of the [D] solution gradually increases and after several hours becomes equal to that of the [H] solution which remains unaltered, indicating progressive substitution of ^{1}H for ^{2}H in the molecular-ion. The total number of exchangeable hydrogen atoms in the solvent is enormously greater than in the solute.

The slow exchange of hydrogen isotopes between cobalt hexammine ion and water was recently reported by Anderson, Briscoe, James and Spoor[4], who followed the process by measuring changes in density of the water. We infer from spectroscopic and polarimetric observations, that the corresponding reaction of cobalt tri-ethylenediamine ion is complete well within two minutes at 0° C. But the rate is easily measurable when [D] is dissolved in formamide containing a few parts per cent of H_2O, the rotation increasing with time to a final constant value. Conversely, the rotation of [H] in formamide containing a little D_2O falls at first and afterwards rises again. Therefore the fastest rate of isotopic exchange in the system, formamide—[*H*]—D_2O, is between [H] and D_2O. Whether the subsequent increase in rotation is produced by interchange between the deuteriumated complex ion and formamide or whether the D_2O—formamide exchange is partly, though indirectly, responsible cannot yet be decided. Clearly the latter process, if it takes place, is slow.

It seems likely that an indicator of isotopic exchanges more sensitive than $[Co(en)_3]^{3+}$ will be found amongst optically active co-ordination compounds.

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March 29.

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Combined Ascorbic Acid in Plant Tissues

EVIDENCE was presented some time ago which indicated that a part of the ascorbic acid present in certain plant food materials was present in the combined state[1]. Mack[2], however, still considers that any apparent increase in the ascorbic acid value of cabbage on cooking is to be attributed to the thermal destruction of the ascorbic acid oxidase, and Levy[3], while recognizing that part of the ascorbic acid in certain plant tissues is in the combined state, records that he has observed a decrease in the ascorbic acid value of cabbage on boiling. Experiments with cabbage carried out here have, however, invariably shown a very considerable increase in ascorbic acid value on heating in a suspension of water on a boiling water bath for 15 minutes in an atmosphere of nitrogen or carbon dioxide. We believe that the oxidase theory accounts partly, but not quantitatively, for the observed increase in value. Thus alcoholic and ethereal extracts, containing no oxidase, also show increase in ascorbic acid value, on being heated for 5 minutes in an atmosphere of nitrogen on a boiling water bath, even when titrations are carried out after addition of formaldehyde or after mercuric acetate treatment, in order to eliminate interfering substances, if any (Table 1).

TABLE 1.

Figures are given in mgm. ascorbic acid per 100 gm. material.

	Direct titration		Titration after addition of formaldehyde to the dye		Titration after mercuric acetate treatment	
	cold	heated	cold	heated	cold	heated
Alcoholic extracts	7·10	9·00	7·10	9·00	5·60	6·75
	3·90	5·26	3·90	5·26	3·55	4·83
	1·50	2·34	1·50	2·34	—	—
Ethereal extracts	0	0·69	0	0·69	0	0·62
	0	1·02	0	1·02	0	0·75
	0	0·73	0	0·73	0	0·71

It will be seen from Table 1 that there is always an increase in the ascorbic acid values of the alcoholic and ethereal extracts on heating and that, although mercuric acetate lowers the figure (due, according to our observations, not merely to removal of interfering substances but also to a partial loss of ascorbic acid), the increase on heating is significant. In the case of ethereal extracts, the actual figures after heating are low owing to the low solubility of combined ascorbic acid in ether, but it will be observed that before heating the value is nil. Although there are naturally considerable variations in the increase among different cabbage samples, we have observed an increase on heating under our conditions of experiment in all cases without exception.

Further evidence of the presence of combined ascorbic acid in cabbage is provided by experiments (Table II), which show that treatment of cabbage suspensions and extracts with hydrogen sulphide in the hot condition gives a considerably higher value for ascorbic acid than similar treatment at room temperature (25° C.). Cold treatment with hydrogen sulphide, of course, always gives higher values than the simple method of extraction with trichloroacetic acid, owing to the reduction of the considerable quantities of dehydroascorbic acid present, but the difference between the effects of the hot and cold treatments with hydrogen sulphide indicates again the presence of combined ascorbic acid in cabbage, which is split up by heating. This difference can scarcely be explained on the basis of the oxidase theory, as cold treatment with hydrogen sulphide under our conditions of experiment should be capable of reducing all the dehydroascorbic acid produced by the action of the oxidase.

TABLE 2.

Figures are given in mgm. ascorbic acid per 100 gm material.

Effect of H_2S at 25°		Effect of H_2S on boiling water bath
Aqueous suspensions of cabbage	64·5	72·7
	67·0	73·0
	67·8	81·7
	62·5	71·6
	64·0	73·8
Aqueous extracts of cabbage	40·0	49·5
	34·6	41·6
	38·5	45·2
	40·0	47·2
Alcoholic extracts of cabbage	12·3	20·3
	9·5	15·0
	21·7	35·3
	24·0	30·0

Further, we have lately observed that chloroform extracts of dried cabbage, which, as such, give no titre with the indophenol reagent, do so after heating in an aqueous suspension, and at least 75 per cent of this reduction value disappears if the extract, after heating, is subjected to the action of a preparation of ascorbic acid oxidase. This is additional evidence for the view that the reducing substance, produced on heating, is very probably ascorbic acid. This view is being further tested by biological experiments.

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[2] Mack, NATURE, 138, 505 (1936).

[3] Levy, NATURE, 138, 933 (1936).

Magnetic and Electrical Dimensions

I DOUBT very much whether Sir James Henderson[1] is justified in assuming that the members of the International Committee—and presumably also those of the various congresses and committees which have from time to time reaffirmed the decision that the permeability of space should be regarded as an entity having physical dimensions (the so-called Oslo convention)—were not as fully aware as he himself of "the implications of the adoption of Ampère's theory of magnetism". That their interpretation of these implications differs from his I do not doubt. When I read that "Prof. Howe would have us jettison . . . that wonderful machine which has produced the electromagnetic theory of light, to which is due the discovery of the quantum theory and all the other developments of modern theoretical physics", I can only smile and say that it sounds magnificently foolish, but bears little, if any, relation to the facts of the case. In his paper he showed that it was not only possible, but also very tempting, to assume that permeability is merely a numeric, and that in space the magnetic induction B and the magnetizing force H are one and the same thing. This is, however, a very old assumption; Gauss and Weber made it and on it built the electromagnetic system of units, but they never deceived themselves into thinking that it was anything more than a conventional assumption. Sir James is mistaken in thinking that I object to the mathematical nature of his arguments; on the contrary, my objection is to the assumptions which he introduces. The question is: What are the dimensional relations between H and B in space? I confess in all humility that I do not know, and I put $B/H=\mu_0$, a constant of space analogous to the gravitational or dielectric constants of space. Sir James Henderson, however, says, "According to Ampère's theory B and H are physically identical" and apparently expects the scientific world, which has debated the matter for at least sixty years, to take his word for it.

Prof. W. Cramp asks me what justification I have for writing $\mu\equiv 1/A'$ in preference to $\mu\equiv A'$ as suggested by Sir James Henderson. First, Sir James has shown that putting $\mu\equiv A'$ is tantamount to assuming that both are numerics, that is to say, by doing this one is making an assumption which prejudges the very question to which an answer is being sought. Secondly, by putting $\mu\equiv A'$, the force between two current-carrying coils becomes inversely proportional to the permeability of the medium, which, using μ in its generally accepted sense, I do not believe. Thirdly, if as Sir James says, "B and H are physically identical" and $\mu\equiv A'\equiv$a numeric, what has become of the property of space to which Prof. Cramp refers? Surely it has been conjured away, and I feel confident that a little detective work will enable Prof. Cramp to discover at what stage of the performance it was made to vanish.

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April 28.

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[1] NATURE, 139, 676 (April 17, 1937).

IN the last paragraph of his letter in NATURE of April 17, Sir James Henderson comes down wholeheartedly on the side of the 'one fluid' theory of magnetism, makes B and H of the same dimensions and, by implication, abolishes μ_0.

I, also, reached this conclusion long ago and in 1924 suggested a form of wording for the definitions of these quantities for insertion in the B.S.I. Glossary which was compatible with this point of view. These definitions raised a storm of criticism at the British Association meeting at Oxford in 1926, with the result that (*a*) the offending definitions were removed from the Glossary; and (*b*) there was formed that British Association Committee on Units over which Sir James Henderson himself presides.

It will be interesting (to me at any rate) to see whether other members of the Committee will follow their chairman's lead; and if they do, whether my definitions will be reinstated and whether μ_0 will be jettisoned once and for all

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Statistics of Birth-rate Problems

IN NATURE of April 3, p. 565, a passage is quoted from a recent book of mine in which reference is made to the work of Dr. R. Kuczynski in developing statistical methods of dealing with birth-rate problems. While it is obvious to a reader of the book that I was not making any attempt to give a full account of the development of statistical methods in this field, the mention of one name only in the sentence quoted may seem to imply a neglect of the work of others. Therefore, in order to correct any misapprehensions which the quotation of this sentence may have caused, I should like to direct attention to the earlier work of R. Boeckh and of A. J. Lotka, of which an account will be found in the *Annals of the American Academy of Political and Social Service*, November 1936.

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Liverpool.

Points from Foregoing Letters

USING radioactive phosphorus as indicator, a group of investigators from the University of Palermo have determined the relative amounts of inorganic phosphorus (sodium phosphate) taken up by different organs when injected into young rats. Subsequent analysis shows the presence of radioactive organic (lipidic) phosphorus in liver intestine and kidney, in much greater amounts than in muscle or brain. This indicates, according to the authors, that "the participation of the phospholipids . . . results in a complete synthesis starting from inorganic phosphorus".

From observations made in Melbourne on the wave-form of the electromagnetic pulse radiated from lightning flashes (giving rise to atmospherics), Prof. T. H. Laby, F. G. Nicholls, A. F. B. Nickson and Dr. H. C. Webster find evidence of multiple reflections between the earth and an ionized layer at an 'equivalent' height of 78–82 km.

Prof. V. A. Bailey reports observations supporting his theory of the interaction between radio waves Several European stations have collaborated in sending out suitable radiations. Interaction was observed in one case, caused by a gyro-station with a radiated power of only five kilowatts. Comparative tests with London National and London Regional show the existence of resonance in interaction.

Dr. M. S. Vallarta states that the constant intensity of cosmic radiation beyond a certain latitude may be accounted for by a magnetic action of the sun, and that the value of its magnetic moment calculated from the latitude effect leads to a value of the field intensity at the sun's surface in good agreement with that found by Hale and his collaborators. Two observable consequences of this interpretation are discussed.

That certain spectrographic lines and bands of interstellar origin observed by Merrill may be due to the presence of molecules (Na_2, NaK) is suggested by Prof. M. N. Saha. He points out that 'temperature' in interstellar space is near the absolute zero, and that only such states of atoms and ions occur there as have infinitely long life.

G. C. E. B. Hulbert and Prof. C. M. Yonge give reasons for inferring that the function of the osphradium in gastropods is to estimate the amount of sediment carried into the mantle cavity by the water currents created by the lateral cilia on the gills.

Drs. Donald and Alistair Gunn and Miss P. M. Jenkin have collected records which, they state, show that there is no lunar periodicity in human menstruation.

By irradiating (with radium) cells *in vitro* held at a temperature of 6° C., so that active cell life is inhibited, and afterwards allowing the cultures to develop, Prof. L. Halberstädter and L. Doljanski have succeeded in establishing a numerical relation between the amount of growth inhibition and the dose of rays applied.

A number of elements (molybdenum, silver, bromine, antimony, etc.) when bombarded with neutrons are found by F. A. Heyn to give radioactive substances with half-periods corresponding to those obtained when gamma rays are used. This, he points out, is additional evidence that a neutron entering the atomic nucleus may expel two neutrons with the production of a radioactive body.

The absorption spectra, and hence the optical rotatory power, of cobaltammines are, according to Messrs. C. H. Johnson and N. H. Poynton, affected in a specific manner by substitution of ^2H for ^1H in constituent NH_3 or NH_2 radicals. Measurements of optical rotation can thus decide the isotopic composition of a complex ion or of a solvent in equilibrium with it.

Prof. B. C. Guha and J. C. Pal state that alcoholic and ethereal extracts of cabbage give a higher ascorbic acid value on heating in nitrogen, even if the estimation is carried out after mercuric acetate treatment. Further evidence is offered for the existence of combined ascorbic acid in cabbage. The dye-reducing value obtained after heating chloroform extracts of cabbage disappears in large measure by the action of ascorbic acid oxidase, suggesting that the substance produced on heating is ascorbic acid.

Research Items

Bronzes from Iran and Elsewhere

AMONG a number of bronzes from Iran, Iraq and Asia Minor selected because they represent types not hitherto in the British Museum (Bloomsbury), and figured and described by Mr. Sidney Smith in *Brit. Mus. Quarterly*, 11, 2, are a number from Luristan, including an amulet with a suspension ring, which takes the form of a conventionalized 'naked goddess', such as were made in stone and clay at a very early period in Assyria, and similar to a type found in Crete. A small mace-head with bosses is of a type hitherto only known in stone. Each of the bosses is pierced, as if sockets were made to hold studs, but if so it is difficult to conjecture their use. An unusual object is an elaborate holder or *pelle d'offrandes*, of which the form imitates either a wheeled-cart or a sledge, the wheels or runners being replaced by four legs. Three animals stand facing the rear of the cart on an edge some four inches long by ¾ inch broad above the cart, the bottom of which is sunk nearly an inch and is only 2¼ inches long, terminated by an upturned edge ¼ inch inside the termination of the sides. The long shaft—eight inches—which turns in a socket as long as the upper edge, carries two animals facing in different directions, has a ring-attachment which serves as a support, and rises to a yoke, cast separately, the three ends thus made being shaped into unidentifiable animal heads. These bronzes are subject to the doubts about the dates of bronzes from Luristan. A fragment of a concave-sided vessel from Nihawand seems to have been chased over a bitumen ground, as it is not *repoussé*. The faces of the chased figures appear noseless with pointed chins. A harp seems to have eight strings, while a rectangular object is also doubtless a musical instrument and has been identified as an *adapu*, beaten with the hand. A curious object held by a broken seated figure seems to be a misshapen fish. A 'spectacle' amulet from Asia Minor, like others of the same type in ancient times, represented the convolutions of the intestines, and in modern Egypt is a prophylactic against the pains of childbirth.

Zuni Mythology

INTENSIVE study of folk-lore has tended to be neglected for a variety of reasons; but Ruth Benedict points out ("Zuni Mythology". *Columbia University Contributions to Anthropology*, 21, 2 vols.) that Zuni folk-lore affords excellent material for such study, in that a large body of tales has been recorded over a considerable period, indeed more than fifty years, the culture is well known, and in contrast to almost all the other tribes of North America, folk-lore among the Zuni is not moribund. This last-named factor brings out the importance of allowing for variation. In considering the relation of the themes which Zuni folk-lore elaborates in relation to culture, a number of points emerge. No folk-tale is generic. It always relates to a particular people, livelihood, social organization and religion. The final form is dependent on culture. Survivals belong to a dead culture, as in European folk-lore, and the function of myth cannot be studied in such cases. A living folk-lore reflects current use, although there is a lag. Also something must be allowed for idealism and the conventionalization of a Golden Age, which explain the discrepancy between story and fact. A discrepancy of constant occurrence in Zuni folk-lore is the occurrence of polygamy. While all other Indians recognize polygamy and sometimes polyandry, the Zuni are monogamous. This probably represents an element analogous to the fairy element in other systems, the grandiose wish and day dream. Other contrasts are compensatory. For example, the abandonment of children is alien to Zuni culture; and yet it is a popular feature in the folk-tale. This is because the interest centres on the child, and in the story the parents are put to shame. There is no recognition of suicide in Zuni culture, or of taking vengeance on an unfaithful spouse. So in the tale the Apache are summoned, as destruction must overwhelm innocent and guilty alike. An interesting feature is the position of women in sexual matters. The women are regarded as the pursuers; the male is bashful and hangs back.

Episternal Bones in Man

IN 1820, Béclard first directed attention to the occasional presence of episternal bones in man, but they were more fully described eighteen years later by Breschet, to whom subsequent writers have generally given the credit for their discovery. Since then they have been recorded by numerous workers, and a detailed investigation of 2,218 human and 107 anthropoid sterna has enabled W. M. Cobb (*J. Anat.*, 71, Jan. 1937) to review the subject. Ossa suprasternalia were found in 6·8 per cent of 544 adult whites and 2·2 per cent of adult negroes. None was found in the 107 anthropoids. They appear to be homologous with the rudiments of the epicoracoids of the primitive shoulder girdle. The human sternum with a convex manubrial border and ossa sternalia is to be regarded as the most primitive condition, while that with no ossa and a convex border the most advanced. Since all the anthropoids studied were of this latter type, they are in this respect more advanced than human beings.

Mysids and Euphausiids of the Great Barrier Reef

PROF. W. M. TATTERSALL, in his memoir on Mysidacea and Euphausiacea (Great Barrier Reef Expedition 1928–29. Scientific Reports, vol. 5, No. 4; 1936), records seventeen planktonic mysids and six species of bottom forms, and a small collection of euphausiids comprising sixteen species, two of which are larval forms which could not be identified. The occurrence and seasonal distribution of both groups have been discussed in a separate report (vol. 2, No. 8). From these observations it is shown that the night hauls of plankton contain numerous mysids which are scarce during the daytime, and it is probably that they live at the bottom and only become planktonic by night. The new genus *Pseudomysidetes* is created for the new species *P. russelli*, closely related to Mysidetes, and three other species are described as new to science. The euphausiids are specially interesting as they form apparently the first collection made from this locality. Twelve of the fourteen identified species were captured by the *Siboga* Expedition, which operated mainly in the Dutch East Indies, and the remaining two are tropical species which might have been expected in the same area and actually occur in other parts of the Pacific. All are oceanic, except *Pseudeuphausia latifrons* which is a shallow-water coastal form, widely distributed in the Pacific, and this species is the dominant one and is the only form characteristic of the shallow lagoon area inside the reef. A fairly complete series of larval stages enabled the life-history to be followed; this is closely related to that of *Nyctiphanes* and suggests that *Pseudeuphausia* is nearer to *Nyctiphanes* than to *Euphausia*, under which genus it was first described.

Locusts in Malaya

IN a recent bulletin (No. 18, Dept. Agric., Scientific Series, Straits Settlements and Federated Malay States), Messrs. G. H. Corbett and N. C. E. Miller discuss the incidence of two species of locusts in Malaya. As regards the oriental migratory locust (*Locusta migratoria manilensis*) it appears that there is no clear evidence that this insect is indigenous to Malaya. The regular absence of its solitary phase, and the fact that swarms are comparatively infrequent, point to this conclusion. Since Malaya has only been visited twice by swarms of *Locusta* during the past twenty-four years, this fact seems to be due to the distance which swarms have to travel in order to reach that territory. The suggested country of origin is Borneo, and it is considered quite likely that swarms may visit Malaya when outbreaks are in progress in other countries of the Pacific. The second species—the Bombay locust (*Patanga succinta*)—appears to cause negligible damage, but the occurrence of the insect in its solitary phase suggests that it may be indigenous.

Metabolism and Growth-Responses of the Cucumber

MODERN research has not yet made it clear to what extent such growth responses as flowering and fruiting are caused by, or are themselves the cause of, variations in chemical composition of the plant. There is an undoubted relation between the two, and a paper by Dr. R. B. Dearborn (Cornell Univ. Agr. Exp. Sta. Mem. 192, Ithaca, N.Y., July 1936) presents a very detailed contribution to our knowledge in this field. Cucumber plants were grown under conditions of high, and of low, nitrogen supply, whilst the composition of normal bearing plants was compared with that of plants which had their flowers or fruits removed. It was found that fruiting plants had a higher rate of vegetative growth and made more plant material for 10–14 days after pollination, than deflorated plants. Pollination therefore appears to exert a stimulus upon the general growth. The development of fruit had less effect upon the plant when the nitrogen supply was adequate, than when it was low. Amino and amide nitrogen accumulated in deflorated plants, so that the utilization of these fractions is in all probability impeded by the absence of fruit. Carbohydrates accumulated more in low-nitrogen plants than in those with higher nitrogen metabolism. Detailed estimations of the various fractions of carbohydrate and nitrogen are to be found in the paper, and the results show a definite relation between certain of these fractions and the type of growth. They do not, however, determine whether this relation is causal or subjective.

Powdery Mildew of Cucurbitaceæ in Egypt

THE fungus *Erisyphe cichoracearum*, which causes a powdery mildew of melons, cucumbers and other members of the Cucurbitaceæ, is very destructive to these crops in Egypt. Dr. Amin Fikry has published a detailed account of the disease (*Bull.* 175, Tech. and Scientif. Serv., Min. Agric., Egypt, Govt. Press, Bulâq, Cairo, 1936. P.T. 7), particularly with the view of controlling it. Powdery mildew is distributed widely throughout the country, and freely attacks all cucurbitaceous crops except water melon, which may, however, be attacked severely under conditions of high relative humidity. Dusting infected plants with flowers of sulphur was found to be the most satisfactory and practical means of control, though spraying with Burgundy mixture was also effective. A simple apparatus, which applied the sulphur by shaking it through a muslin cloth, was designed, and appeared to be very effective—superior, even, to mechanical dusters. Striking increases of crop followed two applications made when the fungus first appeared, but very little benefit accrued when the sulphur was applied either as a precautionary measure, or when the disease was well established. The bulletin is well illustrated by twenty-four plates, which portray symptoms on different plant hosts, and show various methods of control.

Native Agriculture in Northern Rhodesia

THE Ecological Survey of Northern Rhodesia, which was inaugurated in 1931, was faced with the difficult problem of evolving a quick and sound method of mapping and classifying large areas of country in order to provide a basis for native agricultural development. To have employed a large-scale soil survey would have been both slow and costly. Regional or geographic survey would be unsatisfactory without soil or geological information, which was not available. Vegetation survey, if conducted with due allowance for climatic variation and for changes induced by biotic factors, was found to provide the quickest efficient means of land classification. Mr. Trapnell (*Bull. Misc. Inform., Kew*, 1, 1937), the ecologist of the Survey, describes in detail the method he employed. A direct correlation between vegetation type and native agricultural practice was soon established. The degree of correlation obtained between soil and vegetation type, the reasons for lack of correlation where found, and the type of mapping unit which emerged as desirable for agricultural purposes are explained. The rest of the paper is concerned with agricultural aspects.

Directional Properties in Rolled Brass Strip

AT the annual meeting of the Institute of Metals (March 1937), a paper by Dr. Maurice Cook dealt with a matter of profound importance to producers and users of rolled brass strip. It is shown that the tensile strength of such strip, when the reduction has been sufficient to induce a directional effect, is greatest, and the ductility least, when tested in a direction normal to that of rolling, whilst in the direction of rolling itself the converse obtains. When such cold-rolled strip is annealed, it may still show directional properties which are revealed both by tensile tests and by the occurrence of 'ears' or waves on the edges of cups pressed from such strip. In annealed strip which shows a variation of properties in different directions, the tensile strength is least, and the ductility greatest, when tested at an angle of

45° to the direction of rolling, and it is in this position that the 'ears' are formed. The extent to which 'directionality' exists in rolled and annealed strip is determined largely by the conditions of the penultimate and final annealing treatments and by the degree of the reduction by rolling between them. A study of the orientation of the twinning planes in rolled and annealed 70 : 30 brass strip which shows an appreciable variation of properties in different directions indicates that the frequency of orientation of the twinning planes is least at 45° to the direction of rolling. In the case of strip which does not show directional properties, the twinning planes occur fortuitously in the sample.

Activity Coefficients from Cells with Transference

T. SHEDLOVSKY and D. A. MacInnes (*J. Amer. Chem. Soc.*, 59, 503 ; 1937) have measured the activity coefficients of potassium chloride and calcium chloride by means of potential measurements of cells of the type :

$$\mathrm{Ag}\ ;\ \mathrm{AgCl},\ \mathrm{MCl}(c_1) : \mathrm{MCl}(c_2),\ \mathrm{AgCl}\ ;\ \mathrm{Ag}$$

in which M represents the cation. The calculations involved the transport number t of the cation through the equation

$$-E = 2(RT/F)\int_1^2 t\, \mathrm{d} \log cf,$$

where f is the activity coefficient, for the potassium chloride, and the corresponding equation with the factor $3RT/2F$, instead of $2RT/F$, in the case of calcium chloride. The values of t must be known, and accurate values for the two electrolytes over a range of concentrations have recently been measured by Longswort hand by MacInnes and Dole. It was found that the simple Debye–Hückel equation : $-\log f = \alpha\sqrt{c}/(1+\beta\sqrt{c})$ reproduced the results with great precision over the range of concentrations $0{\cdot}005 - 0{\cdot}2$ for $c_2 (c_1 = 0{\cdot}1)$—the actual measurements extended to $c_2 = 3{\cdot}0$— and $0{\cdot}0018 - 0{\cdot}03$ for calcium chloride (actual measurements up to $c_2 = 0{\cdot}096$; $c_1 = 0{\cdot}05$). The constant β involves the distance of closest approach of the ions, and for potassium chloride and calcium chloride this distance was calculated as 4·1 and 5·2 A., respectively. For higher concentrations, agreement was obtained for the former up to $c_2 = 3$ and for the latter for $c_2 = 0{\cdot}1$, by modified equations obtained by subtracting terms in $c \log c$ and c, respectively, from the simple equation. The results with calcium chloride are of particular interest, since they show that the Debye–Hückel equation in its simplest form applies to the dilute solutions of this unsymmetrical type of electrolyte, the distance of closest approach being sufficiently large to make the higher terms of the La Mer equation negligible.

Estimation of Arsenites, Arsenates, Selenites, and Selenates

IN a communication read before the Czech Academy of Sciences on December 10, 1936, and published in the Academy's *Bulletin International* (1937, p. 1) Prof. J. Milbauer and Dr. J. Vodražka describe a method of estimating arsenites, arsenates, selenites and selenates in mixtures containing all four salts. Molybdic acid serves to detect arsenates in such a mixture, but cannot be used for quantitative estimations since selenium compounds are found to be occluded in the arsenomolybdate precipitate. No such occlusion occurs when arsenates are precipitated as magnesium ammonium arsenate, $MgNH_4AsO_4 . 6H_2O$, on adding ammoniacal magnesium solutions to the mixture. The precipitate is converted into magnesium pyroarsenate, $Mg_2As_2O_7$, and weighed as such. To determine the arsenite a weighed amount of the mixture is oxidized (nitric acid, bromine, sulphuric acid and bromine, potassium chlorate, perchlorate or bromate can be used) to arsenate and the estimation carried out as indicated above. Selenates can be estimated, in absence of chloride, by means of barium perchlorate, which precipitates barium selenate in the presence of perchloric acid. Selenites can then be determined by means of barium perchlorate after suitable oxidation. Should hydrochloric acid or a chloride be present, the total selenium is estimated by reduction with hydrazine sulphate, which yields elementary selenium.

Fuel Briquetting

THE agglomeration of powdery material—especially fuels and ores—is a technical problem of world-wide interest. Its importance is not felt in full measure in Great Britain, favoured as it is by well-distributed supplies of excellent coal. In many countries, fuels are lacking or available supplies consist of low-grade, non-coking or pulverulent material to which the briquetting process is applicable. Accordingly, we find that the technique of briquetting lignite has been highly developed in Central Europe. South Wales has found a Continental market for its anthracite dust in the form of briquettes. In North America the quest of an anthracite-substitute has produced an enormous patent literature. The problem is essentially the production of a suitable binder—preferably smokeless—waterproof, furnishing a briquette which is not only mechanically strong enough for storage and handling before use but also during the process of combustion. The state of the art can be realized from a report on fuel briquetting by R. A. Strong, E. Swartzman and E. J. Burrough issued by the Canadian Bureau of Mines, Ottawa (25 cents, pp. 100). It contains a critical bibliography, and is a welcome contribution to a branch of technology imperfectly supplied with literature.

The Orbit of the Binary Star, Σ 2026

IN *Mon. Not. Roy. Astro. Soc.*, (97, 3, Jan. 1937), Dr. R. v. d. R. Woolley and Mr. L. S. T. Symms contribute a paper in which they describe their method for improving the orbit of this binary, which was discovered by Struve in 1830. Since Comstock published his orbit in 1918, very satisfactory observations have been made, and these have been used to compute an orbit which will probably not be improved for a great many years. The attempt to compute an orbit by Russell's method met with little success, and discordances as large as 15° in position-angle were found when an ephemeris was computed from preliminary curves. Arbitrary alterations were then made in the elements until these discordances were reduced to ± 3·5° in the observed minus computed position-angle, and differential equations were applied to improve the elements of the orbit. A detailed description follows showing the procedure adopted, with the ten places selected as representing the observations satisfactorily. The results show that the period is 680 years, the semi-axis major 3·04″, and the inclination ± 130·6°. It is observed that much of the work in the northern hemisphere which needs to be done on double star orbits is of the nature of improving existing orbits with the use of later observations, and for this purpose the differential method of Innes and van den Bos is well suited.

Mellon Institute of Industrial Research

THE new building of the Mellon Institute of Industrial Research in the University of Pittsburgh was dedicated on May 6, addresses being given by three Nobel laureates, Dr. Irving Langmuir, Dr. H. C. Urey, and Dr. W. P. Murphy. On the following day, a symposium on recent progress in science was held, to which Dr. G. O. Curme, Dr. F. B. Jewett, Sir Frederick Banting and Dr. W. W. G. Maclachlan ontributed.

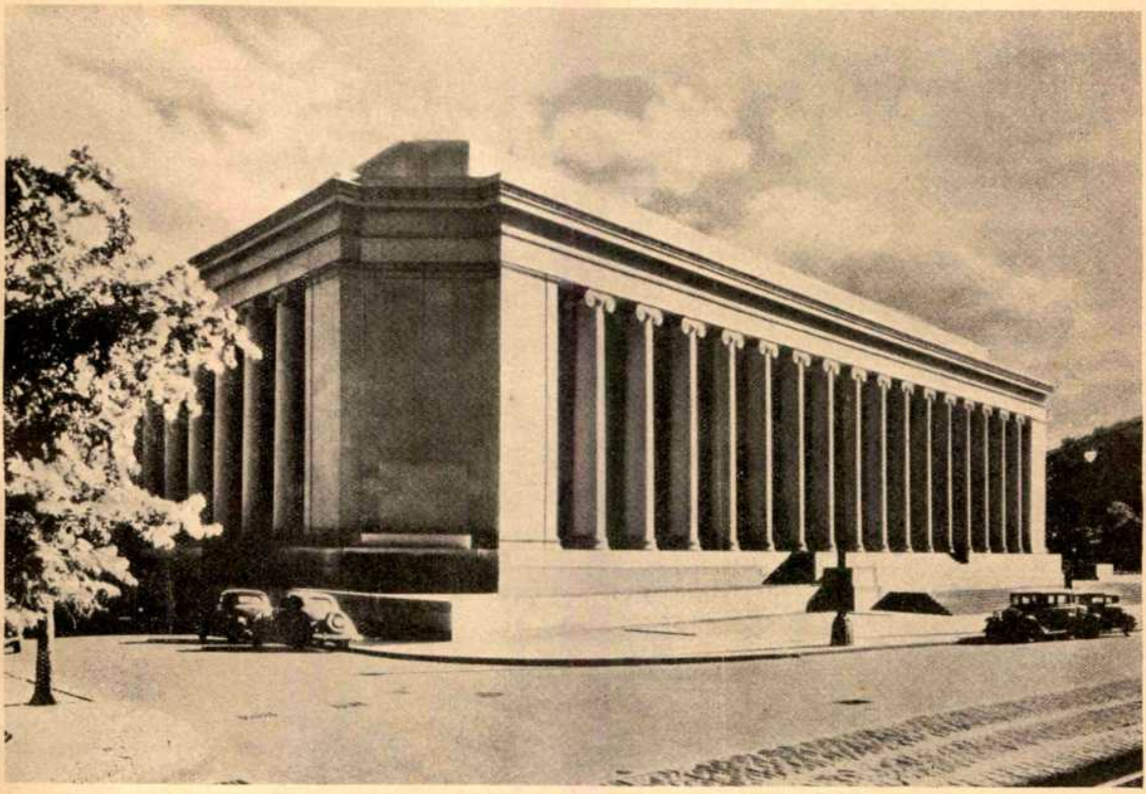

Fig. 1.
NEW BUILDING OF MELLON INSTITUTE, PITTSBURGH, PA.

The new Institute is the gift of the late Richard R. Mellon and his brother Andrew W. Mellon, formerly Secretary of the U.S.A. Treasury. Its origin is to be raced to Prof. Robert Kennedy Duncan's scheme of ndustrial fellowships, under which industrialists co-perate in the prosecution of specific researches. This scheme was first put into operation in 1907 in he University of Kansas and transferred to Pittsurgh in 1911. The Institute under its present name was founded in 1913 by the Mellon Brothers, who uthorized Duncan to design a special building with dequate laboratory facilities. Duncan died prematurely in 1914 and the original building was edicated in the following year, with Dr. Raymond F. Bacon as its first director. He was succeeded in 921 by the present director, Dr. Edward R. Weidlein. An important development, with which Duncan would have been in full sympathy, was the establishment in 1924 of the Department of Research in Pure Chemistry.

Details of the scheme of industrial fellowships having been given from time to time in NATURE (see particularly NATURE, May 23, 1936, p. 855), a summary of the present position and a brief description of the new building will suffice to commemorate the official opening of the largest building in the world dedicated to scientific research. The money appropriated by donors in support of industrial fellowships has amounted in the past twenty-six years to 11,478,406 dollars. In the financial year ending March 1, 1937, appropriations by donors were 816,315 dollars, and 69 fellowships have been in operation, employing 185 scientific workers and engineers. The Institute's contributions to the literature of science include 19 books, 143 bulletins, 744 research reports, and 1,117 papers published in journals; and 669 U.S. patents have been granted. Since 1911, 1,150 fellowships have been established in 275 technological subjects, and 650 processes or products have been invented or developed. In ten instances, new industries have resulted. From 1911 until 1935, no less than 777 scientific workers, having completed the work of their fellowships, have entered the field of manufacture or teaching, and this forms not the least valuable contribution to the promotion of science and industry. In recent years, the Institute has greatly developed its work of a more purely scientific character or bearing on public health. Its investigations on smoke abatement, dental caries, and anti-pneumococcic serum are examples.

With a view to simplicity, beauty and inspiration, the new building was designed in the Greek style (Fig. 1) with a relatively low elevation, three storeys being below ground level. The building has a capacity of 6½ million cubic feet. Its colonnades have a total of sixty-two columns, each shaft—a single block of stone—weighing approximately 60 tons, of which twelve are on the south frontage, sixteen on the east and west and eighteen on the north. At the corners are impressive piers. Models were found in the small temple of Nike Apteros on the Acropolis and in the temple at Sardis in Asia Minor. On three sides a flight of steps leads up to the building. The fifth to eighth floors are devoted entirely to laboratories, most of the space being occupied by the two types of laboratory adopted by the Institute as standard. Doors connecting the laboratories are of aluminium adorned with alchemical symbols.

In accepting in 1935 the Chemical Industry Medal of the Society of Chemical Industry, Dr. Weidlein, the director, said that his task at the Institute had been to assist in infusing science into technology, particularly the chemical industry. This task had two aspects—to convince manufacturing organizations of the functions of scientific research and research management in industry, and to encourage in the public a greater appreciation of the value of science. Thanks to the work of the industrial fellows, the Institute formed a strong link between the world of science and the industries. His concluding words were :

"What about the future ? I believe that all of us at the Institute will have much greater encouragement and opportunities and that we shall be able to do many more useful things when we have the advantage of working in our new building with its splendid facilities for research in pure as well as applied science."

Kew's Contribution to Empire Botany

VISITORS to the Royal Botanic Gardens, Kew, who usually see only the Gardens and Museums, can have little idea of the great role that the Herbarium near the Main Gate has played in the botanical service of the Empire. Since the Herbarium was founded in 1852, members of the staff have, independently and collectively, and in association with other botanists, accomplished a vast amount of floristic work. In order to show the extent of this to the numerous visitors, particularly from overseas, who will no doubt visit the Gardens during the Coronation period, a special exhibit has been arranged in No. 3 Museum. In a large glass case there has been placed a selection of works prepared either wholly by, or with the assistance of, the scientific staff of the Herbarium and Museums.

The general books shown include the classical work of G. Bentham and J. D. Hooker, the "Genera Plantarum", 1862–83, which has been and is still used by botanists in all parts of the world. Next in order is the "Index Kewensis", a work of universal importance compiled at the expense of Charles Darwin, under the direction of Sir J. D. Hooker, by the late B. Daydon Jackson, and continued by various members of the staff. This gives references to the original descriptions of all known species of flowering plants. Alongside is the great index of plant illustrations, the "Index Londinensis", edited by the late O. Stapf. Besides these are the "Hortus Kewensis" of W. Aiton, 1789, which records the species of plants in cultivation at Kew when still a 'royal garden'; the *Botanical Magazine*, the oldest of botanical periodicals, commenced in 1787, and still prepared at Kew, but since 1922 the property of the Royal Horticultural Society; the *Kew Bulletin*, which this year attains its golden jubilee, having been started in 1887; and Hooker's "Icones Plantarum", which last year attained its centenary, and which provides a medium for the illustration of plants of exceptional botanical interest.

The botany of the British Isles is represented by Hooker's "Students' Flora" (1870) and by the "British Flora" of G. Bentham (ed. 1, 1858).

The vegetation of much of China and Tibet is recorded in Forbes and Hemsley's "Index Floræ Sinensis" (1886–1905), Bentham's "Flora Hongkongensis" (1861), and Dunn and Tutcher's "Flora of Hong Kong" (1912).

India has been well catered for by the "Flora of British India", by J. D. Hooker and others (1872–97), and the "Flora of Bombay", by T. Cook (1901–08), the "Flora Simlensis", by Collett and Hemsley (1902), the "Flora of the Upper Gangetic Plain", by J. F. Duthie (1903–29); "Bengal Plants" by D. Prain (1903); and the "Flora of Madras", by J. S. Gamble, completed by C. E. C. Fischer (1915–36). The forestry of India is dealt with in "Indian Trees", by D Brandis (1907), and the "Forest Flora of the Andaman Islands", by C. E. Parkinson (1923).

The "Flora of the Malay Peninsula" (1922–25) was a heavy undertaking by one botanist, H. N. Ridley and the "Enumeration of Siamese Plants" (1925– by the late W. G. Craib, is being continued.

The continent of Australia was early provided fo by G. Bentham's fundamental work, the "Flor Australiensis" (1863–78), and J. D. Hooker's "Flor of Tasmania" (1860), whilst the "New Zealan Flora" (1864–77), by J. D. Hooker, and the "Illustra tions of the New Zealand Flora" (1914) by Cheeseman assisted by W. B. Hemsley, have done much for th botany of that Dominion. J. D. Hooker's "Flor Antarctica" (1847) is a classical work for tha region.

Africa has always taken a first place in the activitie of the Kew Herbarium, and several works of cor siderable magnitude have been issued dealing wit its flora. The "Flora of Tropical Africa" was begun by D. Oliver in 1868, and has been carried on by many botanists, part of the last family, the Gramineæ, commenced by O. Stapf and now being continued by C. E. Hubbard, only remaining to complete the huge task. The work of editing this great undertaking has been carried out by successive directors of Kew, Sir William T. Thiselton-Dyer, Sir David Prain, and Sir Arthur W. Hill, and part of the Euphorbiaceæ was contributed by Sir David Prain.

The "Flora of West Tropical Africa" (1927–36), by J. Hutchinson and J. M. Dalziel, is the first regional illustrated flora of the tropical part of the Continent; its "Economic Appendix" by J. M. Dalziel provides full information on the uses of West African plants. Smaller areas are dealt with in the "Flora of Liberia" (1906), by O. Stapf (in Johnston, "Liberia"); "Trees and Shrubs of Sierra Leone" (1916) by C E. Lane Poole; "Gold Coast Trees and Shrubs" (1913), T. F. Chipp; "Nigerian Trees" (1925), H. V. Lely; "Flora of the Sudan" (1929), A. F. Broun and R. E. Massey, and its companion volume of illustrations by G. M Crowfoot (1929); "Trees of Kenya Colony" (1926), E. Battiscombe; "East African Grasses" (1926–27), by C. E. Hubbard.

The islands of Mauritius and the Seychelles were provided for in J. G. Baker's "Flora" (1877), and latterly the "Seychelles Flora" has been enumerated by V. S. Summerhayes.

The immense task of describing the rich and varied flora of what is now the Union of South Africa, begun by Harvey and Sonder in 1859, the "Flora Capensis", was continued by the Kew staff and others and completed in 1935. As in the case of the "Flora of Tropical Africa", the editorship has been in the hands of successive directors of Kew, Sir David Prain and Sir Arthur Hill also contributing largely to the taxonomic work The "Flora of the Transvaal" (parts 1 and 2, 1926–32), by J. Burtt Davy, is the first of the regional descriptive floras of South Africa. The descriptions for Mrs. E. F. Vallentin's "Illustrations of the Flowering Plants and Ferns of the Falkland Islands" were provided by Mrs. E. M. Cotton.

A. H R. Grisebach's "Flora of the British West Indian Islands" was written in association with Kew; and the "Flora of Trinidad" (1928–), by Williams and Cheesman, is also being prepared in close collaboration with Kew.

Among the general works by individual Kew botanists are the "Synopsis Filicum" (1868), of W. J. Hooker and J. G. Baker; the "Fern Allies" (1887), by J. G. Baker; "British Fungi" (1906), G. Massee; "Diseases of Cultivated Plants and Trees" (1910), G. Massee; and J. Hutchinson's new phylogenetic classification in his "Families of Flowering Plants" (1926; 1935). "Plant Life in the Balkan Peninsula", W. B. Turrill (1929), is an intensive study of a special area.

Researches in sixteenth century botany are represented by the "Herbal of Otto Brunfels", by T. A. Sprague (1928), and the "Herbal of Leonhart Fuchs", by T. A. Sprague and E. Nelmes (1931).

Applied botany is the subject of J. Smith's "Dictionary of Economic Plants" (1882), and his "Domestic Botany" (1871); G. Watt's monumental work, "A Dictionary of the Economic Products of India" (1889–93(6)), and its abridgment, "The Commercial Products of India" (1908); the "Economic Products of the Malay Peninsula" (1935), I. H. Burkill; "Useful Plants of Nigeria" (1908–22), by J. H. Holland; "Tropical Agriculture" (1929), revised by J. H. Holland; "Sorghum" (1936), J. D. Snowden; "Crop Plants of the British Empire" (1936), by H C. Sampson.

Among the more important books on horticulture and forestry are the "Dictionary of Gardening" (1884–88), by G. Nicholson; "The Trees of Great Britain and Ireland", H. J. Elwes and A. Henry 1905–13); "Trees and Shrubs Hardy in the British Isles" (1921), by W. J. Bean; "Rhododendrons" (1930), by J. Hutchinson (Kew), A. Rehder and H. Tagg (published by the Rhododendron Society); "Coniferæ" (1923), by W. Dallimore and A. Bruce Jackson, and the periodical, the *Orchid Review* (1893–), founded and edited for many years by the late R. A. Rolfe. The history of the Gardens is dealt with in "The Royal Botanic Gardens, Kew" (1908), by W. J. Bean.

This list does not include, of course, the numerous smaller papers in scientific journals to which the Kew staff has so largely contributed.

Calculating Machines in Scientific Computing

SCIENTIFIC computing has been materially aided of late years by the development of calculating machines, a development in which scientific workers themselves have had a say. We may instance the use of the modern Brunsviga, with its split register and automatic transfer features, in statistical calculations; the application by Dr. L. J. Comrie of the Brunsviga twin 13z to the Hartmann formula for the reduction of prismatic spectrograms; the use of the Burroughs machine, and later the National Cash Register machine, in the Nautical Almanac Office for finite differencing and integration; the demonstration recently given at Cambridge of the application of the Hollerith rolling-total tabulator for the same purpose, and for general statistical calculations; the machine invented by Mr. R. R. Mallock at Cambridge for solving simultaneous equations; and the Bush machine developed at the Massachusetts Institute of Technology for the numerical solution of differential equations, and since installed by Prof. D. R. Hartree at Manchester.

For some years, the Mathematical Tables Committee of the British Association has concentrated on the production of new tables by means of subtabulation on its "National" machine, a process which has revolutionized the art of table-making; the incidental advantage of having clean type copy produced by the machine for the printer has largely eliminated copying and setting errors. Checking by means of mechanical differencing of tables is equally easy. With regard to the Hollerith, the spectacular production of a table of a polynomial function by feeding the machine with blank cards appealed to many at the Cambridge demonstration, while so far as capacity for work is concerned, it may be mentioned that in a recent agricultural statistical investigation, two Cambridge workers produced a million products in six weeks, that is, at the rate of one product a second

Expensive machines are not readily available to the ordinary scientific worker, and this lends interest to the announcement that Dr. Comrie, formerly superintendent of H.M. Nautical Almanac Office, to whom much of the above mentioned development is due, has set up at 131 Maze Hill, Blackheath, London, S.E.3, a professional "Scientific Computing Service". Dr. Comrie offers his services for (1) scientific calculations generally, and particularly those where mechanical computation and mass production methods may be employed; (2) table-making; (3) purchase and use of calculating machines and mathematical tables; (4) instruction in the art of mechanical computing; (5) press work; and (6) lectures on calculating machines or on computing. He has at his command a variety of machines, including a "National" and Hollerith equipment. As the former is expensive to buy and the latter to hire, here is a means whereby the scientific worker may get computation jobs done efficiently at reasonable rates.

An interesting announcement from Cambridge relates to the proposed establishment of a computing laboratory in the mathematical faculty. The immediate intention is to acquire a Bush integrating machine and the Mallock equation solver, but other machines will be added from time to time, and a wide view is being taken of the service that can be rendered to Cambridge by the establishment of such a laboratory. Besides the applied mathematicians, we can envisage statisticians, economists, biologists, psychologists and others being eager to avail themselves of the specialized equipment that will no doubt be available in time, in order to supplement their existing computational resources. The capital cost of the proposed installation is of the order of £10,000, and it is anticipated that an annual charge of £1,000 per annum will fall to be met by the University, to include maintenance and replacement of machines, and salaries. The scheme has been approved, and the laboratory should be in existence by the opening of the academic year in 1938.

Hybrid Vigour in Plants

INCREASED vigour over either parent of the product of the cross between two inbred lines has been frequently reported in plant breeding and, through vegetative propagation, efforts have been made, especially with trees, to make practical use of the phenomenon. It is usually explained, in Mendelian terminology, as the result of association of several genes for size which had been isolated in either parent, and subsequent loss of vigour in succeeding generations is attributed to segregation. There has been little analysis, however, of the factors contributing to the heterosis or hybrid vigour during the development of the hybrid, so that considerable interest is attached to a recent series of papers by Dr. Eric Ashby, which have brought to light some most unexpected features of this process in specific cases.

In certain strains of maize[1] and in two cases with tomato strains[2] where the hybrid showed greater weight and dry weight, greater height, more leaves and larger leaf area than either parent, analysis of these differences showed no appreciable difference between hybrid and parent in relative rates of growth or of dry weight increase, of rates of production of leaves and new leaf area or of photosynthetic efficiency. Cell size in hybrid and parent also seemed approximately the same, but the embryo of the resting seed seemed larger in all cases.

The only possible conclusion from these results would seem to be that the organization of the growing shoot of the hybrid is upon a larger scale. Embryo and shoot apex form cells more rapidly, but this does not result in a quicker release of leaf primordia from the shoot apex because the whole plan of shoot organization, though still that characteristic of the species, is built upon a larger scale. More cells must accumulate at the apex before the new leaf primordium must separate. Naturally, therefore, when it arises, this primordium is planned on a larger scale from the outset, presumably its procambial and vascular strands are commensurately larger and it grows into a larger leaf, though individual cells, in their metabolic and photosynthetic efficiency, correspond with those of the parent forms.

Dr. Ashby speaks of larger primordia in the seed, but the term is usually applied to leaf primordia, and in the embryo of the tomato, apart from cotyledons, leaf primordia will scarcely be manifest yet. It would seem that the comparison is rather upon the scale of organization of the meristematic aggregate in the hybrid shoot; planned on a more generous scale, it yet maintains the rate of leaf development of the parent, so that its growth must mean a larger number of meristematic cells maintained in full activity at any moment, therefore more cell divisions and the growth organization of the species maintained at its usual *tempo* but on a larger scale.

Dr. Ashby's studies are therefore full of significance in relation to the problem of shoot organization in the higher plant, as well as in connexion with the genetic explanation of hybrid vigour. Dr. Ashby points out that his results are not in accordance with the usual interpretation given to the linkage of genes in the F_1 generation, but there is as yet so little information as to the way in which the gene is geared into the machinery of development that it is early to say whether the conventional explanation in terms of genes can be applied to the machinery now revealed as operating in the development of the hybrid.

[1] *Ann. Bot.*, 44 (1930) and 46 (1932).

[2] *Ann. Bot.*, N.S., 1, 11–42 (1937).

Science News a Century Ago

Population of England and Wales

IN a paper read to the Statistical Society on May 15, 1837, entitled "On the Movement of the Populations of England and Sweden throughout seventy-five Years, ending with 1830", Mr. T. R. Edmonds made many observations of interest to statisticians and physiologists. In the course of his remarks, he said that in the majority of European nations the annual births amounted to 1 in 30 and the annual deaths to 1 in 40 of the total population. The highest birth-rate was about 1 in 23 and the lowest about 1 in 33. The highest rate of deaths observed had been 1 in 30, the lowest (in England), 1 in 50 of the population. The highest rate of increase of population observed was in the United States, where the increase for a long period had been at the rate of 32 per cent every ten years. In England, it had been 16 per cent every ten years. In Sweden and England, the proportion of marriages, births and deaths had been progressively diminishing. The annual loss in population in England and Wales through emigration was 4,000 persons in 1820, 9,000 in 1827 and 30,000 in 1832. Part of this loss had been made up by immigrants from Ireland.

The Electrical Society of London

IN *Sturgeon's Annals* (1, 415) is an article directing attention to the Electrical Society of London, which had just been formed, and for which all subscriptions were to commence on May 16, 1837. Members within twenty miles of London were to pay two guineas, members living beyond that distance one guinea. The article was accompanied by a copy of the rules signed by the honorary secretary, Thomas Patrick, of 11 Lowther Arcade, Strand.

"It gives us great pleasure," said the writer of the article, "to learn that Electricity is no longer to be left to the isolated exertions of individuals, or the chance notice of learned societies. . . . The labours of the Astronomer, Geologist and Chemist will now have for their aid a Body ready to pursue with effect and vigour any line of investigation which mutual pursuits may suggest ; and there will thus, we trust, be another of those enobling links of brotherhood, amongst mankind of all nations, drawing still closer the relationship of intellect."

Royal Geographical Society

THE seventh anniversary meeting of the Royal Geographical Society was held on May 16, 1837, Sir John Barrow, the president, being in the chair. In he course of his remarks, Barrow paid tributes to he memory of Horsburgh, Marsden, Murphy and Davidson, whose deaths within the last twelve months had been a great loss to science and the Society ; referred with great satisfaction to the ravels of Captain FitzRoy, Lieut Wellsted, Dr. Andrew Smith, Major Mitchell and Colonel Chesney, nd alluded to the expeditions then in progress nder Back—who was exploring the coasts of North America—Alexander in South Africa and Schomurgh in British Guiana. He also spoke of Grey and ushington who were due to sail in a few days for he coast of Western Australia, "with the hope of eing able to penetrate some distance into the terior of that vast country and set at rest the uestion of the existence, or the contrary, of a great land sea".

The English Medical Profession

AN editorial article in the issue of the *British Annals of Medicine* of May 19, 1837, contains the following remarks : "Besides many excellent anatomists this country possesses in Grant, Sharpey, Owen and others men who imitate the German physiologists and in their lectures take a large survey of the structures and phenomena of the organic kingdom in every stage of their development. Philosophical physiology is growing fashionable. Mr. Owen's lectures—clear, earnest, eloquent, beautifully illustrated—attract almost as many auditors to the theatre of the College of Surgeons as those of Cuvier did to the Garden of Plants in his best days. It is yet humiliating to reflect that England has not taken the initiative in those positive parts of medical science that have been cultivated with most success. In pathological anatomy our Hodgkins and Carswells were preceded by Dupuytren, Laennec, Cruveilhier, Andral and Louis ; in physiology Treviranus, Burdaceh, Muller, Ehrenberg, Purkinje and Valentin had made immortal discoveries or written unrivalled works in the spirit of positive science before the new doctrines found an echo in our schools. . . . The ardent inquirer who wishes to devote himself to scientific investigations cannot count, as in Germany, on an asylum in the Universities ; the endowments and fellowships of Oxford and Cambridge are the prey of rich, indolent men, and he is driven by necessity, as Liebig remarked, to serve Mammon. If a physician, he publishes a book upon new medicines, a treatise upon nervous affections, a book upon the diseases of females, or some other fortune-fraught theme, and is thus seduced, by corrupt institutions, from the path his genius might have illustrated under happier influences."

The Paris to Brussels Railway

IN the *Mechanics' Magazine* of May 20, 1837, it is stated that "The Railway which has long been projected for uniting the capitals of France and Belgium, at length bids fair to be commenced in good earnest. The king of the French has granted to Mr. John Cockerill the celebrated English iron-master of Liège, the 'concession' of the railway for fifty years. The French government is to advance 25 per cent of the cost on the distance from Paris to the Belgian frontier ; and Mr. Cockerill is to be entitled to all tolls and profits for the first half century, when it is presumed, the works will become the property of the nation. . . . The terms of the concession were not agreed to until after the 'high contracting parties' Louis Philippe on one side and Mr. Cockerill on the other had had several interviews. The latter must be allowed to possess a most industrious spirit ; he was a severe sufferer by the revolution in Belgium in 1830 ; and yet it seems is not deterred from adventuring his capital on a soil like that of France, which in fifty years may experience probably half as many revolutions."

John Cockerill (1799–1840) was the son of William Cockerill (1759–1832), the Lancashire mechanic who had worked first in Russia and then in Sweden before settling at Liège. It was John and his brothers Charles and James who founded the famous iron-works at Seraing, of which John became the sole proprietor in 1835.

University Events

Cambridge.—The Adams Prize, offered every two years for an essay on some branch of pure mathematics, astronomy, or other branch of natural philosophy, value £246, has been awarded to Mr. W. V. D. Hodge, Pembroke College. Essays of great distinction were submitted by Mr. T. Groom, St. John's College, Dr. J. A. Todd, Trinity College, and Dr. P. Du Val, Trinity College.

At St. John's College, the following have been elected into fellowships: Dr. A. C. Offord, Keddey Fletcher-Warr Student in mathematics, University of London, 1934–37; F. Smithies, Wrangler and B, Part II, Mathematical Tripos, 1933, Baylis Student, 1934, Rayleigh Prize, 1935, Carnegie Fellow, 1935–37; R. A. Lyttleton, Clare College, Wrangler and B, Part II, Mathematical Tripos, 1933, Tyson Medal for Astronomy, 1933, Procter Fellow at Princeton University, 1935–37.

The Buildings Syndicate recommends that a site be assigned for the new Austin Wing of the Cavendish Laboratory.

C. C. Okell, of St. John's College, has been approved for the degree of Doctor of Science.

At Emmanuel College Dr. R. G. W. Norrish, professor of physical chemistry in the University, has been elected into a professorial fellowship.

It is proposed that a Mathematical Laboratory be constituted as a Department in the Faculty of Mathematics, that the head of the Department be the director of the Mathematical Laboratory, and that Prof. Lennard-Jones be appointed director of this Laboratory.

Proposals are before the University for the addition of metallurgy to the list of subjects which may be taken in Part II of the Natural Sciences Tripos.

Manchester.—The resignation is announced of Prof. W. L. Bragg, since 1919 Langworthy professor of physics, who has built up in the University a school of research well known for its investigations of the solid state of matter. Prof. Bragg has been appointed director of the National Physical Laboratory (see p. 829).

Societies and Academies

Paris

Academy of Sciences (*C.R.*, 204, 1049–1092, April 5).

Charles Achard, Augustin Boutaric and Mlle. Paulette Berthier: Researches on the viscosity of solutions of bile. Viscosity data from three specimens of ox bile in aqueous solutions at concentrations varying from 5 to 100· per cent, and discussion of the results applying the formulæ of Einstein and of Kunitz.

Lucien Malavard: The method of electrical analogies for the calculation of the wall corrections [of wind tunnels].

Etienne Kondor: The Caquot theory of the equilibrium of soils.

Mlle. Marie Bloch: The spectrum of Nova Lacertæ 1936, slightly after the maximum brightness. Comparison of the spectra of Nova Lacertæ and Nova Herculis.

Georges Allard: An expression for the mean electrical density of a complex atom.

Ny Tsi-Zé and Shang Keng-Yi: The vibrations of plates of quartz cut in various planes around the optical axis of the crystal. The relations found by experiment between the angle starting with the Curie section and the frequency are given as curves.

Théodore V. Ionescu: Calculation with the aid of the quantum theory of the energy emitted by an antenna.

René Freymann: The two infra-red (OH) bands of the alcohols and the polyalcohols. molecular associations.

André Michel: The relations between the different solid solutions formed by ferrous sulphide.

Louis Bouchet: The colloidal state caused by various specimens of zinc acting on some natural waters.

Michel Cymboliste: The hardness of electrolytic chromium. The hardness varies with the current density, the temperature and the chromate concentration. Deposits of chromium, with hardness varying between 1,200 and 400 (Brinell), can be obtained at will by varying the above factors.

Maurice Girard: The influence of the replacement of a hydrogen atom in the β position by a methyl group in phenyl-α-oxycrotonic acid.

Paul Chovin: Researches on the Pechmann colouring matters. The synthesis of some colouring matters with unlike substituents.

Vsévolad de Goloubinoff: Differential geochemical prospecting of mineral deposits.

Vladimir Frolow: The analysis of the levels of Lake Ontario.

Frantisek Link: Influence of the season and of the climate on astronomical refraction and the distribution of air masses

André Eichhorn: Nuclear evolution and chromosome enumeration in *Begonia Pictaviensis*.

René Vandendries: New views on the sexuality of the Basidiomycetes.

Pierre Carrère: Some metacercaria of *Atherina mochon*; the experimental development of a Gasterostomid.

Constantin Dawydoff: The Gastrodes of Indo-Chinese waters and some observations on their evolutionary cycle.

Michel Polonovski, Gaston Bizard and Henr Warenbourg: The action of insulin on the muscular glycogenolysis in the dog.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 1, 1937)

L. Godeaux: Some algebraic hyperspatial surfaces.

T. De Donder and Miss Y. Dupont: New theor of the dynamics of continuous systems (4). Application to elastic bodies.

H. Schots: The square of squares. To form magic square for which all lines, diagonal and ortho gonal, are bimagical, requires 64² elements.

E. Anglade: Certain Laplacian sequences assoc ated with a ruled surface.

R. Godeau: Asymptotic lines and the equatio of Lagrange.

S. De Backer: Viscous fluids and propagab waves.

J. P. Bosquet: Propagation of acoustical energ in perfect fluids.

Geneva

Society of Physics and Natural History of Geneva, February 4.

E. **Briner** and E. **Perrottet**: A method of analysis of very dilute ozone based on the catalytic action exercised by this gas in the oxidation of aldehydes. The method has the advantage that its sensibility increases with the dilution of the ozone.

Aug. **Lombard**: A new sheet of lower Cretaceous at Voirons (Préalpes externes, Haute-Savoie). The author describes a layer of fossiliferous limestones of Hauterivian-Barremian age situated in the Lucinge region at Voirons. This layer is connected with the lower series of sheets of the same age and of the same known facies at Hivernages, connected with the sheet of the external Préalpes. It helps to fix more exactly the limit of the autochthonous molasse of the ultra-Helvetic series drifted in the neighbourhood of Lucinge

Arn. **Pictet** and Melle A. **Ferrero**: A new factor for the agouti coat dissociated in the segregation of an interspecific crossing of guinea pigs. The authors have studied the genetics of the difference of coloration of the coat in a cross between the domestic and wild guinea pig. As the result of crossing, these two species can acquire new types of coat, previously non-existent in them. Moreover, when the same factor exists in the two species, its intensity increases in the descendants.

Arn. **Pictet**: The localization of the factors of heredity in ventral and dorsal areas. The author, after observing a mutation evident in the result of a crossing of wild and domestic albino guinea pigs, has been able to prove that the albino possesses in the latent state all the coloration factors and that it carries the same independent areas of variegation as the non-albinos studied. Hence the albino is a mosaic of dominant variegated areas invisible to the eye and albino areas.

Rome

Royal National Academy of the Lincei (*Atti*, 24, 3–43; 1936).

M. de **Franchis**: Proof of the fundamental theorem on hyper-elliptical surfaces.

G. **Marletta**: Property of the second angle of Green.

B. **Caldonazzo**: Ballast effects due to a couple of sources.

G. **Arrighi**: Oscillations about configurations which have motions of pure permanent rotation.

M. **Airoldi**: *Pelagosite* as a member of a new genus of calcareous alga.

V. **Bambacioni-Mezzetti** and A. **Suardi**: First observations on the importance of cotyledons for the new formation of roots on hypocotyls of *Lupinus albus* L. and of *Vicia villosa* (Roth.).

G. **Goidànich**: Causes of the so-called vernal defoliation of the poplar in northern Italy.

G. **Dragone-Testi**: Germination of the embryos of maize detached from the caryopsis and deprived of the scutellum in presence of polyoses containing fructo-furanose.

H. **Bytinski-Salz**: Development of the tail in Amphibia (1). Experiments on isolation and defects.

E. **Platania**: Nature of the peritrophic membrane f *Reticulitermes lucifugus* Rossi.

(*Atti*, 24, 45–97; 1936).

G. **Rovereto**: Panoramic analysis in the geomorphical description of Liguria.

U. **Cassina**: New graphical construction of the osculatory plane.

G. **Palozzi**: Projective-differential geometry of new lattices of ordinary space.

G. **Bernardini** and D. **Bocciarelli**: Energy and intensity of groups of neutrons emitted by Po + Be (1).

G. **Charrier** and E. **Ghighi**: Oxidation decomposition of 4-phenyl-1, 9-benzanthrone-10 with (1) a solution of chromic anhydride in acetic acid and (2) an alkaline solution of potassium permanganate.

E. **Ghighi**: Decomposition of isodibenzanthrone (isoviolanthrone) by oxidation with an alkaline solution of potassium permanganate.

H. **Bytinski-Salz**: Development of the tail in Amphibia (2). Changes of the correlations between the regions constituting the tail rudiment and the behaviour of the ectoderm of the caudal fin.

V. **Famiani**: Content of vitamin B_1 in grain compared with the international standard for the same vitamin.

A. **Salvatori**: Chlorine content of the albino rat in relation to age.

Vienna

Academy of Sciences, January 28

I. W. **Breitenbach** and H. **Rudorfer**: Heat of polymerization of styrol in solution.

Hans Strouhal: Zoological expedition to the Ionic Isles and the Peloponnesus (18). *Isopoda terrestria*: Armadillidiidæ, Armadillidæ.

Hermann Eichler: (1) New laws of colour indicators. (2) Catalytic synthesis of resazurin.

Werner v. **Koppenfels**: Hypergeometric integral as a period of the quadrilateral representation.

Franz Bukatsch: Influence of the thermal waters of Bad-Gastein on the assimilation of carbon dioxide by different water plants.

February 18.

Erwin Kamptner: Inactive spores of marine coccolites.

Alfred Leimdorfer: Experimental study of the central regulation of the sugar in the blood.

M. **Pestemer** and T. **Langer**: Ultra-violet absorption of binary mixtures of liquids (10). The system benzene-heptane.

Z. **Herrmann** and Ch. **Slonim**: Constituents of the Leclanché cell.

W. J. **Muller** and **Janet Zaph Briggs**: Theory of passivity (31). Passivity of chromium.

W. J. **Muller**: Theory of corrosion (7). Relation between electrode potential, corrosion and corrosion passivity of metals in aqueous solution.

Franz Werner: Data of fourth zoological expedition in the Ægean Archipelago.

Viktor Pietschmann: New local form of *Cobitis tænia* L. (Cyprinoidea), *Cobitis tænia tesselatus*.

Anton Skrabal and **Adolf Berger**: Determination of the dissociation constant of hypochlorous acid by a kinetic method.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, May 18

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. E. S. Russell: "The History of Physiology: Ancient Biological Conceptions".*

GRESHAM COLLEGE, BASINGHALL ST., LONDON, E.C.2., at 6.—A. R. Hinks, F.R.S.: "Studies of the Solar System" (succeeding lectures on May 19, 20 and 21).*

Thursday, May 20

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Charles Singer: "The History of Physiology: The Emergence of Modern Physiological Doctrines to the End of the 18th Century, with Special Reference to the Growth of Views on the Circulation of the Blood" (succeeding lecture on May 21).*

CHEMICAL SOCIETY, at 8.—Discussion on "Synthesis and Stereochemistry of Condensed Alicyclic Systems" to be opened by Dr. R. P. Linstead.

Friday, May 21

BEDSON CLUB, ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Sir John Russell, F.R.S.: "Chemistry in Modern Food Production".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

TWO EXAMINERS in the Aeronautical Inspection Directorate (Metallic Materials Section, Micrographic Sub-Section)—The Secretary (S.2.d), Air Ministry, Adastral House, Kingsway, W.C.2 (May 17)

ASSISTANT AGRICULTURAL CHEMIST in the Kirton Agricultural Institute and Experimental Station, near Boston, Lincs.—The Principal (May 24).

ASSISTANT LECTURER IN MATHEMATICS in the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton (May 26)

LECTURER IN ENGINEERING in the Plymouth and Devonport Technical College—The Secretary for Education, Cobourg Street, Plymouth (May 29).

LECTURER IN MECHANICAL ENGINEERING in the Rutherford Technical College—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne, 2 (May 29).

ASSISTANT LECTURER IN CHEMISTRY (and Botany or Zoology or Physics) in the Studley Horticultural and Agricultural College for Women—The Secretary (June 7).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Battersea Polytechnic, London, S.W.11—The Principal.

Official Publications Received

Great Britain and Ireland

Association of Special Libraries and Information Bureaux. Classified List of Annuals and Year Books. Supplementary to the ASLIB Book-List. Pp. 16. (London: Association of Special Libraries and Information Bureaux.) 3*s*. 6*d*. [164

Business Man's Guide to Management, 1937. 5th Annual edition By G. E Milward. Pp xiv+120. (London. Management Library.) 5*s*. [164

The National Physical Laboratory. Report for the Year 1936. Pp. iv+144 (London. H M Stationery Office.) 2*s* 6*d*. net. [194

Reports of the Council and Auditors of the Zoological Society of London for the Year 1936, prepared for the Annual General Meeting to be held on Thursday, April 29th, 1937. Pp. 79+4 plates (London Zoological Society of London) [194

Manuring for Profitable Production: a Handbook for Farmers and Students By Frank Ewart Corrie Pp. 24. (London British Glues and Chemicals, Ltd) [194

First Report of the Alloy Steels Research Committee · Discussion· Correspondence and Committee's Reply. (Special Report No. 14a · Supplement to Special Report No. 14.) Pp. ii+25+1 plate. Second Report of the Steel Castings Research Committee Discussion, Correspondence and Committee's Reply. (Special Report No 15a. Supplement to Special Report No. 15) Pp. ii+36. Seventh Report on the Heterogeneity of Steel Ingots. (Special Report No. 16.) Pp. viii+238+85 plates. The Work of the Coke Research Committees of the Iron and Steel Industrial Research Council. By E O. Evans and J. M. Ridgion. (Special Report No. 17.) Pp. vi+62. (London. Iron and Steel Institute.) [194

The Zoological Society of Scotland. Popular Official Guide to the Scottish Zoological Park. By T H. Gillespie. Eleventh edition. Pp 120. (Edinburgh: Zoological Society of Scotland.) [234

Imperial Bureau of Plant Genetics (for Crops other than Herbage). An Outline of Cytological Technique for Plant Breeders. Pp 16. (Cambridge. School of Agriculture.) 1*s*. 6*d* [234

Milk and Nutrition: New Experiments reported to the Milk Nutrition Committee Part 1: The Effect of Commercial Pasteurisation on the Nutritive Value of Milk, as determined by Laboratory Experiment. Pp 67. (Reading National Institute for Research in Dairying) 2*s* 6*d* net [264

Ministry of Labour. Report for the Year 1936. (Cmd 5431.) Pp. vii+141. (London: H M. Stationery Office) 2*s* 6*d* net. [274

Other Countries

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Health and Safety of Industrial Workers

THE centenary of the Factory Act in 1935 led to a good deal of attention being directed to the inadequacy of the Factory and Workshops Act, 1901, which is largely obsolete, and the need for a new Act for the regulation of industry in Great Britain has been widely admitted during the last fifteen years both inside and outside Parliament. More than once, indeed, bills have been introduced; only to be laid on one side in favour of other matters said to be more pressing.

If, however, a new factory act is essential from the point of view of industry, it is, as a recent broadsheet entitled "Industry and Health" recently issued by Political and Economic Planning (P.E.P.) emphasizes, from the point of view of health and safety in industry that it derives its greatest importance, and additional interest is attached to the new Factory Bill in view of the present concern for the physical condition of the nation. Physical culture may be invaluable as a means of maintaining or improving health. It cannot be a remedy for injuries to health which are inflicted by such conditions as bad housing, overcrowding, malnutrition or unhealthy and dangerous conditions of work. The attempt to improve the physical condition of the people means, accordingly, not merely a campaign for physical education, but also a determined and simultaneous attack on all factors undermining the health of the community whether at work or at home.

It has to be recognized in the first place that although, during the nineteenth century, broadly speaking, Great Britain led the world in imposing the observance of minimum standards of safety, health, hours and conditions of employment in factories and workshops, during the twentieth century we have permitted the country to lag behind in these vital matters. Several industrial nations in Europe and in America have surpassed us in the solicitude they show towards their workers. Accordingly, the new Bill cannot be considered only in terms of the improvements it introduces. We must also have regard to the extent to which it remedies the relatively backward state into which our labour code has fallen during the last two or three decades.

Acts of Parliament, moreover, though invaluable for establishing effective minimum standards, and for rounding up laggards, have their limitations as methods of promoting reform. It is impracticable to enforce at any time standards substantially higher than those which the majority of firms adopt or are ready to adopt. The minimum standards prescribed by law may in fact be, and often are, far below those adopted by the more progressive and enlightened industrial units: and the spread of more enlightened methods must to a large extent precede the prohibition of those that are considered unsatisfactory.

It is this fact which makes such legislation of special interest to the scientific worker. While the improvements which the Bill will effect in working conditions will depend largely on the administration, owing to the wide powers given to the Secretary of State in limiting, extending or modifying its provisions, vigilance will be demanded both during and after the passage of the measure to ensure that its intentions are implemented. A large share of responsibility for this vigilance must rest upon scientific workers. Only if they are prepared to make their contribution can we expect the full effect of the new Bill to be realized —securing a genuine advance in the conditions of health and safety not merely within industry but also indirectly in the health of the nation as a whole.

The significance of the contribution of the scientific worker will be best appreciated if we recall first the immense superiority of labour conditions among the progressive firms over the majority, not merely the most backward; a superiority which is largely to be attributed to the more scientific outlook on the part of the managerial staff in such firms. It is further illustrated by the enormously greater incidence of industrial accidents among smaller firms where adequate scientific and technical supervision is lacking, as is shown by the annual reports of H.M. Chief Inspectors of Factories. In fact, the safety provisions of the new Bill are probably its best feature, but their efficacy will largely depend as much upon effective technical supervision and control within industry itself, particularly in the smaller firms, as upon an extension of the factory inspectorate commensurate with its greater responsibilities.

This question of health and safety in industry does not derive its whole interest from the new Factory Bill. The revival of heavy industry, and the re-employment of men who through their unemployment have lost some of their dexterity, make it probable that accident rates will rise even higher than they did last year. The tendency of armament firms under Government pressure to work night shifts and overtime will increase the danger. Moreover, the cost to industry of ill-health, whether due to unsatisfactory conditions such as long hours or poor lighting, or to the nature of the process, is already so high that little further stimulus to improvement should indeed be necessary. It was estimated by the Home Office that in 1934 industry spent nearly £11,000,000 in providing for its liabilities under the Workmen's Compensation Acts. The total number of working weeks lost annually by employees covered by National Health Insurance is estimated at thirty millions, equivalent to an entire year's work of some 600,000 persons. Moreover, any attempt to assess the burden of ill-health to industry must also allow for the losses from labour turnover through unhealthy conditions from inefficiency, due to the same cause among those actually at work.

The vital problem at the moment in industrial health is labour conditions, especially hours of work, the length of which is only restricted by law in four industries, the most important being coal-mining and road transport. In these respects, the Bill falls lamentably short of the recommendations of the report of the Departmental Committee on the Hours of Employment of Young Persons. That this position should be arising eighteen years after the work of the Health of Munition Workers Committee had demonstrated its detrimental effect on industrial output and efficiency indicates an astonishing lack of wise and scientific management. Moreover, it must be remembered that the existence of this position makes it much more difficult for the more enlightened firms to persist in their efforts to shorten the working week and to eliminate overtime. In addition, there is no adequate mechanism for ensuring that the results of research carried out by such bodies as the Industrial Health Research Board are considered and implemented.

When all due allowance is made for the natural time-lag between such research and its application in the improvement of factory conditions in respect of lighting, ventilation, humidity and air conditioning generally, there can be no doubt that the gap is excessive and very seriously detrimental to both industrial efficiency and the health of the workers. The minimum conditions laid down by the 1901 Act are antiquated and sometimes deficient, and although definite standards for different factories have sometimes been worked out, they are only enforced when the Secretary of State is satisfied that any trade is dangerous or unhealthy and where he can therefore issue special orders under the statute. The new Bill does include a clause providing that "sufficient and suitable lighting, whether natural or artificial" shall be maintained in every part of the factory. The new Bill also raises the standard of overcrowding from 250 cubic feet of space per worker to 400 cubic feet and contains general provisions regarding temperature and ventilation, although any standards are to be enforced by legislation. Specific provisions for the removal of dust and for the control of underground workrooms are included. Similarly under welfare there are general provisions regarding first-aid boxes, drinking water, and, in factories employing females, seats must be provided. Provision of washing facilities, rooms for drying clothes, and mess rooms for employees are only compulsory if special orders are made by the Secretary of State.

It is thus evident that the new Bill makes a cautious but definite advance in dealing with the environmental defects and long hours in factories which tend to increase the incidence of diseases occurring in the rest of the community. Unfortunately, the progressive firms which have made a study of environmental conditions still cover only a small percentage of the population.

Similarly, the incidence of industrial accidents is greatest among the smaller firms, despite notable exceptions, and this problem is one that can scarcely be dealt with by legislation alone. Even a very great increase in the inspectorate would be unable by itself to cope with contravention of the law in respect of hours of work of young persons or ensure the strict observance of the new safety provisions. What is needed here is a significant increase in the extent of trained scientific supervision, competent to foresee dangers and to take the necessary precautions in advance and not merely as a sequel to some accident taking toll of life or limb. This is above all a matter for professional associations of scientific workers.

This aspect of the question becomes more important when we consider the relation of the Factory Department to the Home Office, and not to the Ministry of Health, which is concerned with most other medical services of the country. This system has been criticized as anomalous, and obviously close co-operation between the local medical officer of health and the various authorities concerned with the health and conditions of factory workers is extremely desirable. If, however, employees are to be kept in a good state of health, maximum industrial efficiency achieved, and the enormous expense caused by accidents and sickness saved, something much more than the minimum measures enforced by present legislation is required.

The most important need is in fact a considerable expansion of the medical services in industry itself which have already been introduced by a number of firms or industries, sometimes to deal with a particularly industrial hazard or high accident rate. Such services, moreover, are often organized to cover the medical examination of all employees from the point of view of their own health and, as in factories handling food, that of public health generally, and the whole tendency in industry is for this preventive medical service to increase. It is accordingly a disappointing feature of the present Bill that more is not done to make the medical examination of young persons a better protection for them.

It should not be forgotten that the medical services now developing in industry are responsible for an increasing amount of research aimed at the prevention and elimination of industrial hazards. This, of course, is not a matter for the medical officer alone. The chemist, the physicist, the engineer, the works or departmental manager have their own contributions to make, and the problem is one of organizing team work and co-operation in the most effective way. Nor should it be forgotten that questions of professional ethics and responsibility are also involved. The relationship between the general practitioner and the industrial medical officer now being worked out by a subcommittee of the Medico-Political Committee of the British Medical Association is only one aspect of the professional position of the medical officer in industry which equally applies to other types of scientific worker. The clash of loyalties which may quite easily arise is unlikely to be resolved without a definite and accepted ethical code.

The development and improvement of an industrial medical service in fact involves many extremely complex problems, including questions of co-operation between different industrial units. It is believed that unless there is a special occupational hazard, it is uneconomic to employ a full-time medical officer where less than 5,000 persons are employed. Only about one per cent of the industrial population is found in factories of this size, yet smaller factories are confronted with many of the problems which the full-time industrial medical officer has to handle in a large firm. Moreover, there are still firms with high accident rates and specific occupational hazards employing more than 10,000 persons, which have no medical officer on the premises.

The new Factories Bill has accordingly very considerable claims on the interests of scientific workers. Upon their co-operation, both in a technical capacity, and as departmental managers or as members of the inspectorate itself, apart from participation in the considerable volume of research into problems of industrial safety and health still required, the real success of its aims in no small measure depends. Further, the very extent to which they have come to share in the direction and management of industry itself stresses their responsibility for effective and informed criticism of the new Bill, particularly where, as in regard to the provisions relating to the employment of young persons and particularly overtime, it is open to grave abuse and falls lamentably short of standards of enlightened practice of proved desirability.

Malaria in Europe

Malaria in Europe: an Ecological Study. By Dr. L. W. Hackett. (University of London Heath Clark Lectures, 1934, delivered at the London School of Hygiene and Tropical Medicine.) Pp. xvi +336 +22 plates. (London: Oxford University Press, 1937.) 10*s*. 6*d*. net.

IN the Heath Clark Lectures, delivered by the author at the London School of Hygiene and Tropical Medicine in December, 1934, a semi-popular account was given of the most recent developments in malariology. The present volume, published under the terms of the bequest, gives a presentation of material gathered for these lectures. As the author points out, the book is in no sense a text-book on malaria, but a discussion of the newer findings in malaria and the way these are changing our ideas of what endemic malaria is, why it persists, and how it can be attacked. That the title should be "Malaria in Europe" is no surprise to those familiar with recent work on this disease, for there has been no more interesting chapter in the history of malaria research than that which has had to do with the recent unravelling of the malaria problems in Europe.

About ten years ago, the Rockefeller Foundation, in collaboration with the Italian Health Department, founded the Malaria Experimental Station in Rome, where Dr. Hackett and his colleague Prof. Missiroli have done such outstanding work, and soon after, similar centres for field study were created in Greece, Bulgaria and Spain, in all of which activities Dr. Hackett has played a prominent part. The co-operation of Prof. Martini of Hamburg and Prof. Swellengrebel of Amsterdam was obtained for the observation of northern European anophelism and malaria. After preparatory studies, these centres have been engaged in large-scale experiments with every fundamental measure which seems to hold out possibilities of success in combating malaria. As a result of all this work, and of investigations on European malaria by malariologists of many nationalities, there has emerged a very concrete picture of the natural history of malaria in Europe, and of the nature of control measures to be adopted on this continent. Whilst the problems dealt with have been quite special to Europe, it is remarkable that the answers to these problems have had a surprisingly important application to malaria in other parts of the world, and especially to our conceptions of what constitutes a 'carrier species' of anopheles.

The author commences with consideration of the nature of endemic malaria as now understood. The outstanding mystery of endemic malaria in Europe is the way in which it has been steadily disappearing within the last century or more, independently of any conscious effort of man to bring this about. Many reasons have been put forward to explain this, such as better housing, improved economic conditions, and other causes, but it is now realized that this slow recession of malaria from Europe has mainly depended upon causes connected with the natural history of malaria itself. The common European malaria-carrying species, *A. maculipennis*, is not, as formerly thought, a single homogenous species, but consists of some four or five or more sub-species, each of which possesses its own peculiarities in habits and behaviour, peculiarities that, though they might often seem unimportant, have nevertheless in a remarkable manner been responsible for a number of the major epidemiological features of malaria in Europe. An anopheles has the choice perpetually before it of feeding on man or on his cattle. It depends upon the conditions present and the anopheles' own predilections under these conditions how frequently it feeds upon one or the other. A single feed upon man is of no significance, since in order to transmit malaria a second feed must be taken at such time as sporozoites derived from a previous feed have matured. Hence there is a disproportionate effect as regards decrease in transmission if the number of feedings on man is lessened by 'deviation'.

The condition mainly determining the presence of endemic malaria in Europe is agriculture. Primitive agriculture is usually associated with malaria. With rotation of crops, it becomes necessary to maintain cattle to feed on the fodder, and stall-feeding replaces pasture feeding. With 'stabulation', zoophyllic sub-species tend to be deviated, and if these zoophyllic forms alone are present, as is the case over large parts of Europe, malaria disappears, though anopheles are still abundant. This is the explanation also of the 'anophelism without malaria' so constantly seen referred to in the literature on European malaria. To an unknown extent, similar influences must be operating in regard to tropical conditions, and the very numerous species and varieties there occurring.

Much is now being done in various tropical regions on the working out of the habits and relative carrier danger of different species, so-called 'species sanitation' aiming at reducing the more dangerous forms by measures directed against these species through some vulnerable feature in their habits or life-history. In all preventive action the proper "appraisement of the malaria situation" becomes of great importance, and an excellent chapter on this aspect of the case is given. There are chapters also on the part played by the different malaria parasites themselves, and the role of immunity in man in the epidemiology of the disease, also a chapter on treatment in theory and practice, and an extremely interesting section on the strategy of malaria control and various fundamental lines of attack upon the disease.

Very seldom are the facts about disease so pleasantly and easily written about as in this volume, which is quite unique of its kind. Nowhere else will the reader obtain so easily the spirit of modern malaria research in its application to prevention. S. R. C.

The Case for Buchan

Buchan's Days:
a Modern Guide to Weather Wisdom. By E. L. Hawke. Pp. 231. (London: Lovat Dickson and Thompson, Ltd., 1937.) 5*s*. net.

ALEXANDER BUCHAN, secretary of the Scottish Meteorological Society from 1860 until his death in 1907, was esteemed in his lifetime as a worthy man, an able secretary and a tireless investigator. He wrote two excellent books on meteorology, but it is probably true to say that, until a few years ago, his name was almost unknown outside the circle of meteorological devotees. Now, strangely enough, his name is probably the first that would occur to ninety-nine out of a hundred examination candidates who were asked, in a 'general knowledge' paper, to state the name of a distinguished meteorologist, dead or alive.

Buchan's posthumous fame has been acquired as a result of his researches on the irregularities in the annual march of temperature, as revealed by daily averages of temperature at certain Scottish stations. When such daily averages are plotted, it is found that the resulting graph differs very materially from a smooth curve. The temperature does not rise steadily from a minimum in winter to a maximum in summer and then fall steadily again to the winter minimum. On the contrary, a series of humps and hollows is found, indicating that a steady rise or fall is not, on the average, maintained for more than a few days at a time. Buchan satisfied himself that certain of these humps and hollows were due to a tendency for spells of relatively warm or cold weather to recur around definite dates. Buchan's "warm periods" and "cold periods" have thus kept alive the name of the worthy Scottish meteorologist.

Since Buchan's death, there has been much controversy as to whether these "periods" are a real and permanent climatic feature of our area. Participants in the controversy have not always taken the trouble to refer to Buchan's original papers; consequently, much of what has been written is irrelevant to the issue. Mr. E. L. Hawke has done a useful service in giving a fair and clear summary of the original papers. His commentary upon the papers is not very likely, however, to win over many adherents to what we may call the 'Buchan doctrine'. He directs our attention to the resounding "successes" scored, for example, in the famous frosts of February 1917 and February 1929, and to the support given in certain cases by the Greenwich daily averages. But that sort of evidence does not really get us any further. Everyone knows that our weather tends to occur in 'spells'. The essence of the Buchan doctrine is that cold spells and warm spells tend to occur around certain specified dates rather than on other dates. Well then, let us take the best temperature record we can get, start with January 1 and see how often the temperature on that date has been, say, ten degrees or more above normal, and how often it has been ten degrees or more below normal (the 'normal' being the value indicated by an idealized smooth curve drawn through the monthly means). Do this for every day of the year. The job will take some time, but we shall be rewarded in the end with a set of figures from which we can say with reasonable certainty whether or no there is any special tendency towards abnormality during Buchan's periods or during any other periods. The adherents of Buchan seem strangely reluctant to use this very simple and obvious method of establishing their case.

Part 1 of Mr. Hawke's book is devoted to Buchan, with a very interesting, but not very relevant, chapter on "Weather Lore". Part 2, entitled "Round the Year", contains a series of chapters on the general climatic features of the months and seasons. These chapters are very good of their kind, and contain much curious information such as: "on May 18, 1891, a heavy drifting snowstorm over many hundreds of square miles in England gave holiday-makers the only recorded opportunity for tobogganing on Whit Monday". E. G. B.

The Medical Officer of Health in Present-day Germany

Der Amtsarzt:
ein Nachschlagewerk für Medizinal- und Verwaltungsbeamte. Bearbeitet von Dr. A. Gütt, Dr. L. Conti, Dr. W. Klein, Dr. O. Schwéers, Dr. Th Sütterlin Prof. Dr. R. Thiele, Prof. Dr. F. Wiethold. Pp. xx+767. 22 gold marks. Deckblätter zu der Amtsarzt. Erste Folge. Abgeschlossen am 1.8.1936. Pp. 35. 3 gold marks. (Jena: Gustav Fischer, 1936.)

THIS book, intended as a work of reference for the use of medical officers of health and officials working in administrative capacities related to medicine in present-day Germany, is of a character entirely different from the usual medical text-book or work of reference. Although it represents a source of information on public health, hygiene, medical jurisprudence, social and State medicine and their legal aspects in particular, there can be little doubt that it is intended to convey instruction conforming to the National Socialist point of view. In this way a definite attempt is made to imbue medical activity with unilateral political ideas and force party views upon it. There are several articles exclusively devoted to political and party matters; this is not in any way concealed and cannot therefore be left out of account. There are, of course, chapters on subjects such as bacteriology, chemistry, pharmacology, pathology, psychiatry, etc., in conformity with universal scientific opinion. It need scarcely be mentioned also that in a country where social services have long been so widespread, these have been continued, varied and in some cases added to under the new regime.

The National Socialist party, through its State organs, controls every activity connected with the subject of public health, commencing with medical students and including nurses, masseurs, disinfectors, social workers, etc., by State examinations. Admission to the universities, hospitals and training schools is dependent on the so-called 'Aryan' descent, nationalist reliability and sometimes even party information. Lay treatment is permitted, except for ailments of the sexual organs and vaccination. Lay practitioners must not be called 'quacks' if they are members of the union of lay practitioners in Munich. The same snatching at popularity is shown in the endeavour to raise the standard of the midwives at the expense of the medical practitioners. A midwife is allowed to deliver even breech cases or the adherent placenta without calling in a medical man; in certain districts she is not only permitted but bound to carry out, when required, internal version of the fœtus. The two latter occurrences have to be notified to the medical officer of health. "The demand to transfer more or less all maternity cases to maternity homes is not justifiable from the point of view of social hygiene as the results of cases delivered at home are at least not bad. Moreover, the participation of the whole family in the trying hours of entrance into motherhood strengthens family feeling and family ties so much that it must on no account be forgone"

The infant welfare movement is blamed for "having in some places overstepped the limits prescribed for social welfare work and thus acting, if not rightly supervised, against natural selection". The most important and promising suggestion of the writer of this chapter is to divert child welfare endeavours from the prevention of death amongst infants, at present the predominant activity, towards creating new life by greater fertility and by fighting against a decreasing birth-rate. In another place (marriage laws) it is pointed out that diminution of unemployment cannot be expected by a married couple of which one partner is incapable of procreation. Their marriage is therefore against the interest of the community, because children, as they are only consumers and not competitors in the labour market, play a special part in political economy.

It is impossible to discuss in detail the regulations on health certificates for couples intending to marry or those dealing with the possible prohibition of marriage; or to deal with the advisory centres on questions of heredity, race and marriage. The laws for prevention of an offspring likely to be tainted with a hereditary disease are too detailed for discussion here, but we may note that compulsory sterilization is provided for this purpose, and also interruption of pregnancy up to the end of the sixth month is permitted by law. Compulsory castration can, and in the commentator's opinion, "has to be carried out unhampered by liberalistic sentimentality" in the case of second offences of most sexual crimes including homosexuality, for which the offender is sent to prison for a term of at least six months. Voluntary castration is permitted to those who without a previous trial or conviction profess to feel a propensity for one of the above-named vices. The medical officer of health has to decide whether "further lapses are to be feared".

As in the chapter on infant welfare, no mention is made of the fact that morbidity and physical weakness are not infrequently due to an avoidable or remediable neglect of acute conditions, only of a temporary nature and easily overcome in a few years. On the subject of procreation and marriage, heredity and race, the same pessimistic and fatalistic crudity is displayed. Almost every physical, mental, psychic quality of man seems to be inherited and unalterable, practically none produced or aggravated by economic, environmental or other conditions of life. No notice is taken of the fact that not a few manifestations of neurotic persons mentioned in the list of indications for the most cruel interferences with their lives are not hereditary and are curable, or at least improvable to such an extent as to make the disability from which they are suffering negligible to the community.

The chapters dealing with eugenics, racial hygiene and measures tending to the "gradual purification and improvement of the hereditary stream of our people" abandon in many respects the scientific basis of causation and replace it by the nebulous mysticism of the Nazi creed and empty catchwords. The profession of medicine, which is justly proud of, and continually aims at, scientific fundamentals and independent objectivity, is thus degraded to a state of servitude to the views of the prevailing political party, in which the medical officer of health is the expert party representative.

The addenda are in conformity with the general trend of the book. X. Y. Z.

Agricultural Chemistry

A Practical Course in Agricultural Chemistry: for Senior Students of Agriculture, Dairying, Horticulture and Poultry Husbandry. By Frank Knowles and Dr. J. Elphin Watkin. Pp. ix+188. (London: Macmillan and Co., Ltd., 1937.) 10*s*. net.

FORMERLY agricultural chemistry was one of three main subjects in courses on agriculture, but to-day increasing specialization inside the industry itself has been accompanied by a multiplication in the courses available in the university departments and colleges engaged in agricultural education. A student may present himself for a course in horticulture, or dairying, or poultry-keeping, or in agriculture; he may be an intending producer, technician, adviser, teacher, or specialist; but in any event a goodly proportion of his time will be spent on agricultural chemistry. For most students, the materials and vital processes concerned are the same, but the emphasis on them varies according to the type of specialization desired or the nature of the qualification sought.

The authors have had this diverse field in mind, in their effort to provide what has hitherto been lacking, a laboratory text-book which would adequately serve all types of senior student. So far as methods of estimation are concerned the result is to be commended, but while laboratory estimations are a valuable help to a student, they are less effective if unaccompanied by, or based on, qualitative work, an aspect which seems to have been lost sight of in some chapters. On this account, and because of the impracticability of elaborate technique in ordinary classes, the book may prove less helpful to beginners than to advanced students.

In the field, soil is studied as a natural object, but in the laboratory it becomes and is treated as a dead material. Before it is 'prepared' for analysis, however, much can be learned by close examination, by hand and eye. The main constituents of soil are worth similar attention, but the chapter on soils neglects this aspect of the subject. The order of presentation of the determinations seems to lack purpose, such as is obvious where mechanical analysis leads up to physical properties, and chemical analysis is followed by base status and availability of nutrients.

In the chapter on fertilizers, a few exercises are introduced to illustrate manufacturing processes; but the need of the student to grasp their simple physical and chemical properties is ignored. It is to be regretted that farmyard manure is considered mainly on an N.P.K. basis.

By contrast, the chapter on biochemistry is based on qualitative work, and the whole field of materials—except flesh—is explored by informative exercises in isolating the chief constituents. The methods of analysis for feeding stuffs include some associated with special features of individual commodities, but this section is not set out in such a way as to strengthen the student's knowledge of feeding stuffs as a whole, as distinct from his ability to analyse them. The excellent chapter on dairy products includes material which has not hitherto appeared in a student's text-book.

The section on water analysis contains methods of estimation alone, but that on insecticides and fungicides, an innovation in this class of book, contains in addition informative exercises on their composition and important properties.

The book as a whole is compact, comprehensive, and clearly written, and should be found of use to all classes of agricultural students. H. H. N.

The Physics and Chemistry of Paintings

Three Lectures given before the Royal Society of Arts, March 1937. By F. Ian G. Rawlins. Pp. 52. (London: Royal Society of Arts, 1937.) 2*s*. 6*d*.

THESE three lectures by Mr. F. Ian G. Rawlins are not only of the greatest interest to those who have specialized on the materials and methods used in painting pictures in the past, but are also epoch-making in that they mark a departure in the whole conception of their duties on the part of those responsible for the preservation of the priceless works of art contained in our public galleries.

The first realization of the part to be played in the systematic scientific examination of works of art we owe to Prof. Forbes, of the Fogg Museum, Harvard University, who opened a laboratory for the study of these questions. This was followed by the creation of a scientific department in the Louvre, and the establishment of laboratories in the British Museum under the able guidance of Dr. A. Scott, and to-day we have the laboratories at the Courtauld Institute under Mr. Daniel Thompson, and the appointment of Mr. Rawlins on the staff of the National Gallery.

In the opening lecture, Mr. Rawlins discussed the general problems and the physical and chemical properties of the materials out of which a picture is built up. In the second lecture he discussed the 'diseases' of pictures, and the experiments undertaken at the National Gallery for the systematic collection and examination of dust, and the microscopic examination of the surface of pictures through the Ultropak microscope fitted with crossed nicols to exclude reflection, and the uses of ultra-violet light in examining pictures. The concluding lecture was devoted principally to the use of X-rays, the description of the special apparatus at the National Gallery and the methods used to systematize and control results. He also described a very interesting new feature, the use of the Lovibond tintometer to measure the colour values of the surface of pictures and record the results of cleaning.

Mr. Rawlins touched on so many problems in the course of his lectures and suggested so many possible lines of inquiry that it is impossible to deal with them in a short notice, but he may be congratulated on having given a series of lectures which will be much appreciated by all students of this subject and form a valuable contribution to our knowledge.

A. P. LAURIE.

Einfuhrung in die Elektrizitätslehre

Von Prof. Dr. R. W. Pohl. Vierte, grossenteils neu verfasste Auflage. Pp. viii+268. (Berlin: Julius Springer, 1935.) 13.80 gold marks.

THE first German edition and the English translation of the second German edition of this book have already been noticed in this journal. The present fourth German edition, much of which has been entirely rewritten and brought up to date, will certainly not fail to have the same appeal as its predecessors.

The book makes interesting reading on account of its original method of presentation. The author starts at once with crude conceptions of 'volt' and 'ampere' in the same way as text-books on mechanics start with 'kilograms' and 'seconds'. Well selected experiments—nearly every one of which is illustrated—serve to refine gradually these conceptions. Thus the modern theory of electricity and magnetism is developed in a clear-cut way. A presentation of this type forms not only a good introduction, but also it certainly helps to clarify the ideas of students who have approached the same subject on more conservative lines.

In the new edition the addition of two very clear chapters on "Matter in the Electric Field" and "Matter in the Magnetic Field" have to be specially welcomed. To avoid enlargement of the book the author has shortened the text in some other places, not, however, always to the best advantage. These shortcomings—they are very few indeed—will not trouble the type of reader who will consult the book in Great Britain, and if we are provided with a new English translation they may be easily remedied.

A. B.

Biology in the School

By H. Alan Peacock. Pp. xvi+354. (London: William Heinemann, Ltd., 1937.) 10*s*. 6*d*. net.

AMONG the ever-growing list of books on the teaching of the biological sciences, the present work will find an honourable place. It is the result of many years of experience on the part of a public school science master. The book is intended as a volume of reference, and as such it is admirable. The spirit is eclectic, and Mr. Peacock suggests many lines along which secondary school work in biology may be undertaken and he avoids the pitfall of the rigid syllabus and method of treatment. "The ideal syllabus has not been constructed and when it has been, much of the infinite joy of learning and of teaching biology will have gone. Biology should be introduced into schools not only because of a practical value equal to, or greater than, that of the other sciences, but also because of its cultural value and the national necessity of thinking biologically."

All the book is useful, but particularly valuable are the sections on the library and the comprehensive book list both for scholars and teachers. The many external and human factors governing a choice of syllabus are dealt with admirably and there are numerous hints on the special technique of teaching the biological sciences—a technique which is still being developed. The foreword has been written by Sir John Russell.

W. L. S.

Science fights Death

By D. Stark Murray. (Changing World Library.) Pp. x+149. (London: Watts and Co., 1936.) 2*s*. 6*d*. net.

THIS book tells briefly and simply what medicine is doing to advance our knowledge of disease. It deals with macroscopic parasites, with bacteria and with viruses, with hormones, industrial diseases, cancer and anæmia. It can be recommended to the layman as a trustworthy and readable sketch.

Recent Crystallography*

By Sir William Bragg, O.M., K.B.E., P.R.S.

BENEATH the immense variety of Nature's structures lie certain remarkable simplicities. Thus the elements used in the building are surprisingly few in number. There are but ninety-two in all, of which only a few are of common occurrence, and many are used very sparingly. Indeed there are one or two of which it can only be said that they should exist, though as yet they have not been found. Oxygen constitutes half of the known world, half the remainder is silicon; aluminium comes next. In living things carbon is one of the most important elements, yet it constitutes only a fraction of one per cent of the world as a whole.

It is becoming clear that Nature is most economical in her designs also. This very remarkable phenomenon is especially evident in the structures of living matter. The proteins which play such a predominant part in the animal are all based upon a certain fundamental pattern, and so is the cellulose which plays a corresponding part in plant-life. The recent discoveries of the biochemists have revealed the existence of several classes of substances, as for example the sterols, which though minute in amount have a powerful effect on life and health. In each class a basic pattern is common to all, and the rich variety is derived from a common theme.

There is a further simplicity in the regularity of arrangement of the atoms and molecules in all substances, or at least in the effort to achieve regularity. It is naturally most in evidence in the solid body. When the solid forms from the melt, or assembles out of solution, or grows from deposited vapour, the atoms and molecules of which it is made settle themselves in orderly array. The process is often sensitive to disturbance of the surrounding conditions, but if it is allowed to go on as it begins, it ends in the production of a visible crystal. The constancy of the angles which the faces of a crystal make with one another is evidence of the regular repetition in space of some fundamental collection which is the unit of pattern of the whole. Crystallographers have long surmised that the crystal is the consequence of such a construction.

The X-ray methods of analysis have made it possible to observe and measure these regular details of the assembly. The methods have often been described; it is sufficient to say now that they depend on the reactions between the fine and regular succession of the X-ray waves and the fine regularity of the crystalline arrangement, the two degrees of fineness being fortunately of the same order. The study of crystalline matter with the help of X-rays is one of the most powerful methods of investigating natural structures. It has contributed materially to the realization of the fundamental simplicities in the choice of design.

When the X-ray methods were introduced, they were first applied to the determination of the simpler crystalline structures—rock salt, diamond and the like. Since then the improvements in technique and in theory have been so great that complicated structures have been completely worked out, such as for example the silicates and some of the less complex organic crystals; and it has been possible to go some way in the examination of the complicated and large molecules which are found in living organisms, such as the proteins to which reference has already been made.

The first of the proteins to be examined in detail was 'keratin', the important constituent of wool, hair and horn. It is a remarkable illustration of the persistent occurrence of regularity in the structures of Nature, and at the same time of the power of X-rays to discover it, that crystalline structure should have been proved to be an important feature of substances which are ordinarily supposed to be anything but crystalline.

The fundamental feature of keratin is the constant repetition in a zigzag line of the atoms carbon, carbon, nitrogen in long succession. The same repetition is found in all the proteins. These atoms carry certain attachments, some of them invariable, others not. In the protein chain when extended to its full length, each nitrogen carries a hydrogen atom, and one of the two carbons in each unit carries an oxygen to which it is joined by a double bond. The other carbon carries a hydrogen, and is also attached by a single bond to one end of a secondary or side chain, which varies from protein to protein, and generally from portion to portion of the same protein. In the accompanying diagram (Fig. 1), taken from Astbury's "Fundamentals of Fibre Structure", the side chains are denoted by R, R, . . . The difference between one protein and another, so far as constitution is concerned, is due to differences in the nature of the side chains.

By X-ray measurements it has been possible to determine the length of the repeat in various forms of keratin, and to show its constancy, and its agreement with the suggested structure and with the values of interatomic distances as found in other organic crystals.

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* Friday evening discourse delivered at the Royal Institution on January 29.

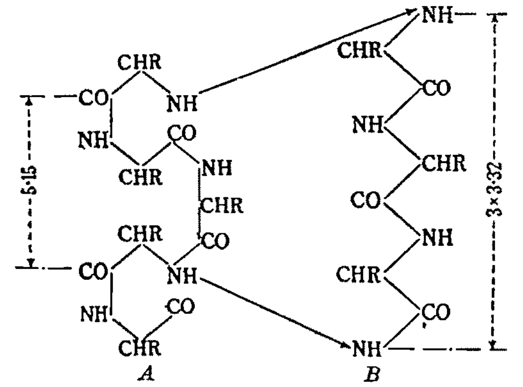

Fig. 1.

A. A keratin chain partly coiled up. Notice the approximation at certain points of the NH and the CO. *B*. The extended keratin chain. (Astbury.)

Svedberg showed in 1929 that by means of the greatly accelerated settling of a suspension subjected to centrifugal force, it was possible to estimate the weights of various proteins. He found that nearly all those which he examined had a molecular weight of about 35,000, or a simple multiple of this number. In blood he found certain others of still greater molecular weights, to be counted in millions. The constitution of all proteins is about the same, that is to say, carbon 50–55 per cent, hydrogen about 7 per cent, nitrogen 15–19 per cent, oxygen 19–24 per cent, with traces of sulphur, phosphorus and metals. In keratin the sulphur content may amount to 2 or 3 per cent.

Proteins are assembled in the course of plant life. Animals require proteins for their nourishment, but do not themselves manufacture them to any considerable extent. They must therefore eat plants, or eat animals that eat plants. Emil Fischer showed, at the beginning of this century, that the assemblage of a protein was accomplished by the successive linking of amino-acids into a long chain, water molecules being shed in the process. The amino-acids are long-chain molecules, at one end of which (and sometimes at both ends) are found the basic group NH_2 and the acid group COOH. The linkage is effected by the interaction of the basic group of one amino-acid with the acid group of the next as illustrated in Fig. 2.

It is an accepted hypothesis that two parts of a molecule, separated from each other by a single bond, can be rotated with respect to each other about that bond. The long chain illustrated in Fig. 1*B* can therefore be crumpled up into less extended forms by successive rotations about its bonds. Astbury supposes that the keratin chains of a wool fibre in its unstretched state are shortened into the form of Fig. 1*A*. It is interesting to observe that a nitrogen is now brought near a carbon which is five links away along the chain (Fig. 1*B*). Frank has pointed out that a junction must be effected here between the N and the C; the H belonging to the N passes over to the C=O group, converting it into C—O—H. Groups of hexagonal rings are thus formed.

The side chains of one long-chain molecule can interact with the side chains of another, and it is in this way that the long molecules are tied together into a firm substance like hair or horn. When the chain is coiled up, these side chain attractions are more and more satisfied by interactions in the molecule itself. It is possible that in this way, as has been particularly emphasized by Wrinch[1], something like a ball is formed, which has relatively little attraction for other similar balls. Such may be the case in the white of an egg in its natural state; boiling the egg breaks up the balls, and the uncoiling chains link together, forming the solid mass of the white in a boiled egg. The substance is said to be 'denatured'.

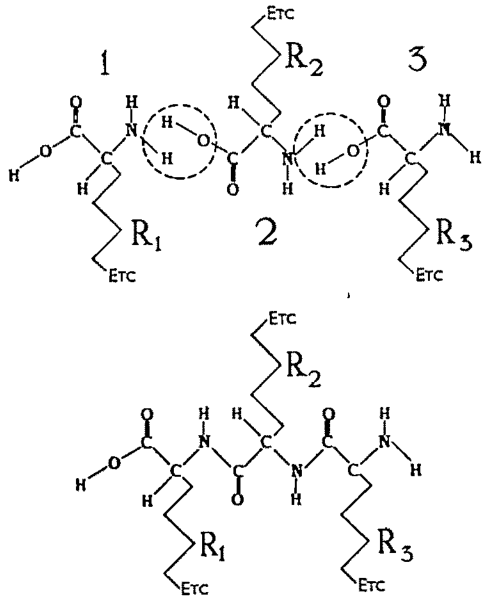

Fig. 2.

In the upper portion of this figure three amino-acid molecules are drawn side by side, as if they were ready to be linked together. In the lower portion the junctions have been made: with the shedding of water molecules formed by the combinations of the atoms within the circles of the upper portion. The side chains R may vary in form. If they are, alternately, a single hydrogen atom and a methyl group (CH_3), the particular protein is the constituent of natural silk.

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[1] Nature, 137, 411 (1936).

(*To be continued.*)

Wood-pulp and the Future

IT is safe to state that during no similar period since the first commercial production of wood-pulp in the middle of the last century has our knowledge of the subject advanced so rapidly as during the past three years. A number of entirely different influences have contributed to this activity. In the first place, one of the benefits associated with slump conditions is the time (and in the case of far-seeing concerns, the stimulation) it provides for research work; and secondly, there has been an increasing demand for rags for paper-making, which has resulted in a shortage, and consequently, rising prices in this market. To this may be added the growing use of certain classes of wood-pulp for rayon manufacture, the present position being that this industry now absorbs ten per cent of the world production of wood-pulp; in some quarters there is even a scare of a shortage of pulp for paper-making in the future.

These various influences are all apparent in the advances referred to. Prolonged research has for example resulted in the production of 'alpha-pulps', so named because they contain a high proportion (90–98 per cent) of α-cellulose; this is the name given to the constituent which is insoluble in a 17·5 per cent solution of sodium hydroxide at 20° C. under specified conditions. The method of production is usually a modified sulphite 'cook', followed by chlorination, extraction with alkali and careful washing.

In comparison with ordinary wood-pulps, alpha-pulps have some interesting properties. In the first place, highly absorbent papers may be made from them, and they are therefore very suitable for the manufacture of paper towels and handkerchiefs for facial tissues, etc., the use of which is far more common in the United States than in Great Britain. Papers made from such pulps also lend themselves readily to impregnation with rubber latex and similar materials, and as a result of subsequent processing they can then be converted into leather substitute[1]. There is already a wide market for products of this kind in the manufacture of handbags, fancy goods, bookbindings, shoe linings, etc. where effect is more important than durability. Furthermore, since alpha-cellulose represents the nearest approach to true cellulose obtainable on the manufacturing scale, it is not surprising that advantage has been taken of the inherent strength of the fibre to use it in the production of certain classes of strong papers. Special mention may be made of papers the tearing-strength of which is important, because in such cases fibre length is of special significance. The use of alpha-pulps in this connexion, however, calls for special care, because alpha-pulps do not respond in the same way as other wood-pulps to the development of strength characteristics by 'beating'. Moreover, as resistance to tear is obtained only by sacrificing other forms of strength, for example, bursting-strength, it is usual to add only a relatively small proportion of the alpha-pulp, and, so far as possible, to beat it separately.

Recent work has shown[2] that the permanence of paper, that is, its resistance to the effects of normal ageing, depends as much on the purity of the cellulose present as on the origin of the fibre, and although the traditional preference for rag is still strong, it is now recognized that a paper made from a carefully prepared wood-pulp can last longer than an inferior rag paper. The difficulty of devising a really reliable accelerated-ageing test is probably the biggest obstacle to the demonstration of the relative merits of these fibres. Apart from these questions, however, the fact that the alpha and similar pulps contain such a high proportion of α-cellulose is an obvious argument in favour of their use in 'permanent' papers. This course has so far been justified by such accelerated-ageing tests as exist; provision, however, has also been made for natural ageing tests, the conclusion of which must be left in the hands of the next generation.

Since the method of preparing alpha-pulps is similar to that employed for the determination of α-cellulose (cf. *supra*), namely, removal of other substances by selective solution in various reagents such as sodium hydroxide, it follows that the yields of pure material are necessarily low. This and the manufacturing costs arising from the use of several treatment processes have made these pulps rather expensive, and would seem to be the factor which at present places a limit to their more extended use.

The advances in the technique of bleaching wood-pulps which have been a feature of recent years have also resulted in the production of some interesting types of pulp. These are based on the treatment of the pulp with the bleaching agents in several stages instead of in one only. Chlorine, either as gas or in the form of an emulsion in water, is used in the first stage. This procedure serves to chlorinate the lignins and other undesirable substances in the raw wood, the resulting compounds being soluble in alkali; removal of these in this way is therefore the second stage. Up to this point, there is no real improvement in the colour of the pulp, but the bleaching proper may now be carried out, hypochlorite being the reagent used. This again may be operated in one, two, or even three stages. It is interesting to note that the use of chlorination for the isolation of cellulose was proposed by Cross and Bevan[3] so long ago as 1903, but it is only within recent years that advances in chemical engineering have enabled the process to be realized in practice.

The principal advantage of this method of bleaching is that the colour may be improved without undue detriment to strength, but the elimination of a good deal of the dirt and troublesome resinous matters in wood and an economy in bleaching costs are further benefits which are not to be ignored. Pulps made by the sulphite process provide some of the best-known examples of the advantage of multi-stage bleaching, but of great interest also are bleached kraft pulps of high strength and good colour, as these have become available only relatively recently. The general principles of the preparation process are similar to those used for sulphite pulps and indicated above, but the results obtained almost justify the descriptions of a modern bleached kraft as a new raw material for paper. This is because, although the colour and cleanliness bring these pulps into favourable comparison with many grades of bleached sulphite pulp, the corresponding strength is very much greater, and the cost is not excessive. It is believed that the advent of this new type of pulp may create a demand for a paper which combines the strength of the familiar brown kraft wrapping with the æsthetic and advertizing value which result directly (and indirectly, through the printer's art) from a good colour; foodstuff wrappings suggest themselves immediately in this connexion; and substitution of certain grades of rag is another possibility.

The use of American southern pine as a source of paper-making wood-pulps other than kraft has already been referred to in NATURE[4], and the requirements of the rayon industry are now also being studied. In view of this work, there seems little doubt that it is only a matter of time before it is possible to deal with the vast supplies of southern pine by the groundwood process, and possibly even by a sulphite process. There are many who are sceptical about even the former of these possibilities; but it is less than seventy years ago that similar doubts were expressed as to the practicability of making paper from wood at all. When it is remembered that there are a hundred million acres of longleaf and loblolly pine available from the southern States of the Union alone, there is ample justification for the statement that this region may well be as important in the future as a source of newsprint as at present it is of kraft-pulp.

The exploitation of new sources of wood at once raises the general question of the conservation of timber supplies and, in particular, the matter of re-afforestation. One respect in which certain of the Scandinavian countries have set an example which might well be followed more closely elsewhere is the organization of the pulp-mill in close relationship to the saw-mill, with the object of eliminating waste. In this connexion, it was stated a few years back by the U. S. Forest Service that every year about six million cords of sound wood suitable in size for pulping processes were wasted in the course of logging operations. This statement refers to one of the richest timber regions in the world, namely, the strip of Pacific coastline between Oregon and Alaska. Here the western hemlock, which is very suitable for the production of sulphite wood-pulp, occurs in close association with an important timber tree, namely Douglas fir, and there are now possibilities that the latter might be amenable to treatment by the sulphate process.

In the case of southern pine, a relatively short time of growth—at the most eighteen years—is required in order to obtain a tree of suitable size for pulping, so that in this instance the problem of re-afforestation should be simplified, at any rate from the economic point of view.

A final word seems desirable on the subject of possible rivals to wood-pulp. These are not lacking, and many indeed (such as straw) precede it historically. Each year brings a host of suggestions which the paper-maker assiduously tests, and frequently finds to be satisfactory from a purely technical point of view. The objection is nearly always the cost of transport, because the fibres usually grow in remote parts of the earth where the cost of harvesting and bringing to the nearest port is prohibitive. The rapidly advancing price of wood-pulp is, however, focusing attention on the results of trials which have been 'filed' for many years. Esparto is of course an old-established rival to wood-pulp and one which enjoys the advantage of being a printing fibre *par excellence*, although it is too soft to be used alone where strength is at all important. At the same time, any decrease in the difference in price between wood and esparto must tend to increase the demand for the latter.

Another fibre which may assume more importance in the future is bamboo. It may be safely stated that the main technical difficulties associated with this fibre have now been overcome, and it is firmly established in India; Sabai grass, which produces a paper having similar characteristics, is also increasingly in evidence in papers from this source. Both types of paper are similar to those made from esparto, and give good printing results. To come nearer home, straw is a source of pulp which is encountered frequently in Continental papers, and particularly in those from agricultural countries such as Holland. Its use in recent years has been on the decline, but as this has been due mainly to the cheapness of wood-pulp, the removal of this competition should mark the revival of straw. Unlike esparto and bamboo, straw imparts a hardness and rattle to paper and has a good colour; it is therefore more suitable for writings than for printings. Although there is, and presumably always will be, plentiful supplies for pulping, the processing of it for use in fine papers will, however, be controlled to a great extent by the demands on the raw material made by the straw-board industry. Danubian reed (*Phragmites communis*) is also available in large quantities in the Danube valley, and a similar reed grows in the marshy districts of Norfolk. Many investigations into their paper-making properties have already been carried out both privately and in conjunction with the Ministry of Agriculture[5], and it was concluded that if it were not for the low yield the reeds might prove competitive with certain classes of wood-pulp; here again, therefore, rising prices may reverse the situation. Similar considerations apply to New Zealand flax[6] (*Phormium tenax*) and hemp stalks. The former is perhaps in a different strength category from wood-pulp, as its strength makes it more comparable with rags, but the latter is of considerable importance to countries such as Italy where some 400,000 tons of stalk are available per annum; this is sufficient to render this particular country self-supporting from the pulp point of view[7]. Here again, however, the rayon industry may claim a share of the new material.

Finally, the possibility of a paper pulp famine in the distant future is extremely remote, as even if wood-pulp supplies fail—an unlikely probability—human ingenuity will soon provide a substitute. On the other hand, the immediate future may be a period of difficulty which will last until the gap between past and future conditions is bridged, so that there is every prospect that the rapid advances in the technology of the subject will continue.

J. G.

[1] Grant, J., NATURE, 134, 921 (1934).

[2] Grant, J., NATURE, 130, 320 (1932); 132, 414 (1933). Grant, J., *Discovery*, 17, 156 (1936). Grant, J , "Books and Documents Dating, Permanence and Preservation" (1937).

[3] NATURE, 138, 175 (1936).

[4] Grant, J., NATURE, 136, 1014 (1935).

[5] *Bull. Imperial Institute*, 33, 421 (1935).

[6] Yeates, J. S , *Paper Trade J.*, Technical Section, 103, 66 (1936).

[7] *Woch. Papierfabr* , 67, 75 (1936).

International Council of Scientific Unions

NINETY-EIGHT representatives of seven International Unions and twenty countries attended the third General Assembly of the International Council, held in the rooms of the Royal Society, London, under the presidency of Prof. N. E. Nörlund. At the opening meeting on April 27, the Council was first welcomed by Sir William Bragg, president of the Royal Society, and then Prof. Nörlund gave his presidential address on "The Figure of the Earth".

After the report of the Executive Committee had been read, Prof. B. Cabrera presented the report of a special committee which was appointed to consider the relations of the Council with the Committee of Intellectual Co-operation of the League of Nations. Among the recommendations of the committee, which were adopted in full, was one that the International Council should act as a consulting body on problems of a scientific nature which the Committee of Intellectual Co-operation might be called upon to solve. Questions of an international character concerning the organization of scientific work would be referred by the Council to the Committee. Prof. S. Chapman presented the report of the Committee on Solar and Terrestrial Phenomena, and the Committee was continued with an increased grant. The Committee on Instruments and Methods was discontinued.

The second session of the Council was largely devoted to the resolution from the Royal Academy of Sciences at Amsterdam asking for the appointment of a committee "which should attempt to arrive at a co-ordination of what has been proposed in respect of the social responsibilities of science and of scientific workers" (see NATURE, 139, 697, April 24, 1937). Prof. J. M. Burgers presented the motion, which led to a lively discussion in which eighteen speakers took part. It was clear that a number of the representatives of national academies adhering to the Council were not in a position to vote for the motion as it stood without reference back to their academies. A restricted field of activity was the most that could secure general support for a committee of the type indicated. The matter was referred to a small committee representative of the different views that had been expressed.

This committee reported that the appointment of a committee with the full powers proposed by the Amsterdam Academy lay outside the objects of the International Council as laid down in the statutes, and at a subsequent meeting of the Council Prof. H. R. Kruyt formally withdrew the motion from the Amsterdam Academy in favour of one to appoint a committtee with the following terms of reference:

"The Committee, at suitable intervals, should prepare a survey of the most important results obtained and of the directions of progress that are opening and of points of view brought forward in the physical, chemical and biological sciences, with reference to:—

"(1) their interconnections and the development of the scientific picture of the world in general;

"(2) the practical application of scientific results in the life of the community.

"The work of the Committee is limited strictly to scientific activity."

The membership of the committee was left to the Executive Council of the Union.

The reports of the recent work of the various International Unions were presented by Dr. H. Spencer Jones (Astronomy), Prof. M. de Martonne (Geography), Sir William Pope (Chemistry), Prof. H. Abraham (Physics), Prof. S. Chapman and Dr. J. de Graaf Hunter (Geodesy and Geophysics), Dr. E. H. Rayner (Radio Physics) and Dr. M. J. Sirks (Biology). Prof. E. V. Appleton completed the report from the Union of Radio Physics by a lecture at the Royal Institution on "International Co-operation in Radio Research."

The social side of the meeting included a reception by the Government at Lancaster House and one by the Royal Institution, at which Sir William Bragg lectured on "Classical Experiments made at the Royal Institution". The Royal Society invited delegates to attend one of its ordinary meetings and also one of its annual soirées. Visits were also arranged for those delegates who wished to see such institutions as the Royal Observatory, the Royal Geographical Society, Kew Gardens, Rothamsted, the Zoological Gardens, the National Physical Laboratory, the B.B.C., and various institutes, museums and laboratories in or near London.

At the closing meeting of the Council, the place and time of the next meeting were fixed as Copenhagen in 1940, on the invitation of the Royal Danish Academy of Sciences. After votes of thanks for hospitality and to Prof. Nörlund and Sir Henry Lyons for their past services, new officers were appointed as follows: *President*, Prof. Charles Fabry; *Vice-Presidents*, Il Marchese Marconi, Prof. H. R. Kruyt; *Members of the Executive Council* (in addition to representatives of the Union), Prof. D. B. Nemeč, Dr. J. A. Fleming; *General Secretary*, Prof. F. J. M. Stratton.

Obituary Notices

Dr. A. H. Church, F.R.S.

DR. ARTHUR HENRY CHURCH died on April 24 at the age of seventy-two years. At sixteen years of age he left his home at Plymouth, where his father was in business as a saddler, to be a pupil teacher at Ashburton Grammar School; four years later he entered University College, Aberystwyth, and at twenty-four was elected science scholar of Jesus College, Oxford. He was a research fellow of his College from 1908 until 1912 and University reader from 1910 until 1930. One married daughter survives him.

Church was not as other men: he went his own way, indifferent, so it seemed, to the opinions of his fellows; exceptionally able, he combined meticulous accuracy with originality and a flair for theoretical discussion. His contributions to botanical science bear the impress of a certain quality of distinction and genius. The greater part of his academic life was spent in the intensive instruction and paternal guidance of Oxford undergraduates, to whom he gave his best and earned their gratitude. To most botanists, he was known only by name and as the author of books and papers characterized by clear thinking, provocative, dogmatic statement and bold hypotheses often demanding concentrated thought on the part of readers. Well fitted by ability and breadth of knowledge to occupy the highest positions in his profession, his ambition was to advance science, not himself; life in the laboratory and in the seclusion of home sufficed; to the great regret of colleagues he avoided scientific meetings and social occasions.

A paper published in the *Annals of Botany* forty-two years ago on a calcareous alga, *Neomeris dumetosa*, illustrates Church's thoroughness in description, ingenuity in attacking theoretical problems, and his great skill as a draughtsman. At the beginning of the present century, Church devoted much time and thought to the mathematical laws governing the orderly disposition of leaves on stems of plants. Phyllotaxis, the arrangement of leaves on a shoot, is the expression of rhythmic production at the growing point: different plants have their own architectural plan. So much is known to students: most botanists are content to go no further. In his book, "On the Relation of Phyllotaxis to Mechanical Laws" (in three parts, 1901–4), and in a few shorter papers, Church made a comprehensive survey of the various types of phyllotaxis, and decided that a morphological theory of spiral growth must be based on a logarithmic spiral on a plane surface. This conclusion and the mathematical reasoning, it must be admitted, did not awake an enthusiastic response on the part of the average botanist.

In 1908 the Oxford University Press published a sumptuous folio volume "Types of Floral Mechanism" in which are described twelve early spring flowers with drawings, many in colour, which have never been surpassed in accuracy. A few years later, Church gave much pleasure to me by acting upon a suggestion that he should apply methods, previously used by him in the description and delineation of Angiosperm flowers, to the elucidation of the floral morphology of the remarkable African Gymnosperm *Welwitschia mirabilis*. The results were communicated to the Royal Society in 1914. A series of "Elementary Notes" on Angiosperms, Gymnosperms and Fungi (1919–21), printed as pamphlets, that are models of concise and logical presentation of facts and theories, bear testimony to his determination to raise the standard of teaching to the highest level. Three admirable botanical memoirs on "Plant Life of the Oxford District" have much more than a local value and should be more widely known.

The best known of Church's Oxford Memoirs is "Thalassiophyta and the Subaerial Transmigration" (1919). The opening words, "The beginnings of Botany are in the sea", served as a text for a learned and exceedingly interesting thesis on the origin of terrestrial vegetation. His view was that life began in a primeval ocean covering the surface of the earth; free-swimming flagellates were succeeded by encysted organisms attached to the sea-floor, some of which in the course of ages developed into highly differentiated green algæ comparable in size and complexity to the large brown seaweeds of our rocky coasts. At a later stage, portions of the earth's crust were uplifted above the surface of the world-ocean, and some of the aquatic algæ that had reached an advanced state of differentiation were, he believed, able to grapple successfully with the serious problems presented by a changed environment and became the advanced guard of a land flora: "the origin of all the main successful adaptations of the land are to be traced down to the benthic phase of the sea". The Thalassiophyta memoir was preceded by one on "The Building of an Autotrophic Flagellate" (1919). He afterwards published several papers in the *Journal of Botany* (1924–25) and elsewhere in elaborating the main thesis.

Church's fascinating hypothesis, not perhaps wholly new, was presented by him in an original form and with a wealth of argument and fact: it has been vigorously criticized by botanists who envisage a different origin of land vegetation; but to many it makes a strong appeal as a contribution to speculative science which will endure.

Forgetting his idiosyncrasies and regrettable aloofness, we think of Church as a self-sacrificing, devoted, kind-hearted teacher, and as one of the ablest and most original botanists of our time.

A. C. SEWARD.

Diwan Bahadur L. K. Ananthakrishna Iyer

WE much regret to announce that Dr. Ananthakrishna Iyer, whose name is well known to all students of Indian sociology, died on February 25 at Palghat in the Malabar district of the Madras Presidency.

Born of a southern Indian Brahman family at Palghat in 1861, and educated at the local Government high-school, this well-known scholar graduated at the University of Madras and entered Government service, which he soon relinquished to join the staff of the Victoria College at Palghat. He then became an inspector of schools in the Cochin State, in which position his services were utilized to develop a State museum, zoological gardens and an industrial bureau. Thus he possessed suitable qualifications for taking part in the systematic ethnographical survey of India which was set on foot by the late Sir Herbert Risley as a sequel to the Census of 1901. Two volumes dealing with the tribes and castes of the Cochin State were issued by him in 1907 and 1912 respectively. The University of Calcutta then invited him to organize a Department of Anthropology, of which he became chairman in 1920.

When in 1924 the superintendent of the Mysore Ethnographic Survey, Mr. H. B. Nanjundayya, unfortunately died, leaving the Survey only partly accomplished, the Mysore State selected Ananthakrishna Iyer to succeed him. Thus commenced the most important of the latter's numerous tasks, and one which will serve as a lasting memorial to his energy and powers of research. Between 1924 and 1935, four volumes were published, giving an account of the population of Mysore on the lines laid down for the Ethnographical Survey, and containing a mass of interesting materials skilfully marshalled by the editor. The first volume, published last, contains a summary of the contents of the other three, and is enriched by contributions from such scholars as Dr. R. R. Marrett, M. Sylvain Lévi, Baron Eickstedt and Mr. C. S. Richards. The public were promised a further volume containing some additional materials, but it is feared that this may not now be available. The loss would be regrettable as it was expected to remedy an obvious defect in the first four, namely, an omission of any list of tribal and caste synonyms, an indispensable guide for scholars who are not familiar with the many names under which Indian social divisions are frequently hidden.

While preparing his final effort, in relation to Mysore, Ananthakrishna Iyer attempted a survey of the small State of Coorg on parallel lines. It is understood that this work was well advanced at the time of his death. It is therefore earnestly hoped that the completion and publication will be entrusted to some competent scholar by the Coorg State.

As a foundation member of the Indian Science Congress, Ananthakrishna Iyer endeavoured to popularize the study of anthropology. In 1934, he was invited by a number of universities in Europe to deliver lectures, and for this purpose visited Oxford, Paris, Rome, Florence, Vienna, Berlin, Königsberg, Halle, Bonn and Cologne. In July of that year, he was present at the International Anthropological Congress in London when he read a paper on the agricultural basis of religion in southern India, and directed attention to the somewhat inadequate provision made on this occasion for the consideration of the results of Indian ethnographical research. In January last, he presided for the last time over the Anthropological Section of the Indian Science Congress Association, held at Secunderabad, when he dealt in his presidential address with his recent work in the Coorg State.

Ananthakrishna Iyer's publications are too numerous to mention here. During a period of forty years he was connected with most of the learned societies dealing with anthropology in Europe and America. He was a foundation fellow of the Indian Academy of Science, Bangalore, and of the National Institute of Science, Calcutta. In 1935 he was made officier de l'Académie Française and honorary doctor of medicine and surgery of Breslau. In the same year he was promoted from Rao Bahadur (1921) to Diwan Bahadur, by the Government of India. By his death, India loses an indefatigable and learned worker in the field of ethnographic study who cannot readily be replaced. His many friends both in that country and in England will regret the passing of an attractive and vigorous personality.

R. E. ENTHOVEN.

Dr. T. G. Macaulay Hine, O.B.E.

DR. T. G. M. HINE, who died on April 25 at the age of sixty-six years, was the son of the late Mr. George Hine, an architect in large practice. From close association with his father, Hine acquired an excellent knowledge of business, and in his youth spent a year in Germany at the practical study of engineering. Educated at Charterhouse, King's College, Cambridge, and St. Bartholomew's Hospital, Hine, after qualifying and acting as house physician, settled down to the study of bacteriology and investigated the fermentative character of organisms of the diphtheria group.

Hine's chief chance, however, came when during the first winter of the Great War cerebrospinal fever broke out among the mass of troops then in training and, as recruits are specially susceptible to the disease, a very serious outbreak was threatened. The disease was known to be due to the meningococcus and to be conveyed by droplet infection through a chain of healthy carriers who harbour the organism temporarily in their nasopharynx. The D.G. of the Army Medical Service, the late Sir Alfred Keogh, was advised as to the measures taken by Sir William Horrocks assisted by the late Dr. Richard Reece and Dr. Mervyn Gordon, whose services were supplied by the Medical Research Committee. A central laboratory was set up at Millbank (headquarters of the R.A.M.C.) with a travelling laboratory attached and Dr. Hine was put in charge. In order to check the disease, contacts were swabbed, carriers segregated, and intensive research undertaken in which Martin Flack, W. J. Tulloch, J. A. Glover, and A. G. Bell all made valuable contributions.

As each salient point came to notice it was applied by Dr. Hine. Thus (1) the first requirement was a suitable medium that could be supplied in bulk for identifying carriers of the meningococcus. When this was arrived at, Dr. Hine manufactured it on a large scale and kept more than fifty laboratories dealing with troops supplied. (2) It was soon found that the only safe way to identify the meningococcus was by serological means, and that four different types of it were operating, of which two were responsible for 80 per cent of the cases. The large-scale production of menotypical agglutinating serums for identifying these strains of the meningococcus, and homologous suspensions for checking the sera, was undertaken by Dr. Hine, who later on was succeeded in this work by Commander A. G. Bell. (3) When trial was made of monotypical therapeutic serum standardized by its antiendotoxic capacity, Dr. Hine undertook its distribution and the assessment of results. This serum was particularly successful in patients infected by Type I, the main epidemic strain of the meningococcus, in which the mortality had previously been highest, but less successful in cases infected by the other types. (4) When it was found by experiments on carriers at the central laboratory that the meningococcus can be destroyed in their nasopharynx by causing them to inhale through the nose the air of a room densely charged with a spray of droplets of 1 : 50 zinc sulphate, Hine's previous engineering experience enabled him to design a jet that was more efficient than the one previously in use.

Although the disinfection of carriers by this means was only temporary, it proved valuable for dealing with instances of mass infection, and when applied the last thing at night before going to bed, appeared to stop the incidence of the disease in some outbreaks: the disease ceasing while the spray treatment was in use and beginning again when it was stopped. The Navy adopted Hine's jet for installation in the Fleet, where it was operated by compressed air instead of by steam as in the Army.

For his services during the War, Dr. Hine received the O.B.E. and was made an honorary major in the Army. After the War, he gave assistance for a time to the administrative staff of the Medical Research Council and then retired to his house near Slapton in South Devon. Dr. Hine was a popular figure in lay as well as medical circles, and was a past Master of the Fruiterers' Company.

WE regret to announce the following deaths:

Prof. R. H. Fernald, director of the Department of Mechanical Engineering and dean of the Towne Scientific School of the University of Pennsylvania, known for his work on fuel technology, on April 24, aged sixty-six years.

Prof. A. R. Ling, emeritus professor of malting and brewing and of the biochemistry of fermentation in the University of Birmingham, on May 14, aged seventy-six years.

Prof. L W. McCay, emeritus professor of chemistry in Princeton University, known for his work on the chemistry of arsenic, on April 13, aged seventy-nine years.

News and Views

Dr. G. F. Herbert Smith

DR. G. F. HERBERT SMITH retires from the keepership of minerals in the British Museum (Natural History) on May 26. He joined the staff of the Mineral Department under Sir Lazarus Fletcher in 1897 and devoted himself particularly to mathematical crystallography and to the development of scientific methods for the identification of gem-stones. An account of his earlier career and of his scientific work appeared in these pages in 1935 (135, p. 948). In 1921 he was appointed assistant secretary and later secretary, of the British Museum (Natural History). This was a loss to the Mineral Department, but an undoubted gain to the Museum as a whole. During his fourteen years in this office he worked for the improvement of the equipment and buildings of the Museum, and the increase of numbers and betterment of conditions of employment of its staff, and for the prestige at home and abroad of a great scientific institution. During his short period of office as keeper of minerals since 1935, he has continued the improvement in display methods initiated by his predecessor. The finely illuminated wall-cases at the entrance to the mineral gallery and the nitrogen-filled case housing the great Cranbourne meteoric iron have all been completed under his supervision. With the office of secretary to the Museum he took over the secretaryship of the Society for the Promotion of Nature Reserves and he has been chairman of the Wild Plant Conservation Board since 1931. These activities will not cease with his retirement from the Museum, and it may be hoped that time may also be found for a resumption of scientific work interrupted by many years of administrative duties. Quite apart from his scientific work, Dr. Herbert Smith has taken a very active part in Civil Service affairs. He was one of the honorary secretaries of the Society of Civil Servants in 1918–1925, vice-president in 1925–1928, and president in 1928–1932. He has been honorary secretary and treasurer of the Civil Service Arts Council since 1924.

Lieut.-Colonel W. Campbell Smith

LIEUT.-COLONEL WALTER CAMPBELL SMITH has been appointed to succeed Dr. Herbert Smith. Lieut.-Colonel Campbell Smith was born in 1887 and educated at Solihull and Corpus Christi College, Cambridge. He took a first class in both parts of the Natural Sciences Tripos (Mineralogy), and was appointed to the Museum in 1910, where his work has been confined mainly to the collection of rocks, which has been entirely rearranged in his time. He was promoted to deputy keeper in 1931. At the outbreak of the Great War he was a lance-corporal in the Artists' Rifles, was later seconded to the Special Brigade, R.E., and rose to the rank of lieutenant-colonel in 1918. He resumed his connexion with the Artists' Rifles after the War and retired in 1935 with the rank of brevet lieutenant-colonel. He was secretary of the Geological Society of London in 1921–1932, and has been secretary of the Mineralogical Society since 1927. He was a fellow of Corpus Christi College, Cambridge, in 1921–24, and is a governor of the Royal Holloway College.

Pulitzer Prize for Science Reporters

THE Pulitzer prizes in letters and journalism for the current year were announced on May 3 by Dr. Nicholas Murray Butler, president of Columbia University. Among the awards was a prize of one thousand dollars to five members of the National Association of Science Writers, all of whom have reported the meetings of the American Association for the Advancement of Science for many years. The award, "for the most distinguished example of a reporter's work", was given in recognition of their accomplishments in connexion with the tercentenary celebration of Harvard University. The criteria on which the award is made are "strict accuracy, terseness, the preference being given to stories prepared under the pressure of edition time that redound to the credit of journalism". Those sharing the reward are: Howard W. Blakeslee, Associated Press, president; William L. Laurence, *New York Times*, vice-president; David Dietz, Scripps-Howard Newspapers, past president; Gobond Behari Lal, Universal Service; and John J. O'Neill, *New York Herald-Tribune*. The work of reporting the celebration was carefully organized in advance by the Harvard authorities in co-operation with the National Association of Science Writers, the president of the University, Dr. Conant, giving personal attention to the matter. The result was eminently satisfactory, and the award of the Pulitzer prize to the five writers mentioned is an encouraging mark of appreciation of the way in which a great university function was described in the periodical press.

The Coronation Broadcast

THE modern development of radio broadcasting is among the most wonderful and at the same time the most satisfactory, of the practical applications of scientific and technical research. This was admirably demonstrated on Coronation Day, May 12, when the elaborate arrangements outlined in NATURE of May 1 were submitted to the test of practical achievement. For more than six hours, almost the entire resources of the British Broadcasting Corporation were devoted to the handling of a sound picture of the procession and coronation ceremony from start to finish. In addition, at a selected point on the route, a combined sound and vision programme was successfully broadcast from the London television station, while, later in the day, a 'round the Empire' programme concluding with an address from H.M. the King was also provided. All those concerned must feel a deep sense of satisfaction in the successful accomplishment of this day's difficult programmes. For the first time in history, the general public in all parts of the world were enabled to participate in very intimate detail in the elaborate ceremony of the coronation of a British king. Hitherto this experience has been confined to the few who, by virtue of rank or service, have been favoured with a position inside Westminster Abbey.

CORONATION DAY, 1937, will be remembered by many millions of people who heard, either in their own homes or while they were actually in position along the processional route, a continuous broadcast commentary accompanied by a sound picture background of the pomp and majesty of the procession and ceremony. A striking illustration of the advantages which broadcasting gives over the possible scope of the ordinary sightseer, was provided by the manner in which the commentary was successively switched forward along the route, so that the listener was enabled to keep up with the progress of the procession. When, as seems undoubtedly probable in the near future, this advantage becomes available to the viewer as well as to the listener, it will be still more generally appreciated. When the picture is further provided in natural colours, the entire scope of the participation of the general public in large-scale ceremonies will have been subject to a revolutionary change.

THE evening programme comprised messages of homage to the new King, presented by speakers in various parts of the Empire in addition to the official greetings from the Prime Ministers or other representatives of the Dominions actually present in London. This expression of homage from the Empire concluded with a speech by H.M. King George VI, who himself recorded the fact that this was the first time that the King had been able to address the nation as a whole on the day of his coronation. Messages congratulating the B.B.C. on these impressive broadcasts have been received from all parts of the Empire and from many foreign lands. These marked the successful use of the two new 50 kW. transmitters at the Daventry short-wave station supplementing the older 10 kW. sets. In many cases, the resulting reception was so satisfactory as to permit the rebroadcasting of the programme through all local transmitters. For example, in Melbourne the broadcast was retransmitted from ninety-seven stations throughout Australia. The Corporation's aim to supply the whole world with an effective broadcasting service was thus realized on this occasion. Truly may it be said that radio broadcasting is a very potent factor in bringing together the peoples of the world to a closer union which should result in greater friendliness and understanding.

Natural Limits of Human Flight

IN his presidential address delivered before the Royal Aeronautical Society on April 26, Mr. H. E. Wimperis discussed the "Natural Limits of Human Flight". He showed how relatively thin is the atmospheric shell in which we live. Birds, he considers, have reached the limits of perfection in natural flight, comparatively little progress having been made in the last thirty million years, whilst the "present attainments in human flight have all grown from the endeavours of a single generation". With regard to high speed, increase in altitude of flight does not necessarily mean an increase in speed, but depends largely upon the supercharging of the engine. Increase of altitude has also other detrimental effects, for example, increase of drag coefficient due to decrease of Reynolds' number, and increase in induced drag due to the increase in incidence when flying near the 'ceiling'. Actual increase in the size of aircraft would raise the speed; but not beyond a certain point, unless more engine power can be got from a given space, or some means found of reducing the drag by changing the turbulent flow to a laminar one. Progress along these lines will soon bring us to the most formidable obstacle of all, namely, the compressibility of the air as the speed of sound is approached; and this Mr. Wimperis regards as being well above the limit obtainable with engines of the type in use to-day, which he placed as between 500 and 600 m.p.h.

POWER of manœuvre was the next point considered by Mr. Wimperis. Speed of dive, which also involves large changes in altitude, has apparently no harmful effects on the personnel of an aircraft. On the other hand, rapid changes in direction or speed bring into play accelerations which impose severe physiological effects on the personnel, and limit the maximum acceleration to the order of ten times gravity. Consequently, with steadily increasing speeds the rate of manœuvre must thus be correspondingly decreased. With regard to the limit of altitude, provided oxygen apparatus is used, flights at 80,000 feet are possible, but increase in altitude above the present limit of 50,000 feet will be restricted to 60,000 feet largely by supercharging difficulties alone. Speaking of the range of flight, Mr. Wimperis said that it is difficult to set a limit to it. In still air, range is independent of altitude and depends chiefly on engine fuel consumption economy, low drag, low structure weight, coupled with large fuel capacity. He also expressed the opinion that aircraft as weapons of attack in warfare will, in the future, not occupy such a favourable position as in the past.

Long Ashton Research Station

THE annual open day of the University of Bristol Research Station at Long Ashton was held on May 6, when horticulturists, cider makers and fruit growers assembled to sample the ciders and other fruit products of the current season. Prizes awarded for the production of cider fruit were presented by Lord Faversham, Parliamentary Secretary to the Minister for Agriculture, after a speech which was broadcast from the West Regional Station. The results of recent investigations in cider making were on view. These included the use of German wine yeasts such as Waldenberg, Steinberg and Zeltingen instead of natural cider yeasts, to obtain finer flavour. Artificially and naturally sweetened ciders have been compared, and apple juice has been successfully concentrated for storage purposes. The production of non-alcoholic apple juices has received considerable attention in the past year. Various combinations of dessert, culinary and cider varieties have been used for this purpose, and the effects of aeration and pasteurization studied. Seitz-filtered still juices are considered the most attractive, pasteurization having an adverse effect on flavour. As a result of the work at Long Ashton, commercial production of syrups from pure soft-fruit juices is now in operation on a large scale, and the numerous domestic uses of these products were illustrated by an exhibit of milk shakes, jellies, cake fillings, etc.

EXPERIMENTS in progress on the extensive fruit plantations of the Station were open for inspection. These include investigations on the manuring of apples and soft fruits, pruning and shaping of fruit trees, rootstock trials with apples, pears and plums, and the influence of cultural treatment on the storage qualities of apples. Of particular interest on this occasion was the attempt to grow cider varieties of vintage quality as bush trees. If this can be accomplished, crops may be borne in a much shorter time than by the usual method of standard tree production. The propagation of basket and cricket bat willows also aroused considerable interest. Progress in methods of pest and disease control was illustrated by exhibits in the laboratories, a recent development being the use of cuprous oxide as a seed treatment for early peas and zinc oxide for ornamentals. The control of plum sawfly and red spider was demonstrated by the use of combined washes containing white oil emulsion and rotenone-containing substances. In addition to horticultural research, the extensive agricultural advisory service of the Station was evident from the exhibits on dairy bacteriology, methods of pig husbandry and the economic feeding of dairy herds.

The Patent Office Library

ON May 3 Dr. Leslie Burgin, M.P. (Parliamentary Secretary of the Board of Trade), accompanied by the Comptroller-General of Patents and other officials, received a deputation from the Parliamentary Science Committee which placed before him its report on various desired improvements in accommodation and other amenities at the Patent Office. The deputation was introduced by Lieut.-Colonel Sir Arnold Wilson, M.P. Dr. Burgin expressed himself most sympathetically towards the points raised, several of which, he stated, were already being dealt with, or were in contemplation. He was precluded at present from discussing the provision of a set of duplicate search files by the adverse findings on that subject of the Sargant Committee of 1931. If, however, the Parliamentary Science Committee presented a detailed case strong enough to justify him in re-opening that subject, he would not bar and bolt the door; but the onus of justification must rest with the Committee. Dr. Burgin stated that an extension of the Patent Office buildings was contemplated during the next few years which would allow for increased library space. On the subject of binding, he said that allocations amounting to £3,100 had been made since the Great War for the purpose of overtaking arrears, apart from substantial increases in the grant for books and binding, which had permitted of enlarged purchases of foreign publications. If the Committee would provide him with specific particulars of the foreign publications and periodicals which, in its opinion, should be added to the Library, every endeavour would be made to meet such suggestions. The deputation was satisfied that improvements in the services afforded by the Patent Office Library are in hand, and that the importance of the matters laid by them before the Board of Trade was fully appreciated by Dr. Burgin and by the officials concerned.

Preservation of Monuments of Antiquity

IN a period of economic transition such as the present, the future of many monuments of antiquity, now in private ownership, even when under the protection of the Office of Works, must continue to be precarious, owing to the breaking up of large estates. Private benefaction and public response to appeal in cases of urgent necessity have been generous in recent years; but they cannot be expected to shoulder the burden indefinitely. The strongest safeguard for the less widely known, but often none the less important antiquities, which necessarily must run the greater risk, is a vigilant educated public opinion, backed by an enlightened authority. An example of the effective application of existing legislation in such conditions is afforded by the recent public inquiry at Worthing on a proposal to develop Highdown Hill between Worthing and Littledown as a building estate (*The Times*, May 13). On account of the natural, archæological and historical interest of the site, this inquiry, held by order of the Ministry of Health, is to be regarded as of considerable importance. The Hill, a southern outlier of the South Downs, rises to a height of two hundred and sixty-nine feet, and is an important feature in the maritime level tract, which is visible from far along the coast. On the summit is an earthwork, of at present uncertain age, in which was discovered in 1892 an important sixth century Anglo-Saxon cemetery. In it were eighty-six burials lying east and west in rows. The contents of the graves, of which the ornamentation suggested Frankish affinities, made this one of the most important finds of its kind in Britain. Yet the site was not scheduled under the Ancient Monuments Acts until 1930, and then only as the result of public protest, when the estate was offered for sale. The present inquiry was held on an appeal from the owner against a refusal of the Worthing Rural District Council to grant an interim development order. It was opposed by the Worthing Rural and Town Councils, the West Sussex County Council and four adjacent owners. A public-spirited offer has been made by the local authorities to accept any financial responsibility involved in the preservation of the site.

The Cerne Giant

THE 'Cerne Giant', it is announced, will come under the auctioneer's hammer on June 16 next when the Abbey estate, Cerne Abbas, near Dorchester, Dorset, is to be sold in lots. The 'Cerne Giant' is one of a small group of remarkable and curious antiquities of Britain which were described by Sir Flinders Petrie some years ago in a special publication of the Royal Anthropological Institute. They are figures of considerable size cut in the turf on the chalk in outline. They are of unknown purpose and unknown age, though almost certainly some, if not all, are prehistoric. The best known, owing in part to its appearance in popular fiction, is the Berkshire 'White horse', but the 'Wilmington giant' in Sussex and the 'Cerne Abbas giant' are almost equally famous. The 'Wilmington giant' is on a slope so steep as almost to appear to be standing upright. The 'Cerne giant' is on Trendle or Giant's Hill, and is a huge ithyphallic figure, one hundred and eighty feet high, brandishing a club, which is one hundred and twenty feet long and in breadth runs from seven to twenty-four feet. The head appears disproportionately small. The outline is cut in trenches two feet broad by one foot deep. The 'Wilmington giant' is rather larger, being approximately two hundred and forty feet high, with a head of twenty-one feet breadth. Various explanations of the giants' figures have been put forward. It has been suggested that the 'Cerne giant' is the figure of the Saxon god Heil, but in all probability it is much older, possibly Iron Age. The circle above the figure of the giant in which the Cerne maypole used to stand, together with the ithyphallic character of the figure, support the obvious attribution to a very ancient fertility cult. The remarkable character of the figure and its great interest for the light it throws on ancient British culture make it regrettable that the ground on which this figure is cut should be in private ownership and subject to such vicissitudes as that now impending.

Archæological Investigations in Cilicia

A DISCOVERY of much interest in relation to the sources of supply of material for implements in the prehistoric period of the eastern Mediterranean and western Asia was the subject of reference by Prof. John Garstang in an account of recent excavation on Hittite sites in Cilicia delivered before the Society of Antiquaries of London on May 6. Archæologists have sought for some time sources of the supply of obsidian, the rare volcanic glass from which the finer types of stone implements were fashioned in Egypt, the Aegean, Greece and western Asia, and of which for long the only source known to have been available for these areas was the island of Melos. An outcrop of this material several miles across, Prof. Garstang states, has now been discovered at the foot of Mount Argaeus in Anatolia. It shows many traces of having been worked in antiquity, and implements of this material, with others of chert, have been found in the lower levels of one of two interesting sites near Mersin. The site in question, on a small river Souk Su (Cold Water), showed signs of a pre-Hittite occupation of possibly so much as two thousand years. In describing the results obtained by the Neilson expedition to Cilicia, Prof. Garstang said that twenty-three sites on the plain of Adana had been examined, some of which yielded superficial evidence of Hittite occupation. Four sites had been opened in co-operation with the Government Museum at Adana. These included the mound at Serkeli on the east bank of the ancient Pyramus, where the important imperial Hittite monument was studied. On the mound of Kazanli, between Tarsus and Mersin, evidence was found of Hittite occupation extending from between 2400 B.C. and 2200 B.C. down to the Assyrian invasions. Prof. Garstang believes that the fall of the Hittite capital on the plateau did not involve the destruction of the Hittite centres of Cilicia.

Electricity in the Hospital

THE Faraday Lecture of the Institution of Electrical Engineers was given on May 6 by Mr. R. S. Whipple, on the subject of "Electricity in the Hospital". Dealing separately with lighting, power, heating, medical treatment and intercommunication, Mr. Whipple could easily convince his audience of the enormous call made on the electrical engineering services of a big hospital. He gave an estimate of the X-ray photographs taken annually by the largest ten hospitals in London as a million. Electro-medicine has indeed gone a long way from the methods of the seventeenth century, when a cure for paralysis was sought by giving the patients shocks from Leyden jars. Mr. Whipple passed in review the instruments devised especially for medical use, with special reference to the electro-cardiograph and the various diathermy machines; these were also shown in action.

New Zealand Handbook

ON the occasion of the meeting of the Australasian and New Zealand Association for the Advancement of Science at Auckland on January 12–19 this year, a useful handbook to New Zealand was issued to members. The book contains some thirty short articles on various aspects of the country, but the greater part is concerned with the geology, natural history and native population. Among the most valuable chapters are those on the climate by Mr. E. Kidson, the geomorphology of Wellington by Prof. C. A. Cotton, the economic geology of New Zealand by Mr. J. Henderson, the ecology by Mr. H. H. Allan and the forests by Mr. E. P. Turner. The volume gives in a collected form a great deal of precise information which is not otherwise easily accessible. The chapter on New Zealand's economic history discusses the future development of the resources of the Dominion.

Christ's Hospital and Prof. Armstrong

THE annual report of the Headmaster of Christ's Hospital contains the following reference to Prof. H. E. Armstrong, who, as many of our readers know, has been confined to his room for several months, though he maintains his interest in scientific and educational activities: "Illness has deprived the Committee of Education of the attendance of Prof. Armstrong, who, as a member of the committee for nearly forty years and latterly as chairman, may claim a large share in the formation and guidance of the Hospital's educational policy and ideals. It is a consolation to know that in his position as educational adviser to the council we shall still have the benefit of his wide knowledge and wise direction. We consider ourselves very fortunate to have as the new chairman of the Committee, the Rev. Prebendary A. Chilton, who brings to this work the special knowledge both of an old Blue and of a distinguished headmaster."

Announcements

AT a recent meeting of the Lawes Agricultural Trust Committee, Lord Clinton tendered his resignation as chairman owing to ill-health, and Prof. H. E. Armstrong was appointed in his place. Sir Merrik Burrell, lately president of the Royal Agricultural Society of England and chairman of its Research Committee, was appointed vice-chairman.

WE regret that the name of Sir Cuthbert Wallace, president of the Royal College of Surgeons, who has been made a baronet, was omitted from the list of Coronation honours published in NATURE of May 15.

THE eighth annual Haldane Memorial Lecture at Birkbeck College, London, will be delivered by Sir Arthur Eddington, director of the Observatory and Plumian professor of astronomy in the University of Cambridge, on May 26 at 6 p.m. The subject of the lecture will be "The Reign of Relativity 1915–1937". Admission is free, without ticket.

THE silver jubilee of the Chadwick Lectures occurs this year and the Chadwick Trustees are holding a reception for their former and recent lecturers, scholarship holders and recipients of Chadwick Medals and Prizes, to precede the lecture on May 26 by Prof. J. G. Fitzgerald, to be given at Manson House, 26 Portland Place, at 5.30 p.m. Dr. Fitzgerald is director of the School of Hygiene and the Connaught Laboratories, and professor of hygiene and preventive medicine in the University of Toronto. He is now on a year's leave of absence for the study of the teaching of preventive medicine in medical schools in the United States, Canada, the British Isles and other countries of Europe, for the Rockefeller Foundation. The title for Dr. Fitzgerald's lecture is "Preventive Medicine—an Avenue of Good Will". This will be the initial lecture of a series on public health questions by representatives of Overseas Dominions.

THE following appointments and promotions have recently been made in the Colonial Service: J. Glover, second plant physiologist, East African Research Station, Amani, Tanganyika; K. Wilkinson, European assistant, Meteorological Service, East Africa; N. S. Haig (agricultural officer), senior agricultural officer, Uganda; M. C. Abraham (assistant irrigation engineer), irrigation engineer, Ceylon; F. H. Clarke (assistant game warden), senior assistant game warden, Kenya; W. G. G. Cooper (geologist), assistant director of Geological Survey, Gold Coast; S. G. Taylor (irrigation engineer), divisional irrigation engineer, Ceylon; A. P. Weir (irrigation engineer), divisional irrigation engineer, Ceylon.

AT the forthcoming meeting of the National Peace Congress, which will be held at Friends' House, Euston Road, London, on May 28–31, a meeting of the Science Commission is to take place with Prof. S. Chapman in the chair. Prof. P. M. S. Blackett will open the discussion on "The Responsibility of the Scientist in Relation to Peace Problems". Further information concerning the National Peace Congress may be obtained from the Secretary, 39 Victoria Street, London, S.W.1.

AN informal conference on "The Conduction of Electricity in Solids" will be held at the H. H. Wills Physical Laboratory, University of Bristol, under the joint auspices of the Physical Society and the University of Bristol, on July 13–16. Several morning and afternoon discussions have been arranged. Among those who will take part in the discussions are: Prof. R. W. Pohl (Gottingen), Dr. J. H. de Boer (Eindhoven), Prof. Borelius (Stockholm), Prof. W. L. Bragg, Dr. C. H. Desch, Prof. G. I. Finch, Dr. E. T. S. Appleyard and Prof. J. E. Lennard-Jones. The conference will be open to members of the staffs of universities and research institutions. Further information can be obtained from Prof. A. M. Tyndall or Prof. N. F. Mott, H. H. Wills Physical Laboratory, The University, Royal Fort, Bristol, 8.

A CATALOGUE of rare and valuable books (No. 609) from Francis Edwards, 83 Marylebone High Street, W.1, contains some unusually interesting volumes of voyages, including Champlain's "Les Voyages de la Nouvelle France Occidentale" (1632), Hearne's "Journey from Hudson's Bay to the Northern Ocean" (1795), Linschoten's "Discours of Voyages into ye Easte and Weste Indies" (1598), Martyr's "History of Travayle" (1577) and a unique item in the form of a twelve-page print of a letter from Sir Joseph Banks describing his voyage with Captain Cook in 1768–71.

THE Oxford University Press announces that "The Science of Petroleum", edited by Dr. A. E. Dunstan, Prof. A. W. Nash, Sir Henry Tizard and Dr. A. B. T. Brooks, is approaching completion. The publishers expect to issue it in three volumes, each containing about one million words, during this summer. It contains about four hundred articles, written by three hundred contributors drawn from all parts of of the world.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 887.

Correspondents are invited to attach similar summaries to their communications.

Resistance Thermometry below 1·0° K.

During an investigation of the thermal coupling between the ionic magnets and the lattice vibrations of paramagnetic salts in the neighbourhood of the absolute zero, we have made some resistance measurements in the temperature range below 1° K. The resistance measured consisted of a specimen of fine phosphor-bronze wire very kindly supplied to us by Prof. Keesom of Leyden.

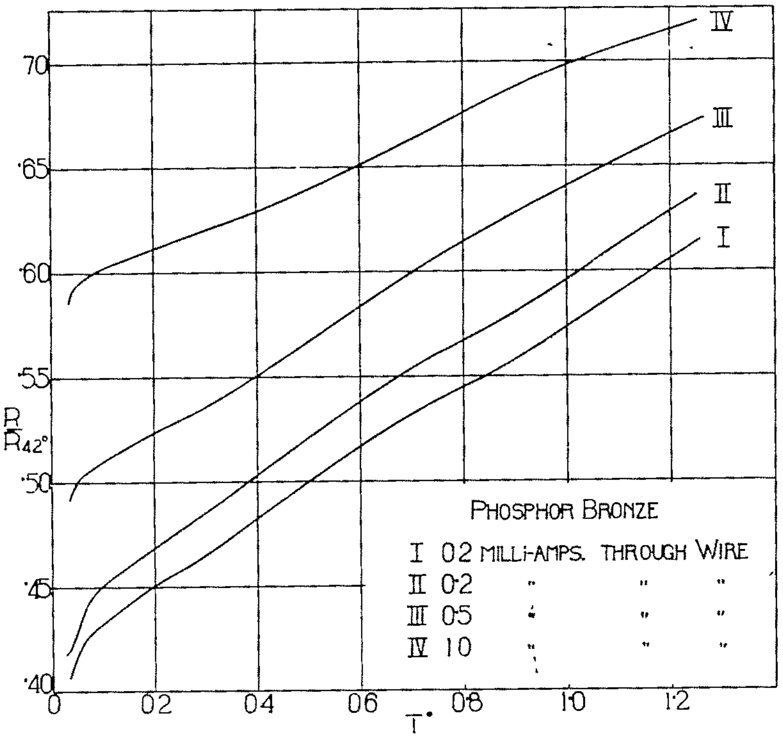

Fig. 1.

The measurements are shown graphically in the accompanying diagrams. The low-temperature unit used to obtain Curves I, III and IV was composed of a cylindrical bomb of German-silver with internal dimensions 70 mm. by 8 mm. The bomb contained grains of iron ammonium alum varying in size from 0·25 mm. to 0·5 mm., and helium at a room-temperature pressure of 120 atmospheres. At the lowest temperatures, the helium was in the liquid II phase, which has been found by Keesom[1] to have a very high thermal conductivity and therefore provided good thermal contact between the salt and the bomb casing. The phosphor-bronze thermometer was wound on the bomb and insulated from it by means of a layer of adhesive cellulose tape. For Curve II the unit was simply a cylindrical tube of German-silver into which iron ammonium alum was hydraulically compressed. From results to be published shortly, it was found for both units that thermal equilibrium between the paramagnetic temperature and the resistance thermometer was maintained down to the lowest temperature reached. By using high-resistance manganin leads, and by having thermal contact between the leads and the liquid helium bath at about 10 cm. above the bomb, warming-times were obtained between extreme low temperatures and the bath temperature which varied from more than an hour for Curves I and II to twelve minutes for Curve IV. The helium bath temperature was 1·25° K., and the demagnetizing field 20 kilogauss. The resistance measurements were made on a Tinsley thermo-electric potentiometer, and the specimen had a resistance of 2·5 ohms at 4·2° K.

In the diagrams the resistance ratios are plotted against T^*, the temperature deduced from susceptibility measurements on the assumption that Curie's law holds for iron ammonium alum throughout the range of temperature involved. Simon[2] has shown, however, that Curie's law does not hold for the salt below 0·1° K., there being a maximum departure at 0·06° K. as well as a sudden bend in the susceptibility curve at 0·034° K., which is interpreted as the Curie point of the salt. Simon's T^*-T relation was determined for an ellipsoid of salt of 6 : 1 length to diameter ratio. Simon claims accuracy to within only 10 per cent in his T^*-T relation, although the shape of the curve is held to be correct. Our specimens were roughly cylindrical of 8 : 1 ratio, and in the case of the bomb containing small salt particles had quite a different density factor from that of Simon's solid ellipsoid. In view of the above, and since our potentiometer measurements are correct only to the third significant figure in the ratio $R/R_{4\cdot2°}$, we decided not to attempt any reduction of our T^* values to absolute values of the temperature. The most that can be said is that our T^* is almost certainly not more than 0·02° lower than T in the neighbourhood of 0·06° K., and differs by less than that both below and above that temperature. The size of the discrepancy near 0·034° K. can be deduced from Fig. 2. At the Curie point (0·034° K.), according to Simon, the $T^{*}-T$ curve becomes normal to the T ordinate; that is, the susceptibility changes without a corresponding change in the absolute temperature. The sharp bend in the resistance curve II near 0·034° shows that our T^{*} is quite close to Simon's value for T at that point. Below the Curie point the discrepancy increases rapidly, since T^{*} changes without a corresponding change in T. The lowest T^{*} which we observed was 0·027°. The corrected resistance curve would probably show no bend near 0·034° such as is seen in Fig. 2.

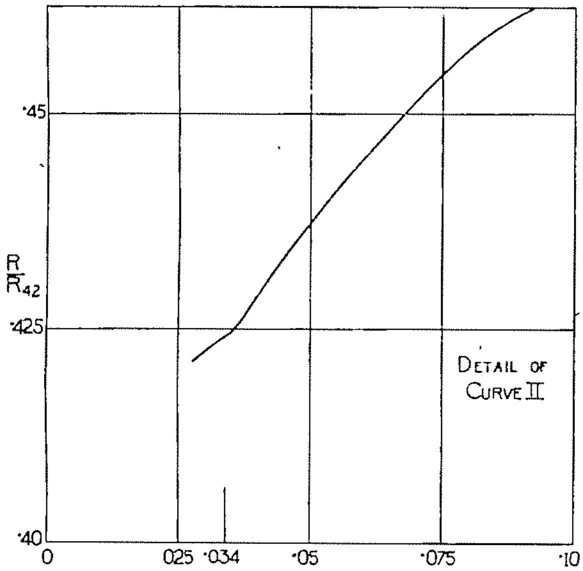

Fig. 2.

From the shape of the resistance curve it is impossible to say whether or not phosphor-bronze would become supraconducting below 0·034° K. The extreme structure sensitivity of phosphor-bronze with regard to resistance can be seen from Curves I and II, where the current densities are the same in both cases. Between taking Curves I and II the thermometer was rewound and leads were resoldered to it. Curves I, III and IV show the effect of changing the current density, and agree with results previously obtained by W. H. Keesom and van den Ende[3].

If the thermometer is left untouched, the temperature-resistance curves are reproducible to within the limits of experimental error. The thermometer may be repeatedly subjected to strong magnetic fields without affecting the calibration, provided the measurement of resistance is made in zero magnetic field. The results show that for a given specimen, a phosphor-bronze resistance thermometer can be quite conveniently used in the range of temperature below 1° K., and possesses approximately the same accuracy as does the ballistic measurement of susceptibility for the determination of T^{*}.

J. F. ALLEN.
E. S. SHIRE.

Royal Society Mond Laboratory,
Cambridge.

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[1] Keesom, W. H., and Keesom, Mlle. A. P., *Physica*, **3**, 359 (1936).

[2] Kurti, Lainé and Simon, *C R*, **204**, 754 (1937).

[3] Keesom, W. H., and van den Ende, *Leyden Comm.*, 219*b* (1932).

Positrons from Radio-Scandium

ACCORDING to Fermi's theory[1] for the emission of β-particles, and its modification by Konopinski and Uhlenbeck[2], a nucleus can, instead of emitting a positron, absorb an electron from the K-shell, thus giving rise to the emission of the K-radiation from the element formed by the transformation. The ratio of the probabilities F for the emission of a positron and F_K for the absorption of a K-electron has been calculated by Møller[3] and by Mercier[4]; for scandium ($Z = 21$), the value for F_K/F varies from 0·1 to 5 according to the assumptions made in the theory.

I have carried out experiments with radio-scandium to see if the emission of positrons is accompanied by the emission of the K-radiation of calcium. Radio-scandium was obtained by bombarding lime, supported on a mica leaf, with α-particles from 300 millicuries of radon. The mica leaf with the lime was placed at the centre of an expansion chamber and the tracks photographed with air in the chamber in a magnetic field of 700 gauss. About 500 tracks were photographed, of which about 250 were utilized for measurements. The distribution of energy is shown in Fig. 1; the accuracy in the energy measurements is only moderate due to the use of air in the chamber, but is sufficient to give the upper limit of energy as 1·1 ± 0·1 MeV.

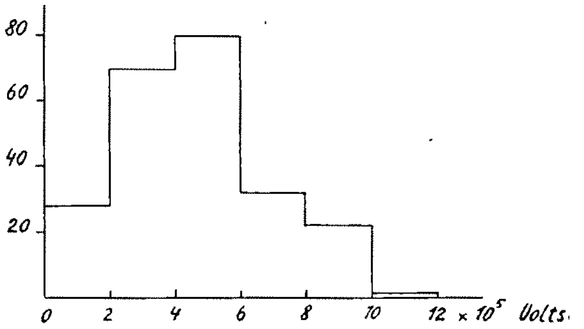

Fig. 1.

The K-radiation of calcium, when present, would by its absorption in the air of the chamber produce electrons with a range[5] of about 0·2 mm. This was checked by sending X-rays scattered from a target of calcium into the expansion chamber through a thin aluminium window. In the experiments with lime no trace of the X-radiation in question was observed; a number of short dense tracks was actually found, but these tracks were in nearly all cases secondaries from fast electrons and were further distributed uniformly throughout the chamber, whereas the X-radiation from calcium could only be found in one half of the chamber, since the mica leaf supporting the lime would absorb the X-radiation almost completely. The persistence of tracks with a high density of ions is larger than for tracks from fast electrons, so that the absence of K-radiation from calcium is fairly certain.

An estimate of the upper limit for the ratio F_K/F can be obtained from a consideration of the absorption of the K-radiation from calcium and the dimensions of the expansion chamber. In the absence of any observed effect such an estimate must necessarily be rather vague, but it appears fairly safe to assume that $F\ /F$ is less than $\frac{1}{10}$ and is probably less than $\frac{1}{100}$. The result of the present investigation, when compared with the calculations by Møller and by Mercier is, therefore, that Fermi's theory for β-decay is probably in accord with experiments; the modifications introduced by Konopinski and Uhlenbeck predict an emission of X-rays from elements emitting positrons, which is so intense relative to the emission of positrons, that it could scarcely have been overlooked in the experiments.

J. C. JACOBSEN.

Institute for Theoretical Physics,
Copenhagen.
April 6.

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[1] Fermi, *Z. Phys.*, **88**, 161 (1934).

[2] Konopinski and Uhlenbeck, *Phys Rev.*, **48**, 7 (1935)

[3] Møller, *Phys Rev.*, **51**, 84 (1937)

[4] Mercier, *C R. Acad. Sci.*, **207**, 1117 (1937).

[5] Williams and Nuttall, *Phil. Mag.*, **2**, 1109 (1926)

s-Trideuterobenzene and the Structure of Benzene

THE first and probably largest single step in the solution of the spectroscopic problem of the structure and vibrations of benzene was taken when, by comparison of the Raman and infra-red spectra of C_6H_6 and C_6D_6, the eleven active fundamental frequencies were identified, and shown to have isotope shifts agreeing with an application of Teller's theorem to the D_{6h} model[1]. It remained to determine the nine inactive frequencies, and secure the confirmation they should yield. For this purpose the plan outlined was to remove symmetry piecemeal by oriented deuteration in the sequence 1 : 3 : 5-$C_6H_3D_3$ (no centre), 1 : 4-$C_6H_4D_2$ (no 3-fold axis), C_6H_5D (no centre, no 3-fold axis), thus allowing previously inactive frequencies to become active a few at a time.

We have now completed the spectroscopic study of *s*-$C_6H_3D_3$, in which six additional fundamentals become allowed in either the Raman or infra-red spectrum. The centre of symmetry, which in C_6H_6 and C_6D_6 forbade coincidences, having now been destroyed, seven allowed fundamentals are common to the two spectra.

Having shown that the laws of electrophilic substitution are followed in the direct deuteration of aromatic compounds[2], we prepared the required benzene in a spectroscopically pure form by trideuterating aniline and eliminating the amino-group. Other methods had yielded spectroscopically impure material owing to partial randomization of the deuterium, a phenomenon which has been overlooked with resulting error in the published literature of partly deuterated benzenes.

We have determined the frequencies of forty lines in the Raman spectrum of the liquid, and the peak and integrated intensities and depolarization factors of eleven of them. We have measured also thirty-two infra-red absorption maxima for the vapour, and studied the contours of the twelve chief bands. The following abridged table contains the more prominent frequencies (cm.$^{-1}$).

Raman		Infra-red
E'' 375	‖	583 A_2''
E' 590·0	——	591 E'
E'' 707·5 D		691 —
E' 830 8	——	833 E'
A_1' 958 5 P	‖	914 A_2''
A_1' 1000 9 P		1065 —
— 1064		1095 E'
E' 1102 6		1226 —
E' 1407	——	1407 E'
E' 1572·2	——	1573 E'
— 2239 3		1631 —
A_1' 2279 0 P		1749 —
E' Obscured		1835 —
— 2975 7		2292 E'
A_1' 3053 8 P		2302 —
E' 3094	——	3087

The fundamentals are indicated by assignment symbols: A means totally symmetric, E degenerate, ′ and ″ symmetric and antisymmetric to the ring-plane, and $_1$ and $_2$ symmetric and antisymmetric to a 2-fold para-axis. The tie-lines show the allowed coincidences of fundamentals: in these the Raman lines are depolarized and the absorption bands perpendicular. The optical properties of the other fundamentals are shown by the symbols P = polarized, D = depolarized, ‖ = parallel. The assignments agree with these properties, and the frequencies satisfy Teller's theorem applied to the D_{3h} model.

The frequency, 1000·9, in which alternate ring-atoms move radially towards and from the centre, is inactive in C_6H_6, but we can now calculate that its frequency must be 1007, which is almost exactly what Kohlrausch[3] and also Lord and Andrews[4] estimated. The puckering vibration, 375, should also be inactive in C_6H_6, but its frequency supports Lord and Andrews's suggestion[4] that the weak Raman line, 404, of C_6H_6 arises from this vibration, which though forbidden appears on account of the intermolecular forces.

C. R. BAILEY. C. K. INGOLD.
A. P. BEST. A. H. LECKIE.
R. R. GORDON. L. H. P. WELDON.
J. B. HALE. C. L. WILSON.

University College,
London.
April 27.

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[1] NATURE, **135**, 1033, **136**, 680 (1935). *J. Chem. Soc.* (1936), nine papers

[2] *J. Chem. Soc*, 1637 (1936).

[3] *Naturwiss.*, **23**, 624 (1935)

[4] *J. Phys Chem*, **41**, 149 (1937).

An Antiluteogenic Factor in the Anterior Pituitary

RECENTLY Evans[1] reported the existence of a new pituitary factor, the 'antagonist', which inhibits follicle development in infantile rats when simultaneously injected with follicle-stimulating extracts from various sources. To avoid misunderstanding, it is proposed to call this factor 'antifolliculogenic', in contrast with 'antiluteogenic'. At about the same time, Bunde and Greep[2] described a regression of persistent corpora lutea in the ovaries of hypophysectomized rats by the luteinizing fraction of pituitary extracts.

The failure of regression of corpora lutea in a few thousand hypophysectomized rats has been very consistently proved in this laboratory. However, quite exceptionally in adult animals, no corpora lutea were found, when between hypophysectomy and autopsy they were used for testing 'growth hormone'. Another observation with importance in this connexion is, that very often after the twelfth day following insemination the complete removal of the pituitary in rats does not interfere with pregnancy, otherwise than that delivery is delayed 2–3 days beyond term. The responsibility for this was ascribed to the persistence of corpora lutea and confirmed by the histological appearance of the ovaries and by death, maceration and compression of the fœtus or abortion when the ovaries or only the corpora lutea alone were removed even a few days before expected delivery. An antiluteogenic function of the pituitary was suspected on these grounds and further experimental evidence in favour of this view was obtained as follows.

An alkaline extract from an acetone dry powder of beef anterior pituitaries after subcutaneous injection in infantile (about 20–28 days old) rats weighing 25–35 gm. produces enlarged ovaries with four to eight corpora lutea each (Fig. 1, *a*). The same extract when given intraperitoneally produces little ovarian growth, a few follicles with antrum and no corpora lutea (Fig. 1, *b*). Subcutaneous injection of a pregnancy urine gonad-stimulating extract yields moderately enlarged ovaries with a few cystic follicles and four to eight corpora lutea on each side (Fig. 2, *a*). Combined injection of the urine extract and the pituitary extract both subcutaneously, yield much enlarged ovaries with twelve to twenty corpora lutea each (Fig. 2, *b*), while after simultaneous injection of the urine extract subcutaneously and the pituitary extract intraperitoneally small ovaries are found with a few (cystic) follicles but no corpora lutea (Fig. 3).

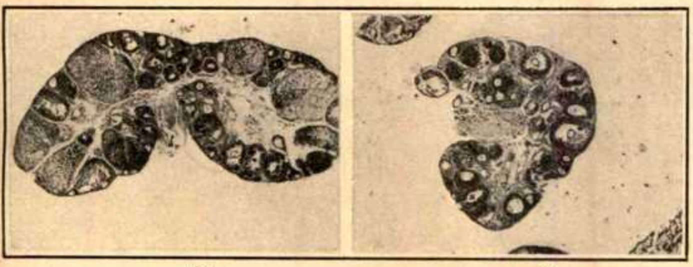
(*a*) (*b*)

Fig. 1.

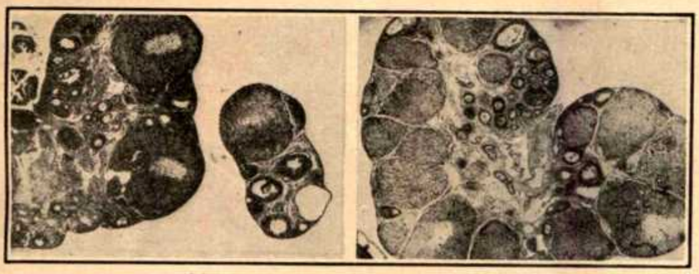
(*a*) (*b*)

Fig. 2.

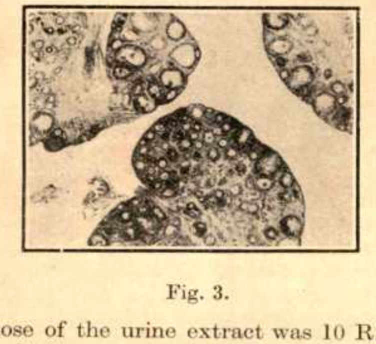

Fig. 3.

The dose of the urine extract was 10 R. œstr. U., of the pituitary extract 160 mgm. acetone dry powder extracted at *p*H 10·5. Six injections were given in 36 hours, the ovaries were removed for histological examination (hæmatoxylin-eosin staining) on the fifth day after the beginning of the experiment; four or five rats were used for every group and littermates were uniformly distributed. The experiments were repeated three times.

Confirmatory evidence was found by the interruption of two early (twelve day) pregnancies after eight intraperitoneal injections in five days. At autopsy no fœtuses were found. They probably were resorbed, because the placentæ were recovered in macerated condition from the uterine horns.

J. FREUD.

Pharmaco-Therapeutic Laboratory,
University, Amsterdam.
March 23.

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[1] *Univ. Californ. Publ. Anat.*, **1**, No. 8, 237 (1936).

[2] *Proc. Soc. Exp. Biol. and Med.*, **35**, No. 2, 235 (1936).

Oxygen Evolved by Isolated Chloroplasts

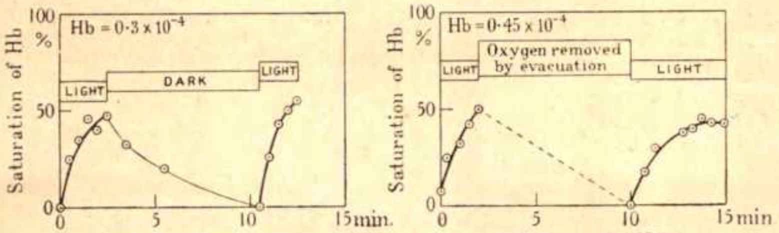
THE high affinity for oxygen possessed by muscle hæmoglobin suggested its use as a very sensitive spectroscopic method for detecting and measuring small quantities of oxygen[1]. This method has now been applied to study the oxygen evolution of isolated chloroplasts exposed to light. While being much less sensitive than the bacterial methods which have been successfully applied in the past, the hæmoglobin method (originally used by Hoppe-Seyler to demonstrate oxygen from green plants) has the advantage of giving the measure of oxygen. A solution of hæmoglobin containing $0{\cdot}45 \times 10^{-4}$ gm. atoms of iron per litre, is equivalent to 1 c.mm. of oxygen per c.c.; the degree of saturation can be determined spectroscopically with an accuracy of 5 per cent.

Fresh suspensions of chloroplasts obtained from various angiosperms with sucrose solutions do not evolve measurable amounts of oxygen in the light, even in presence of carbon dioxide. If, however, chloroplasts were suspended in an aqueous extract made from an acetone-leaf preparation, oxygen in measurable amounts was evolved in light. Extracts of acetone yeast or boiled yeast would produce the same effect as the leaf extract. The activity of these preparations depended on their ferric iron content, and they could be replaced by ferric potassium oxalate. Molecular oxygen is evolved, while ferric iron is reduced to ferrous.

At the beginning of the experiment oxygen is rapidly evolved, but as the partial pressure of oxygen rises the oxygen is absorbed and its evolution comes to a stop. This shows certain advantages of the hæmoglobin method over a manometric method, which could not be applied in the present case. A strong illumination of approximately 40,000 lux was used. The chloroplasts were present in an amount equivalent to $0{\cdot}2 \times 10^{-4}$ molar chlorophyll. The vessel was an evacuated Thunberg tube, 1·5 cm. diameter and containing 5 c.c. of fluid. Oxygen output curves in terms of percentage saturation of the hæmoglobin with oxygen are shown in Fig. 1 for (*A*) chloroplasts in leaf extract, (*B*) chloroplasts in an extract of boiled yeast, (*C*) and (*D*) chloroplasts in ferric potassium oxalate, all at 20° C. The evolution of oxygen in presence of ferric salts was not influenced by concentrations of sodium azide and hydroxylamine which markedly inhibit catalase.

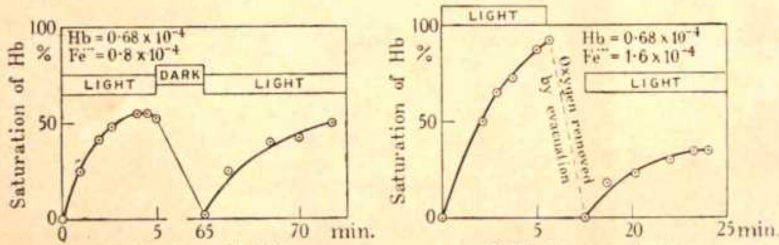
The iron-oxygen reaction of chloroplasts may indicate a mechanism connected with carbon assimilation. The appearance of molecular oxygen in light from a biological system apart from the whole cell or from hydrogen peroxide and catalase is unique. There is no evidence, however, that this particular reaction takes place in the living cell, neither is it proved that carbon dioxide takes part in the reaction. Carbon dioxide is the only known reagent which will cause oxygen evolution by the living plant ; ferric iron at present seems to be the only reagent which will cause measurable oxygen evolutions by free chloroplasts. This may be connected with the very interesting specific *in vitro* reaction found by Rabinowitch and Weiss[2] with ethyl chlorophyllide and ferric chloride, where the chlorophyll derivative appears to be reversibly oxidized in light while the iron is reduced.

Until other facts have been definitely established, it might be misleading to discuss the different theories of photosynthesis involving iron salts. The fact, however, that molecular oxygen in measurable quantities can be evolved by a biological system, less organized than the whole cell, gives new possibilities for applying biochemical methods to the green plant.



A *Lamium album*, 27 July
Chloroplasts in leaf extract

B *Stellaria media*, 27 Oct.
Chloroplasts in yeast extract



C *Stellaria media*, 10 Nov.
Chloroplasts in ferric oxalate
*p*H 6·5 *M*/50 phosphate

D *Stellaria media*, 10 Nov.
Chloroplasts in ferric oxalate
*p*H 6·5 *M*/50 phosphate

Fig. 1.

R. HILL.

Biochemical Laboratory,
Cambridge.
April 10.

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[1] Hill, R., *Proc. Roy. Soc.*, B, **120**, 472 (1936).

[2] Rabinowitch, E., and Weiss, J., NATURE, **133**, 1098 (1936).

Commensalism between a Marine Mussel, an Anemone and several other Organisms

ON February 4, 1937, Mr. A. R. Holland, assisting us in biochemical investigations on the California mussel, *Mytilus californianus*, brought to our attention one individual which showed a fair-sized cup or raised crater, built of the same calcareous material as constitutes the shell, attached at its base to the anterior region of the inside of the left valve, protruding through the mantle into the gill chamber, and containing a number of commensal invertebrates and some attached plant material.

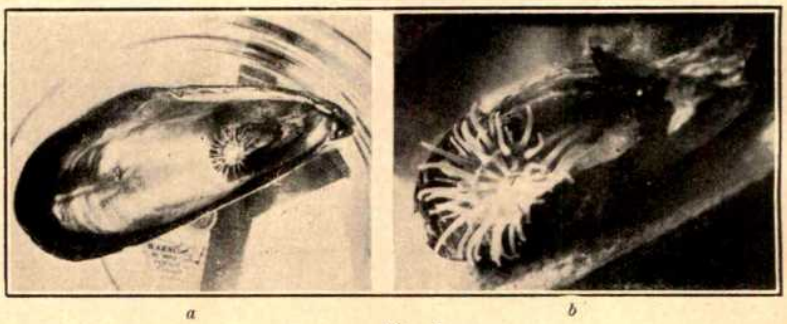

Fig. 1.

LEFT VALVE OF MUSSEL WITH FLESH REMOVED. (*a*) WHOLE VALVE ; (*b*) ENLARGED VIEW OF CRATER CONTAINING ANEMONE.

Most striking among the commensal animals was a small anemone, attached to the inside of the crater, with disk and spread tentacles extending over the rim of the crater into the gill chamber (Fig. 1). Other organisms found in the crater were a small bivalve mollusc, several polychæte worms, numerous Protozoa, a large siphonaceous alga apparently of the genus *Derbesia* and some small filaments of Myxophyceæ, along with much detritus. For the information regarding the algal organisms we are indebted to Prof. N. L. Gardner, of the Department of Botany at the University of California, to whom we submitted the plant material.

The mussel was a healthy female containing masses of orange-coloured eggs in its mantle ; the shell is 11·5 cm. long ; the crater 3·5 cm. long, 1·7 cm. wide (outside diameter at widest portion), and 1·2 cm. in depth, its bottom being the bright, nacreous inner surface of the valve.

The anemone was also healthy, ready to feed, and is still living (March 18) in the crater ; it showed a pale greenish ring around the oral aperture, the tentacles being only very faintly greenish in tint. Zoochlorellæ were not observed. The animal is almost certainly a young specimen of our common anemone *Cribrina* (= *Bunodactis*) *xanthogrammica*. It showed, at the time of discovery, a tentacle spread of 2 cm., the diameter of the oral disk being 0·8–0·9 cm.

Where the mantle surrounded the outer wall of the crater's short column, it was attached thereto, and had formed a dark out-curling lip around the edge of the crater's opening; this lip was composed of a chitinous material similar to that which is laid down by the mantle at the inner rim of each valve.

Prof. G. E. MacGinitie, at the Kerckhoff Marine Biological Laboratories of the California Institute of Technology, writes (personal communication) that he has encountered such craters as described above in certain other lamellibranchs, notably *Schizothærus*, but that the condition is rather rare. He states that such pockets, built up by the animals in response to the presence of insoluble detritus which may lodge between the mantle and the shell, will soon become inhabited by other forms which invade it in larval stages, and that it is a matter of relative chance what forms adapted to such a locality first secure residence. The laws governing survival then determine which members of such a group may retain their places and which must be crowded out or devoured.

The subject of commensal organisms encountered within lamellibranch shells is rather extensive, and has no place in this note. It seemed of interest, however, to report this particular case, since a fair search through the literature and discussions with various ecologists failed to reveal previous reports of commensalism between a normal anemone and a healthy, plankton-feeding lamellibranch.

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ROBERT T. YOUNG.

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University of California,
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Water and Fat Content of Tsetse Flies

IN recent letters Mr. R. W. Jack[1] and Dr. C. H. N. Jackson[2] state that, when considering the effects of climate on tsetse metabolism, it is valuable to express the percentage of water present in the insects at different times as a function of the "fat-free" dry weight. This is because the amounts of this food-reserve vary greatly; it occurs concentrated in the fat-body and not in large amounts in the individual cells of the vital tissues. Jack and Jackson imply that their methods show the conditions in the tissues of the tsetse more accurately than do gross percentages of water and dry matter present in the bodies of the insects.

I am doubtful whether this manipulation of the results is really useful. If we wish to know what conditions obtain in the tissues, it will be necessary to study individual tissues by microanalytical methods. There are many constituents of an insect's body which vary greatly, such as skeletal structures, gut-contents or fæcal materials, and they, as well as fat, should be subtracted to obtain the sort of results which Jack and Jackson desire. There is one other substance which they do not consider, but which should be studied in investigations of the water-balance of insects, and that is the circulating fluid or hæmolymph. Dissections of bedbugs, ***Rhodnius***, tsetse flies and other insects show that sometimes the tissues are amply bathed with fluid, while at other times they appear almost dry. The hæmolymph acts as a sort of 'buffer' against desiccation. The tissues themselves do not usually appear to vary greatly in water-content, for so long as there is a sufficient supply of hæmolymph to circulate, the cells of the various organs reached by it are not themselves desiccated unduly. This has been shown experimentally by analyses, by microscopic examination of the living tissues themselves, and the same conclusion is supported by Wigglesworth's observations[4] on the extent of the fluid in the tracheoles of desiccated insects. These changes in volume of the circulating fluid will affect the gross analyses enormously, whether or not the fat is subtracted.

These comments are made because I feel that if other workers adopt Jack's and Jackson's suggestions, they may be diverted from more significant studies of the effects of climatic conditions on vital structures. Laboratory studies[3] show that the gross percentage of water in a tsetse fly may vary more widely than Jack's and Jackson's field observations indicate, without the insect being harmed or its metabolic rate being affected. The insects have to lose a great deal of water, probably equivalent to the whole of their hæmolymph, before they suffer from desiccation. Normally, even under dry conditions, they appear to exhaust their reserves of fat before this happens; or they obtain a meal of blood which contains sufficient excess of water to allow the body to return to normal.

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[1] Jack, R. W., NATURE, 139, 31 (1937).

[2] Jackson, C H. N., NATURE 139, 674–5 (1937).

[3] Mellanby, K , *Bull. Ent. Res.*, 27, 611–32 (1936).

[4] Wigglesworth, V. B., *Proc. Roy. Soc* , B, 109, 354-59 (1931).

Histology of *Derris* Roots

WE have recently investigated the histology of *Derris elliptica* roots, with respect to their contents of rotenone and related toxic substances. Cells which apparently contain resins are distinguishable in unstained sections. We have applied Durham's test to sections, and have shown that the resin cells, and these only, respond to the test.

Rotenone cells first appear in young roots just as suberization is beginning, but never before, as isolated groups in the secondary cortex. These are invariably arranged opposite to the protoxylem elements, and correspond in number to them. Rotenone afterwards appears in cells scattered through the xylem parenchyma and the cortex. These increase in number with the age of the root, and are especially numerous in the medullary rays. They appear to be structurally non-specialized, and are indistinguishable from normal xylem parenchyma.

Starch also occurs in *Derris* roots. It is mainly confined to the semi-lignified cells forming a sheath to the vessels, but it also occurs in scattered irregular groups in the non-lignified xylem parenchyma and in the cortex. We have never observed starch and rotenone in the same cell: in fact, we are satisfied that, in the xylem parenchyma, starch cells and rotenone cells form mutually exclusive groups.

A paper giving the full results of this investigation is being prepared for publication.

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F. J. NUTMAN.

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Tanganyika Territory.
April 16.

Estimation of Ammonia Volatilized from Soils

ALTHOUGH it has been recognized that a part of the nitrogen in the soil system may be lost in the form of ammonia, the extent of such loss—especially under field conditions—has not yet been satisfactorily determined, largely owing to want of suitable technique. Estimates based on difference in total nitrogen are not sufficiently accurate. Aeration methods are tedious and time consuming: they also disturb the biological conditions in the medium. Extraction and distillation methods are unsuitable, as the estimates thus obtained may not be entirely due to free ammonia. The following method was therefore developed, and was found to work quite satisfactorily.

The procedure consists in pasting a piece of filter paper (previously acid treated, for example, Whatman No. 30 or 41) moistened with standard acid on the inside of a glass or enamelled dish which just covers the beaker or other vessel containing the soil. The ammonia evolved from the medium is absorbed by the acid. At convenient intervals the dish can be removed and the unused acid in the paper estimated by back titration against standard alkali with methyl red as indicator and boiling to drive off carbon dioxide.

The above procedure is very simple and rapid. By suitably altering the strength of acid, varying quantities of ammonia can be estimated. The method can be applied to time studies, the paper being changed periodically. The temperature can also be varied according to requirements. The studies can be carried out under both laboratory and field conditions.

Applying the above method, it has been found that practically all soils treated with ammoniacal fertilizers—especially under tropical conditions—lose ammonia by volatilization. In some cases, all the added nitrogen is lost in the course of ten days. Soil treated with organic manures with narrow C—N ratios also lose large quantities of nitrogen as ammonia.

The mechanism of the related processes has been studied and will be reported elsewhere.

V. SUBRAHMANYAN.

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April 7.

The So-called 'Transition Temperature' of Metallic Films

THE relation of the electric resistance to temperature of metallic films of zinc, cadmium, magnesium and antimony, condensed from vapours on a cold surface of glass, was investigated employing an apparatus similar to that described in a previous paper[1]. A double-walled copper cylinder was inserted in the inner vessel in order to cool pentane contained in the latter indirectly with liquid nitrogen, and a stirrer was used to ensure uniformity of temperature distribution. The bath temperature was read with a copper-constantan thermo-junction and a millivoltmeter, and the thicknesses of the metallic films were estimated by weighing with a microbalance having an accuracy of 1×10^{-5} gm. The metallic specimens were from Kahlbaum.

Zinc, cadmium and magnesium were condensed on glass at − 150° C. and antimony at − 75° C., and the heating rates were kept between 1·0° ~ 1·2° C. per minute. An example of the changes of resistance for various thicknesses of films is shown in Fig. 1. The so-called 'transition temperature'[2], which is the crystallizing temperature, is indicated by arrows, and becomes less distinct when the thicknesses of the films reach several hundreds millimicrons. Abrupt increases of resistance in zinc, cadmium and magnesium are caused from the crack-formation in the films.

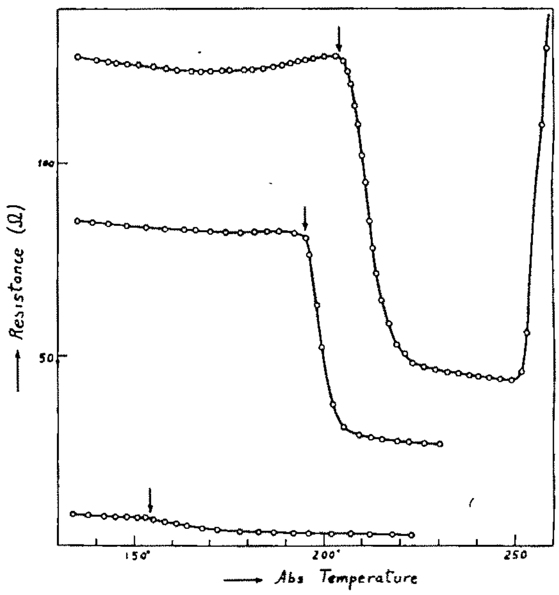

Fig. 1.

RESISTANCE OF CADMIUM FILMS.

If the films are not too thin, linear relations exist between the thicknesses and the logarithm of the transition temperatures. The gradients of these straight lines are exactly the same for zinc and cadmium, and almost the same for antimony and magnesium. When this straight line relation is extrapolated to zero thickness, the ratio of transition temperature (Tu) to melting point (Ts) of the respective metals ranges from 0·36 to 0·41, which coincides with that for the bulk metals[3] as shown in the following table:

	Zinc	Cadmium	Magnesium	Antimony
$\log_e t_u$	5 625	5 485	5 8	5 82
t_u	277°	241°	330°	337°
t_s	692°	594°	906°	903°
t_u/T_s	0 40	0 41	0 36	0 37

The present investigation is being extended to other metals.

TADAO FUKUROI.

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Steel and Other Metals,
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March 1.

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[1] T. Fukuroi, *Sci. Rep Tôhoku Imp. Univ.*, Prof. Honda Anniversary Volume, 80 (1936).

[2] Kramer, J., *Ann. Phys.*, (5), 19, 37 (1934); *Naturwiss.*, 20, 792, etc. (1932).

[3] Tammann, G, *Z. anorg Chem*, 157, 325 (1926) or Jefferies and Archer, "The Science of Metals" (1924), p 86. The ratios of the recrystallization temperature and the melting point are given as $TR/Ts = 0{\cdot}32 \sim 0\ 43$ for ordinary metals.

Dispersion of Sound Velocity in Liquids

As is now well known[1], the spectral character of monochromatic light scattered by many liquids exhibits an observable change as the result of such scattering; an instrument of sufficiently high resolving power, for example, a Fabry-Perot étalon[2], indicates the presence of Doppler-shifted components on either side of the main radiation. From this we are able to infer that sound waves of very high frequency represent a considerable part of the energy of thermal agitation in such liquids. The frequency of the sound-waves actually revealed by this method depends on the wave-length of the incident light, the angle of scattering and the liquid employed; in most actual cases, it lies within the frequency range 1,000–10,000 megacycles per second.

It is a question of considerable importance, whether these spontaneously existing sound-waves of thermal origin of very high frequencies ('hyper-sonic waves'), have velocities of propagation differing appreciably from those of lower frequencies (audio-waves and ultra-sonic waves) capable of being produced artificially by mechanical or electro-acoustic methods. The sound velocities within the ultra-sonic range (< 100 mega-cycles) can be measured with high precision (Hiedemann[3] and Parthasarathy[4], etc.). For the determination of the hypersonic velocity, we have to depend on the magnitude of the Doppler-shifts as observed interferometrically, the measurements of which are, however, liable to serious errors owing to (*a*) the angular width of the scattered beam, (*b*) the intrinsic breadth of the Doppler component, and (*c*) the imperfect monochromatism of the incident radiation, including especially the hyperfine structure satellites. The third source of error is particularly serious, as the satellites are intense and by their superposition shift the apparent position of the Doppler components. An examination of the published literature shows that none of the measurements reported so far has taken account of the sources of error sufficiently to enable any definite conclusions to be drawn from them.

TABLE 1.

Liquid	Observed Doppler shift (cm.$^{-1}$)	Velocity in metres/second	
		'Hyper-sonic' frequency 5 0 × 10^9	'Ultra-sonic' frequency 7 32 × 10^6
Carbon tetrachloride	0 261	1070 ± 25	928 ± 1
Acetone	0 221	978 ± 25	1205 ± 1

The subject has been taken up afresh by me, at the suggestion of Sir C. V. Raman, and systematic efforts have been made to eliminate the sources of error mentioned above by choosing the experimental conditions suitably. By using a low-density and cathode-cooled mercury arc lamp, and by a proper selection of the radiation used and of the invar distance piece separating the plates of the étalon employed, with reference to the sound velocity in the liquid under investigation, it has been found possible to eliminate the errors and obtain dependable results.

The programme now on hand includes numerous liquids; it will be sufficient here to report the results for carbon tetrachloride and acetone, which have stood the test of careful repetition and scrutiny.

It is interesting to note that in carbon tetrachloride the hyper-sonic velocity is definitely greater than the ultra-sonic velocity, while in acetone the reverse is the case.

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April 10.

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[1] Brillouin, L., *Ann Phys*, 17, 88 (1922) Gross, E., NATURE, 126, 201, 400, 603 (1930).

[2] Raghavendra Rao, B V, *Proc Ind. Acad. Sci.*, A, 1, 261, 473, 765 (1934), 2, 236 (1935); 3, 607 (1936).

[3] Hiedemann, E., and Bachem, *Z. Phys.*, 94, 68 (1935).

[4] Parthasarathy, S, *Proc. Ind. Acad. Sci.*, A, 2, 497 (1935).

An Effect of Rectified Current from a Tunger Valve upon the Electrolytic Separation of Heavy Water

A RATHER low yield of the heavy water obtained with the usual method of electrolysis, using the single-phase full-wave Tunger valve rectifier, led us to investigate the cause of loss of the heavy water. Besides a good deal of loss through evaporation and spraying, and possibly a loss arising from an exchange reaction occurring at the electrode, the rectified current employed may have been also a contributing factor to the loss.

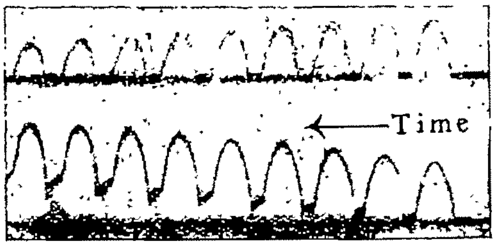

Fig. 1.

With this latter view in mind, the following experiments were performed. Two identical cells in a closed form with nickel electrodes, which were so constructed as to make a loss from evaporation and spraying entirely negligible, were employed. In each of these two cells was placed an equal amount of the electrolytes (40 c.c.) with 1 per cent D_2O content. To one cell was supplied the direct current, to the other the rectified current. The two cells were independently connected with a Wood discharge tube. The intensity of the Dγ line in the Balmer series was observed from the water remaining in the cell, simultaneously with the decrease of the volume of the electrolyte. The result after the exposure of one minute showed that on the D.C. side the Dγ line appeared at one ninth the initial volume, whereas on the rectified current side the same intensity of Dγ line appeared at one twenty-seventh the initial volume.

The effect was also investigated with the oscillograph, using this time fifteen cells actually employed for the production of the heavy water. The result showing the variation of current and voltage with the time immediately after the rectified current was supplied are shown in Fig. 1, where *a* shows that the current passing through the cell becomes smaller with the period of the pause becoming greater; and *b* shows that the back E.M.F. reaches the half-value of saturation in 10/120 sec., during which a H atom may be able to stay on the electrode.

The action at the cathode may be as follows: first, neutralization of the hydrogen ion or its hydrated ion with an electron from the cathode metal, and secondly, recombination of H atoms to form a molecule. Both H and D atoms accumulated at the cathode tend to diffuse back into the solution during the pauses of *a*, but their respective rates will be different. According to the theories of W. R. Gurney[1] and R. P. Bell[2], the rate of diffusion of an atom into the solution depends on the force constant of the link between the ion and the water molecule. With the increase of atomic weights, the force constant of the link or the heat of hydration becomes smaller, that is, the rate of the diffusion becomes smaller; thus, for example, the heat of hydration of H ion is 200 kcal. per gm.mol., while that of Li ion 15 kcal. per gm.mol. Therefore, the rate of back diffusion of the H atom will be higher than that of the D atom. Consequently, D may remain on the electrode sufficiently long for another D or H atom to approach it, with the formation of D_2 or HD, which will escape as a gas molecule. This process may perhaps account for a loss of D content during the electrolysis, in our case.

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[1] Gurney, W R., *Proc Roy Soc.*, A, **134**, 137 (1932)

[2] Bell, R. P, *J. Chem. Phys*, **2**, 104 (1934).

A New Alloy of High Density

IN an article in NATURE of March 20[1], Dr. C. J. Smithells describes a very interesting method of producing alloys of tungsten without melting the tungsten itself. He mixes tungsten powder together with copper and nickel powder and then heats them to 1,450° C., at which temperature the mixture sinters, the tungsten becoming embedded in a tungsten-copper-nickel eutectic. He thus avoids the technically extremely difficult, if not impossible, task of heating large masses of tungsten to melting point.

This metallurgical process is of particular historical interest, as it makes use of the principle employed by the Pre-columbian Indians of the Esmeraldas coast in South America. As I have shown[2,3], these Indians used the above method to produce coherent platinum; the platinum was heated together with a small quantity of gold until the melting point of the latter was reached. The platinum thus became embedded in a platinum-gold eutectic. Subsequent alternate heating and hammering produced a homogeneous alloy so resembling ordinary platinum that superficial examination will deceive even a modern metallurgist.

Copenhagen. PAUL BERGSØE.
April 12.

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[1] NATURE, **139**, 490 (1937)

[2] NATURE, **137**, 29 (1936).

[3] Ingeniørvidenskabelige Skrifter A 44 Copenhagen.

Effect of the Penetration of X-Rays on the Resolving Power

FROM the generality of the principle of uncertainty $\Delta E.\Delta t = h$, it follows that the equation for the resolving power of a grating $\lambda/d\lambda = m.n$ (where λ is wave-length, m is number of rulings, n is order of the spectrum) is valid not only for the ruled grating, but also for space-lattices. On the other hand, for example, for the ruled plane gratings used for X-rays, the resolving power is limited by the fact that it is not possible to collimate the reflected beam of X-rays. It can be shown that for the space lattices also the resolving power is limited, owing to the widening of the lines caused by the penetration of X-rays into the crystal, since the reflected beam of width w_0 is not collimated (see Fig. 1), so that the resolving power, corresponding to the number m of reflecting planes, cannot be attained.

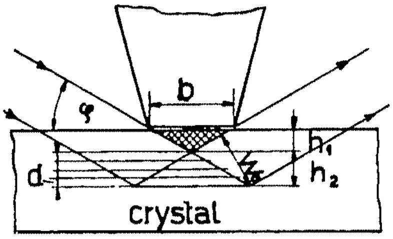

Fig. 1.

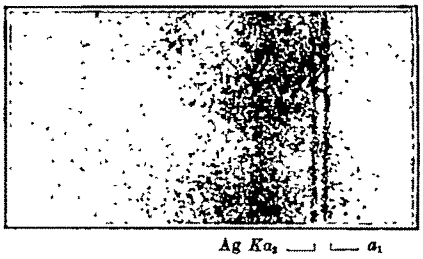

Fig. 2.

We attempted to find the effective depth of penetration of the radiation into the crystal using the Seemann 'edge' method, only instead of sharp edges we used blunt edges of various thicknesses b, placed against the surface of the crystal. Thus, as shown in Fig. 1, we screened from the incident X-rays of glancing angle φ a surface portion (though mostly effective) of the crystal to the depth $h_1 = \tan\varphi.b$.

We used the $K\alpha$ lines of silver. By using an edge of thickness $b = 0{\cdot}3$ mm. pressed against the surface of the crystal, we have screened (for silver $K\alpha$, calcite crystal $\varphi = 5° 20'$), a depth $h_1 = 1{\cdot}5 \times 10^{-2}$ mm. With this arrangement we obtained the photograph shown in Fig. 2. Comparing this result with those obtained by means of sharp edges for this region of shorter wave-lengths[1], it can be seen that by screening a definite depth of the crystal, and thus diminishing the number of reflecting planes, the resolving power has been considerably increased (about five times).

From the width of the silver $K\alpha$ lines on plates taken at varying distances from the crystal, and by measuring the divergence of the beam $\Delta\varphi = 11''$, we have calculated the width w_0. This width corresponds to the depth h_2, which remains effective for interference in the crystal after screening $h_2 = 2 \times 10^{-2}$ mm.

The decreased number of reflecting planes corresponding to this depth h_2 is thus still of a greater order than that corresponding to the resolving power $\lambda/d\lambda = m.n$ actually obtained, so that the resolving power is still not limited by the time uncertainty Δt between rays reflected from the first and m-th planes. On the other hand, it can be shown from the results of Allison and Parratt[2], that the limiting of $\lambda/\Delta\lambda$ by Δt occurs for long wave-lengths, for example, for Si *Kα*.

By using the screening method described above also for the *Kα* lines of copper, we found that the resolving power for these lines was increased, if compared with that obtained by us without screening, but was not greater than that obtainable from a vacuum spectrograph using the Bragg method.

V. DOLEJŠEK.
J. KLEIN.

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Charles' University,
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March 31.

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[1] See, for example, M. Siegbahn, "Spektroskopie der Roentgenstrahlen", 1931, p 105, Fig. 92.

[2] Allison, S. K., *Phys. Rev*, 38, 203 (1931), Parratt, L. J., *Rev Sci. Inst*, 6, 113 (1935).

Points from Foregoing Letters

RESISTANCE-TEMPERATURE curves have been obtained by Dr. J. F. Allen and E. S. Shire for a phosphor-bronze resistance thermometer down to a susceptibility temperature of 0·027°. The results show that a phosphor-bronze resistance thermometer can be conveniently used in the range of temperature below 1° K. From Simon's relation the probable difference between susceptibility temperature and the absolute temperature at such very low temperatures is not greater than 0·02°.

The energy distribution of positrons emitted by radio-scandium, produced by irradiating lime with alpha particles from radon, has been determined by Dr. J. C. Jacobsen. He finds that there is no emission of X-rays corresponding to the *K*-radiation of calcium, as would be expected from the hypothesis of Konopinski and Uhlenbeck.

As a further step in the spectroscopic investigation of the structure and vibrations of the benzene molecule, a table giving the more prominent frequencies in the Raman spectrum of *s*-trideuterobenzene (s-$C_6H_3D_3$) is submitted by a group of investigators from University College, London.

When the pituitary glands are removed from rats, the corpora lutea do not regress in the usual way, but persist. This, J. Freud points out, suggests the presence of an antiluteogenic factor in the pituitary, and he finds further support for this view in the fact that when an extract of the anterior pituitary is injected intraperitoneally in infantile rats, the formation of corpora lutea is inhibited. Subcutaneous injections, on the other hand, do not prevent the formation of corpora lutea.

The evolution of oxygen from illuminated chloroplasts isolated from the cell has been measured spectroscopically by the use of hæmoglobin by R. Hill, who finds that the evolution of oxygen is caused not by carbon dioxide, as in the intact cell, but by ferric salts which become reduced to ferrous salts while molecular oxygen is liberated.

Dr. K. Mellanby does not consider that expressing the content of water in tsetse flies as a function of the fat-free dry weight gives an accurate picture of conditions in the tissues, as is suggested in recent letters by R. W. Jack and C. H. N. Jackson. Gross changes in the volume of circulating hæmolymph occur, considerably altering the dry-matter water ratio. The tissues themselves are not desiccated so long as any circulating fluid remains.

Prof. V. Subrahmanyan directs attention to loss of soil nitrogen by volatilization of ammonia and describes a method for estimating it. The ammonia is absorbed in filter paper previously moistened with known quantities of standard acid. Applications of the method are indicated.

A table giving a comparison of the velocity of ultra-sonic waves (of frequency 7×10^6) in carbon tetrachloride, and also in acetone, with the velocity of 'hyper-sonic' waves (of frequency 5×10^9) as deduced from new measurements of the Doppler shift in the monochromatic light scattered by those liquids, is submitted by B. V. Raghavendra Rao. In carbon tetrachloride, the hyper-sonic velocity is greater than the ultra-sonic while in acetone the opposite is the case.

A comparison of the increase in the concentration of heavy water by electrolysis, (*a*) with direct current, (*b*) with current rectified with a 'Tunger' valve, shows that the direct current is more efficient for separating the heavy water. From the shape of the current-voltage curves of the rectified current (analysed by means of the oscillograph), T. Asada and E. Honde infer that the loss in the heavy component produced by the rectified current may be due to the fact that the rate of diffusion of the heavy hydrogen (deuterium) being slower than that of the light hydrogen, a deuterium atom may remain on the electrode sufficiently long for another atom to approach it, with the resultant formation of D_2 or HD molecules, which then escape as gas.

Curves giving the electrical resistance at different temperatures of very thin metallic (cadmium) films condensed on glass are submitted by T. Fukuroi. The curves show a fall in resistance at the 'transition temperature'—which itself depends on the thickness of the film. The author gives a table indicating that in the case of films of zinc, cadmium, magnesium and antimony, the transition temperature is a constant fraction of their melting point.

By screening a calcite crystal to a definite depth by means of a blunt 'Seemann edge', Prof. V. Dolejšek and J. Klein find that the resolving power for the *K*-α lines of silver is increased about five times. From the generality of the principle of uncertainty they deduce that, as in the case of the ruled gratings, the resolving power of the space lattice of crystals is limited owing to the widening of the lines caused by the penetration of the X-rays into the crystal.

Research Items

Military Organization in Swaziland

IN a study of the military organization of the Swazi (*Africa*, 10, 1, 2), Hilda Beemer points out that the one service which the military organization is no longer allowed to perform is the key to its former importance and present impotence. Inter-tribal warfare has been suppressed, and for the purpose of war against the European its weapons are out of date. Wars were waged to extend the boundaries, to retain tribal independence, and to secure internal solidarity. At times it was a competition instituted by the warriors to show their courage, loyalty and strength. The prize was glory and booty, more especially cattle. The young bloods would boast to the king, asking to be allowed to show that they were better than such and such a regiment, who would then ask permission of the king to be allowed to show their prowess against an outside enemy. An enemy rich in cattle would be chosen, and the tribal war-doctor would doctor the regiments to bring them home alive and 'wipe out' the terror of taking life. This was a national and not a personal rite ; and the individual soldier would often arm himself with powerful medicine purchased from private doctors. The king himself never went to war but while the regiments were away he, with the national war doctor, worked out destructive magic against the enemy, and in this way also fortified his own subjects. The old war magic was in the hands of a special clan who were forbidden to use it for private individuals or for civil strife between two sections of the Swazi. The tribal ancestors were always considered to be present in spirit, giving courage to the men and ennobling their aim. Spoil brought back was distributed by the king according to group and individual achievement. A certain number of cattle was always set aside for national use in the cattle posts of the king, while every man who killed an enemy was entitled to a decoration for bravery.

Clowns in Hopi Ceremonial Dances

DR. ELSIE CLEWS PARSON has edited the voluminous journals kept by Alexander M. Stephen, who from 1881 until the early 'nineties, when he died, was in touch with the Hopi of Arizona, and assisted J. W. Fewkes by his intimate knowledge of Hopi ceremonial and custom in the studies which the latter published with the Bureau of Ethnology (*Columbia Univ. Contrib. Anthrop.*, 23, Pts. 1–2). Stephen was admitted to three societies, the Flute, the Lalakon and the Snake, and he lived in several households, both Hopi and Tewa, on the Mesa top. His journals contain much detail unpublished even in the parts incorporated by Fewkes. Little attention is given to material culture (though an exception is his account of pigments, and their relation to sexual attribution and the cardinal points), and his observations deal mainly with the seasonal festivals, of which he took detailed notes while they were being performed. Owing to the changes which have since taken place and the reticence of the Hopi, which even Stephen found a hindrance, the material is especially valuable. One of the remarkable features which Stephen observed is the puzzling ceremonial of the clowns. Of this he gives a graphic description. On First Mesa there are four clown types, of which the Ta'chukti, like the Koye'mshi, wear masks with knobs and carry a fawn skin bag. They wear the black dress of a woman as breech-clout, and mask and body are painted with pinkish clay. They sing Zuñi songs, pretend to talk Zuñi and even make Zuñi prayer sticks. Their origin myth is a Koye'mshi brother-sister incest story, their play obscene or phallic, and their games are those of the Koye'mshi. They are sprinkled with meal as sacred figures and rain-making is an attribute of their eponymous spirit. They have no fixed chieftainship or organization. The Chuʳku'wimkya wear a wig and are painted yellow with red stripes across their faces. They initiate in an ash house, an outline in ash made in the dance court. The initiation is for temporary membership only, and seems to be part of their play. The ash house appears in the clown ritual elsewhere.

Nemertea and Crinoidea of the John Murray Expedition

NUMBERS 3 and 4 of the "Scientific Reports of the John Murray Expedition 1933–34" (British Museum (Natural History), 4 ; 1936) contain the Nemertea by J. F. G. Wheeler and the Crinoidea by Austin H. Clark. Only two specimens of nemerteans were collected by the Expedition, a littoral form taken with the dredge in shallow water off the Arabian coast which proved to be *Amphiporus reticulatus* Burger, previously only known from the Bay of Naples ; and a pelagic form sorted from the plankton taken in the Indian Ocean, representing a new genus and species which is described in the report under the name of *Nannonemertes indica*. This new nemertean is referred to the family Pelagonemertidæ, Mosley. The crinoids form an important addition to our knowledge of the fauna of the Indian Ocean, as they were very imperfectly known in this region, the sixteen species recorded enabling the author to supplement the information already available and to describe one new genus and five new species. An annotated list of all crinoids at present known from the seas west of Ceylon and the west coast of India is given and the crinoid fauna of the Indian Ocean and the Red and Arabian Seas is discussed. Many interesting points arise and for the first time it has been possible to describe, "with the probability of a reasonable degree of accuracy", the faunal relationships of the different portions of the Indian Ocean.

The Asteroid Nervous System

To Johannes Müller (1850) we owe the first recognition of the asteroid nervous system. As a result of subsequent work, it is widely taught that it is composed of three parts, a sensory ectoneural system, a hyponeural system (Lange's nerve) and an apical system, the two latter being motor in function and of mesodermal origin. The whole problem of this system has been re-investigated by J. E. Smith (*Phil. Trans. Roy. Soc.*, B, 227, 1937). The work was mainly based on *Marthasterias glacialis*, but six other species were also studied. It is suggested that a more useful division would be into sensory and motor systems. There is a general ectodermal sensory system with concentrations in the radial nerves and the circumoral ring found in all classes. The ring, however, is absent in Crinoids, which have a well-developed apical sensory system not homologous with the apical nerve of Asteroids, which is motor. The ectodermal system communicates with the motor system through the interspaces of the boundary zone of connective tissue. The hyponeural (motor) system is also a constant feature but the extent and position of its development are related to the type of motor activity of the animal. Thus in Echinoids, where a test prevents movement of the body wall, the radial hyponeural nerve is absent.

Fowl-Pox and its Transmission

FOWL-POX is a virus disease which attacks chicken, pigeons, geese, turkeys and other birds, and causes considerable loss to the poultry farmer. It appears as cheesy diphtheritic membranes in the mouth, and as warty growths on the comb, wattles and mucous membrane of the mouth and eyelid. In the past, it was supposed that these various lesions were caused by different agents, but R. L. Kaura and S. G. Iyer confirm the present view that all are due to a single filter-passing virus (*Indian J. Vet. Sci. and Animal Husbandry*, 6, Pt. iv, 313 ; 1936). They find that diphtheritic lesions from the mouth produce the fowl-pox lesions on the skin, and that the Indian strain of virus is immunologically indistinguishable from the English Weybridge strain. A. L. Brody has studied the transmission of the disease (Cornell Univ. Agric. Expt. Station, Memoir 195. Ithaca, N.Y., 1936). Direct contact is one certain method by which fowl-pox is spread within a flock, and contaminated inanimate objects may possibly do so as the virus on them remains alive for at least six weeks. Mosquitoes, such as *Aedes ægypti*, may also transmit the contagion by intermittent feeding. Inoculation of the bodies of mites (*L. sylviarum*) four days after their last association with diseased birds produced pox, but mites after feeding on diseased, and then on healthy, birds did not cause pox.

Pruning the Tea Plant

J. R. TUBBS (*J. Pom. and Hort. Sci.*, 14 (4), 317 ; 1937) has estimated that the young shoots of the tea plant (*Camellia Thea*), of which the majority of leaves are normally harvested almost as fast as they grow, have produced at the time of harvesting only half the amount of carbohydrate used up in their development. The consequent continual depletion of he reserves of the bush frequently causes die-back of branches, followed by fungal attack and the death of the whole bush. An investigation on plantations at 200 ft., 1,500 ft. and 4,600 ft. above sea-level howed that die-back was more common at the lower levations, and smaller amounts of reserve carbohydrate were found in the roots. Several methods of pruning were tried, and it was found that by llowing a number of branches to retain their foliage, method designated 'lung-pruning', the drain on carbohydrate was checked and the incidence of die-back reduced.

uchromocentre Type of Nucleus and Feulgen's Stain

IT is now commonly recognized that plant nuclei are usually either of the large chromosome type giving chromatin 'reticulum' in the resting stage or of he small chromosome type in which, in the resting tage, the small amount of chromatin is present in he form of euchromocentres lying peripherally to a large central region containing the single large nucleolus. G. Yamaha and S. Suematsu (*Sci. Rep. Tokyo Bunrika Daigaku*, 3, Section B ; 1936) have examined many species of Cucurbitaceous plants, which with *Impatiens* and *Ricinus* have the latter type of nucleus, and have followed the behaviour of the constituent parts of the nucleus to Feulgen's stain through the nuclear cycle. During prophase, in addition to the euchromocentres, the nucleolus and nuclear sap also stain faintly with Feulgen. At metaphase-anaphase the chromosomes are fully chromatic, but the nucleolus, which persists to this time, and the nuclear sap no longer stain. After the formation of the nuclear membrane at the completion of telophase, a clump of irregular granules, often in connexion with the disappearing chromosomes, appears and afterwards this clump rounds off to form the typical nucleolus of the resting stage. There seems strong evidence in this case that material responsible for the Feulgen reaction is, at least in part, transferred from nucleolus and sap to chromosomes during prophase and from chromosomes to the sap and a new nucleolus at telophase.

Air-Mass Analysis

AT a meeting of the Royal Meteorological Society held on April 21 a paper was read by E. W. Hewson on the application of wet-bulb potential temperature to air-mass analysis, particularly in regard to the rainfall that is to be expected to result ultimately from the ascent of air in the warm sectors of depressions with various vertical distributions of wet-bulb potential temperature. Wet-bulb potential temperature was introduced sixteen years ago by Normand as a simple function of the temperature and humidity that will remain constant during any adiabatic or pseudo-adiabatic process, the name being derived by analogy with ordinary potential temperature—the temperature that any sample of air will take up when its pressure is brought adiabatically at a standard pressure. It was shown that the potential instability in a column of air is determined by the vertical distribution of potential wet-bulb temperature, and that a mass of damp air may become unstable merely by being lifted to a greater height above the ground, the condition for this being that the wet-bulb potential temperature shall decrease with height. Evidence in support of the ideas put forward is furnished by a table of data referring to a number of depressions with warm-sectors for which aerological soundings are available, and by a diagram in which the maximum rainfall in 12 hours is plotted in each case against the sum of all the decreases of wet-bulb potential temperature in the different layers through which this quantity showed a steady decrease with height. The two quantities were seen to be highly correlated, but the author emphasized that the diagram is not suitable for forecasting rainfall for the whole of a depression, but only for regions bordering the trajectory followed by the air during the 24 hours immediately after the aerological sounding which furnished the computed rainfall.

Radio Fading and Solar Eruptions

THE relation observed between the fading of high-frequency radio signals and solar eruptions is the subject of a News Service Bulletin by Dr. R. S. Richardson issued by the Carnegie Institution of Washington. The work is connected with the observations of Dr. J. H. Dellinger of the National Bureau of Standards that, between July 1934 and June 1936, thirty-nine fade-outs of radio transmissions have coincided so closely with observations of bright solar eruptions as to suggest the probability of a relationship between the two phenomena. Fifteen eruptions were photographed at the Mount Wilson Observatory of the Carnegie Institution and are described in the bulletin, which is illustrated by reproductions of spectroheliograms of the sun. From his earlier observations, Dr. Dellinger noted that the complete fading of the high-frequency radio signals occurred at intervals of 54 days, but this simple law does not appear to have been maintained since about July 1936. In co-operation with Dr. Dellinger, special hydrogen spectroheliograms have been taken at Mount Wilson with automatic apparatus, and these have been studied in conjunction with the radio records. In five cases, the time when the eruption was first seen agrees to a minute or less with the time at which the fade-out began. In six cases, the eruption preceded the fade-out by from two to twelve minutes; while in no case is a fade-out known definitely to have preceded an eruption. If continued observation confirms the relationship between eruptions and fade-outs, it would appear that the cause of the fading travels from the sun to the earth with the velocity of light; but further investigation is required to explain why some eruptions produce fading while others do not.

Deterioration of Paper

Technical Bulletin No. 541, November 1936, of the United States Department of Agriculture, Washington, D.C., deals with the "Deterioration of Book and Record Papers" and is written by T. O. Jarrell, J. M. Hawkins and F. P. Veitch. It appears to be the general opinion of librarians that much of the paper of books and records on their shelves, especially that made since about 1860, is not sufficiently durable. This conclusion applies especially in the case of books and papers subject to frequent handling. Thirty-eight samples of paper taken from old books, magazines and court records, ranging in age from 19 to 169 years, were examined. The results seem to indicate that paper actually absorbs from the air harmful quantities of acidic sulphur compounds with which the air is generally polluted. The absorption is greater in the portions of the leaves more fully exposed to the atmosphere, and this is one reason why the leaves of old books become more brittle near the outside edges. Seven samples of commercial bond and ledger papers, made in 1914 and 1915, were tested after storing under normal conditions for eighteen years. They were examined after five years and again after eighteen years storage. After eighteen years, the folding endurance of these papers had decreased 23–93 per cent and the bursting strength 0–18 per cent. In general, papers with the higher acidity, as indicated by the *p*H of their water extract, suffered the greatest deterioration. The results are indicative that a water extract with a *p*H of less than 5 is a major factor in the deterioration of even the best classes of paper.

Integrating Electricity Meters

THERE is now a great demand for prepayment meters for use among consumers who do not wish to pay a quarterly account. In a progress report on integrating electricity meters by Mr. G. F. Shotter, which is published in the February number of the *Journal of the Institution of Electrical Engineers*, various novel types of prepayment meters are described. One of these makes provision for arrears of payment which mount up owing to the consumer not inserting sufficient coins to cover the continuous collection of a fixed charge. The meter has a dial which when the consumer has inserted sufficient coins indicates by black figures the amount the consumer has overpaid, the word 'credit' in black appearing on the dial. When he has underpaid, 'credit' in black changes to 'arrears' in red, the figures automatically changing to their opposite sequence and appearing in red. Another possible difficulty due to his supply being cut off owing to arrears mounting up in his absence or for other reasons is overcome by a special device giving a limited supply for a short time upon the insertion of a coin. The current must be used immediately, as the mechanism allocates a larger proportion of the value of the coin inserted to the repayment of arrears. If the current is not so used, the balance of the value of the coin is transferred by the operation of a small motor to the paying off of further arrears. Manufacturers are also supplying prepayment meters which may be changed from D.C. meters to A.C. meters by merely changing the meter element. This type of meter would be useful and advantageous to undertakings which are supplying at present on D.C. but look forward later on to supplying some or all of their consumers with A.C. from the Grid.

Theory of Age-Hardening

RESEARCHES on the copper-aluminium alloys have resulted in the view being put forward that two kinds of hardening occur during their ageing, one of which relates to those changes which take place prior to precipitation, whilst the other is connected with the precipitation of the $CuAl_2$ itself. It has also been suggested that a concentration of copper atoms occurs at certain definite positions in the aluminium lattice prior to a copper-rich phase being thrown out of solution. It is not easy, however, to explain all the facts on the basis of existing theories, and Dr. M. L. V. Gaylor (Institute of Metals, March 1937) now proposes a modification which is believed to cover the known facts more adequately. Briefly, the new hypothesis suggests that age-hardening takes place in two stages, of which the second overlaps the first. In the initial stage, ageing is considered to be due to the diffusion of the solute atoms to the planes about which precipitation will ultimately take place. This view is in agreement with that of Desch. The next stage, which follows the first directly and takes place nearly simultaneously with it, results in some of the atoms forming molecules with neighbouring atoms of the solvent metal. As these molecular groups increase in size, local stress is set up. When the solid solution can no longer withstand these stresses their release is effected by the rejection of the compound from solid solution, and precipitation proper has taken place. It is believed that precipitation of molecular groupings intermediate between that of the solute and the solvent metal may conceivably take place and in support of this view intermediate structures between that of $CuAl_2$ and the aluminium or solid solution have been observed. It follows that age hardening is now considered as being due not so much to the precipitation itself but rather to th mechanism by which the alloy passes through the metastable to the stable state.

Monaco Conference on Corrosion

A VERY successful conference on corrosion was held at Monaco on March 25–27 under the direction of the Académie Méditérranéenne. It was attended by most of the French authorities on corrosion and by a number of delegates from other countries; the latter included Sir Robert Hadfield and Prof. S. M. Dixon, representing the Institution of Civil Engineers, Dr. J. C. Hudson, representing the Corrosion Committee of the Iron and Steel Institute, Prof. J. Timmermans, of Brussels, and Prof. T. O. Rotini, of Milan. Although, apart from one or two original contributions, most of the papers presented dealt with investigations already undertaken or completed by the various authors, they may be taken as representing the general trend of thought as regards corrosion problems in French circles. It may, therefore, be of interest to communicate some of their most interesting features.

The inaugural session was opened by a communication from General C. Grard, who is the chairman of the Corrosion Committee of the French Air Ministry. This Committee is primarily concerned with the corrosion of such metals and alloys as are, or may be, used in aircraft. Thus, for some time after its formation in 1926, its work was confined to a study of the corrosion of light alloys, but its field of research was extended in 1929 to include such ferrous metals as are of interest in aircraft construction. This Committee has a central organization of its own[1] and is also responsible for sponsoring research work in the laboratories of French universities, for example, at Lille, where Prof. Chaudron and his pupils have been conducting fundamental and practical work of great importance for a number of years. In addition, researches are undertaken in industrial laboratories, but it would appear, from conversation with several French workers in this field, that industrial collaboration in this respect is not yet quite so advanced as in Great Britain, where as a result of the influence of the Department of Scientific and Industrial Research and the formation of research associations, there is a very real and effective co-operation between individual firms in many industries.

The necessity for much closer co-operation in industrial research is generally recognized in France, and was alluded to on at least two occasions in the course of the conference. For example, *M.* Michel, of Messrs. Jacob Holtzer, raised the question at the conclusion of his communication on the properties of certain stainless steels, and his appeal for closer collaboration in research on corrosion work was warmly received by the other delegates. It may be added that organized researches on corrosion in France are also being fostered by the Office Technique pour l'Utilisation de l'Acier, although little information about this work has yet been published.

General Grard was followed by Sir Robert Hadfield, who commenced by paying a warm tribute to the memory of his old friend, Prof. Henry le Chatelier. Sir Robert then referred to the researches on corrosion fostered by the Institution of Civil Engineers, in which he has been actively interested since their inception in 1916, and to his investigations of wrought iron samples taken from the Delhi pillar. British field tests on corrosion were also described by Dr. J. C. Hudson, who dealt more particularly with atmospheric corrosion and the work of the Iron and Steel Institute Corrosion Committee.

The biological and particularly the bacteriological aspects of corrosion were prominent features of the conference. This subject was discussed during the opening session in a paper presented by *M.* R. Legendre, the director of the Laboratoire Maritime du College de France at Concarneau, who has been interested in corrosion research for some fifteen years[2] and in particular has been responsible for numerous field tests on marine corrosion conducted at Concarneau. In the course of some experiments on painted steel specimens exposed to complete immersion in a tidal basin at this port, a peculiar type of corrosion was observed underneath the paint. Local deposits of black mud were found between the paint and the steel, below which the steel was brilliantly etched, as if by acid. Samples of this mud were subjected to a bacteriological examination in the Pasteur Institute by *M.* Veillon, who was able to isolate from it a number of distinct types of aerobic and anaerobic bacteria. Laboratory experiments, in which samples of bare or of painted steel were exposed to corrosion in a suitable medium inoculated with various cultures of these bacteria, showed conclusively that the anaerobic bacteria or the anaerobic bacteria acting in symbiosis with the aerobic bacteria promoted corrosion of the steel, as compared with the behaviour of blank specimens exposed in the sterile medium; the aerobic bacteria alone had no effect. A black corrosion product was formed which had a characteristic smell similar to that of the original mud and was considered to be iron sulphide, since analysis showed that it contained both iron and sulphur[3].

References were also made to interesting researches on protective paints conducted in the laboratories of the Office National des Recherches et Inventions at Bellevue by *M.* A. Vila and his colleagues. These have resulted in the development of an accelerated weathering test for paints and of coal tar paints pigmented with flake aluminium. The accelerated test[4] is peculiar in that the French workers have been led by their experience to abandon exposure to ultra-violet light, which is so prominent a feature of most types of accelerated testing apparatus for paints, and to rely on a wide variation in the range of temperature and of the corrosive media to which the specimens are exposed. The aluminium tar paints[5], which are not unknown in Great Britain, consist essentially of a tar medium to which suitable thinners and about fifteen per cent of aluminium pigment have been added, although, according to *M.* Coret, of the Paris Gas Company, twelve per cent of pigment should suffice. *M.* Coret also stressed the fact that the choice of a suitable tar is of great importance and that the presence of compounds that are capable of being readily nitrated is injurious, whilst Dr. J. Roux claimed, probably with justice, that these paints have inhibitive properties.

Another interesting paper was presented by *M.* F. Canac, the scientific director of the Laboratoire du Centre d'études de la Marine at Toulon, who summarized and extended the results of his work on the topography of corrosion[6]. *M.* Canac has utilized an optical method to investigate the character of the attack on a corroded surface; briefly, the method consists in studying the distribution in space of the light diffused from a corroded surface, the angle of incidence being varied. He has shown by mathematical analysis that the diffusion/time curves at different angles of incidence should be characteristic for different types of attack, for example, for uniform corrosion spreading outwards at a constant rate from a regularly distributed number of centres, for intercrystalline corrosion, etc., and he has observed close approximations to the theoretical curves in actual corrosion experiments. This method and also one described by *M.* Nicolau for studying the roughness of a surface, depending on observations of the rate of escape of compressed air from a standard orifice brought into close proximity with it, should prove of value in the study of certain types of corrosion problems.

Prof. A. M. Portevin and Dr. E. Herzog communicated the results of some tests on the corrosion of a low alloy chromium-aluminium steel exposed to sea air and to immersion in sea-water at five different ports in France and Algeria[7]. It is encouraging to note that the results showed a marked superiority in the behaviour of the low alloy steel as compared with ordinary steels, not only in the atmospheric but also in the immersion tests. This observation may be of considerable practical importance, since the improvements effected so far in the corrosion resistance of steel by the addition of small amounts of alloying elements, without markedly increasing its cost, have not proved nearly so pronounced in the case of exposure to immersion in sea-water as in that of exposure to atmospheric corrosion.

Prof. G. Chaudron gave a general survey of his researches at Lille, which deal both with ferrous and with light alloys, and stressed the fact that studies of dissolution potential should include the behaviour not only of the bare metal but also of the metal covered with its oxide film. Prof. A. Travers of Nancy communicated the results of an examination of a cast iron pipe that had suffered severe graphitization whilst lying in the soil, and concluded, as is also the view of Dutch experts who have studied the problem, that bacteriological action plays an important part in this phenomenon; the reduction of calcium sulphate in the soil as a result of bacteriological action also formed the subject of a paper by Prof. R. O. Rotini, of Milan. It is also possible that an electrolytic method of polishing metals, devised by *M.* P. A. Jacquet[8] which, the author states, does not result in the formation of a Beilby layer or mechanical disturbance of the metal, may have other interesting applications besides its effect on the structure of electro-deposits, which he discussed.

It remains to add that the arrangements of the Conference were in the capable hands of *M.* J. Desthieux, the secretary of the Académie Méditerranéenne, that thirty papers were read or presented and that at the end of the Conference the proceedings were very ably summarized by *M.* Canac, who acted as *rapporteur*.

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[1] Girard, C., *Métaux*, 9, 291 (1934).
[2] Legendre, R., *Recherches et Inventions*, 17, 29 (1937).
[3] Veillon, R., *Annales de l'Institut Technique du Bâtiment et des Travaux Publics*, 1, 19 (1936).
[4] Vila, A., *Recherches et Inventions*, 17, 79 (1936).
[5] Roux, J. *Métaux*, 10, 509 (1935)
[6] Canac, F., *C.R.*, Jan. 3, 1933 , Nov. 19, 1934; July 29, 1935.
[7] Portevin, A. M., and Herzog, E , *C.R.*, Dec. 14, 1936.
[8] cf. NATURE, 135, 1076 (1935).

The Post Office Speaking Clock in Great Britain

UP to the beginning of the nineteenth century the time in most towns was taken from public clocks of various kinds, which occasionally varied appreciably from one another. This was a serious obstacle to the postal services, and led to the practice on mail coaches and trains of carrying chronometers to synchronize local post office clocks with a standard clock in London. Shortly after the introduction of the electric telegraph, electro-mechanical devices of various kinds were controlled by telegraphed signals. But it was not until 1874, a few years after the Government acquired the telegraph system, that successful distribution of the 10.00 a.m. Greenwich time signal was accomplished over sixty different lines. The development of this service into the very accurate International Time Signal transmitted from Rugby radio station at 10.00 and 18.00 G.M.T. daily was made in 1927. This service has the disadvantage of not always being available in the home. The well known six 'pips' of the B.B.C. have the disadvantage of being only available at certain times. Then came the synchronous motor-clocks running on frequency-controlled mains, but at present these clocks are far from being in universal use.

The success of 'speaking clocks' abroad, especially in Paris, encouraged the General Post Office to design a speaking clock service which would be of use to every house or shop connected with the P.O. telephones. It was decided that the inaccuracy of the clock should not exceed a tenth of a second, fast or slow, and that the time should be announced six times a minute, each announcement being followed by three audio-frequency pips, the last of which gives the exact time spoken. To hear the time a subscriber connected to an automatic exchange dials the code TIM, and one connected to a manual exchange asks for 'Time'.

A technical paper on this novel service was read to the Institution of Electrical Engineers on December 3 by Dr. E. A. Speight and O. W. Gill. They pointed out that when the exchange is called at, say, 10.25, a voice is heard saying, "At the third stroke it will be ten twenty-five and ten seconds". The third of the three pip sounds gives this time precisely. The next announcement will be ". . . . ten twenty-five and twenty seconds", and so on. Most recording systems may be classified as mechanical, magnetic or photographic in principle. The gramophone is typical of the instruments which give a mechanical record. It is compact and cheap to produce, but it has a fairly high noise level which increases steadily with the fairly rapid wear occurring in reproduction. Experiments on gramophone records made in India showed that it was necessary to replace them in one or two days time. Magnetic sound recording is done by means of a steel tape, but owing to its high velocity a considerable length of tape is required. In this case the initial quality of the reproduced sound is good, but it deteriorates rapidly. The system used by the Post Office is the photographic system, and photocells are used. The technique is complicated, but the record is not subjected to any mechanical wear and is therefore, for all practical purposes, permanent.

During the first week of the public operation of the service, nearly 400,000 calls were made, and during each subsequent week the number has remained practically constant at about 200,000. The relay sets at present permanently installed can each supply 100 simultaneous calls.

Noise on the Road

THE Departmental Committee on "Noise in the Operation of Mechanically Propelled Vehicles" has published its third interim report (H.M. Stationery Office, 1*s*. net). The Committee, of which Dr. G. W. C. Kaye is chairman, was set up by the Minister of Transport in 1934. The present report is based on loudness tests carried out for the Committee by the National Physical Laboratory on some 600 'used' motor-vehicles representative of all the main types on the roads to-day, and of various ages up to thirteen years. A comparison of the results with those from the earlier tests on new vehicles, shows that on the average the used vehicles were the louder by some 4–5 phons. In the range of noise met with on the road (about 70–105 phons) ordinary motor-cars were much the quietest vehicles, while amongst the loudest were certain motor-cycles and sports cars, particularly at high speeds.

The noise from the engines of ordinary cars and commercial vehicles is louder than the exhaust noise, but with motor-cycles and sports cars the position is reversed. This fact lends support to the Committee's earlier criticism of the unsatisfactory nature of the silencing of many motor-cycles and sports cars, and the investigation generally indicates that greater progress has been made in the silencing of sports cars than of motor-cycles.

In its previous reports the Committee made the recommendation that new motor-vehicles should not be offered for sale if the loudness under prescribed conditions of test exceeded 90 phons, adding that motor-cycles should be allowed a latitude of 5 phons for two years. The Committee now proposes for vehicles actually in use on the road a limit of 95 phons (that is, about the noise in a tube train). No vehicles would be allowed on the highway if the loudness, when measured at a point 18 ft. laterally from the middle of the vehicle or 25 ft. behind the open end of the exhaust pipe, exceeded this limit in a normal running test and in a racing engine test conducted in the same way as for newly manufactured vehicles. The Committee also recommends that this limitation of loudness should be applied at first only to vehicles first registered after an appointed day, but that two years thereafter it should apply to vehicles of any age.

It will be appreciated that the noise limit proposed, while making very modest demands on the majority of manufacturers and owners of motor-vehicles, would, by ruling out the arch offenders, form a substantial contribution to the amenities of the road. It is to be hoped, moreover, in the public interest that future developments will enable the limit to be lowered as time goes on. At the Minister's request, the Committee is now investigating the noise caused by motor horns with the view of advising him whether action might usefully be taken to abolish the more strident noises of this kind. The question of the noise arising from trams and trolley buses is under examination by the Ministry in conjunction with the associations concerned.

Hirosima Wave Geometry and Field Theory

REFERENCE has already been made in this journal (Dec. 21, 1935) to the vigorous school of mathematical physics now flourishing in the Hirosima University, Japan. These investigations are continuing (*J. Sci. Hirosima Univ.*, A, 7; 1937), bringing the number of memoirs on the subject up to fifteen. A good summary of the whole series is contained in the paper "Geometrization of the Law of Physics" (*ibid.*, p. 81) by Y. Mimura.

It is claimed that the new theory bears a relation to Einstein's theory similar to that which Einstein's bears to Newton's, or to that which modern quantum mechanics bears to the old quantum theory. Einstein's theory is described as semi-geometrical, and the same term is applied to all existing unified field theories, as they are all built by a mixture of two procedures, namely, the finding of an appropriate geometry, and the finding of an appropriate invariant density to be used with a generalized Hamilton's principle, which is assumed to be the fundamental law of physics.

The Hirosima school considers that the generalized Hamilton's principle should be dispensed with, and they replace it by the condition of the complete integrability of the fundamental differential equation, which is obtained by purely geometrical means. In the hope that 'wave geometry' is identical with physics, extensive investigations of possible varieties have been carried out, including those corresponding to four-dimensional ordinary metrical geometry, to projective geometry, and to conformal geometry.

It is acknowledged that the question as to which wave geometry is to be identified with physics can only be judged by its results. The new field theory has already succeeded in deducing some important physical results, such as a gravitional wave in Maxwellian form, a line element of de Sitter's form, and one equivalent to Schwarzschild's. Perhaps it is not unfair to say that, in these days of competing unified field theories, the ordinary physicist must be allowed to suspend judgment until the physical consequences of the theories have been worked out very much more fully than has been done at present.

Astronomical Determination of Longitudes and Azimuths

HISTORICALLY the relations between geodesy and astronomy have always been of the most intimate character, and the contributions of Bessel, Struve and Gill, famous as astronomers, to measured arcs and the adjustment of observations still play a fundamental part in the determination of the figure of the earth. It was therefore appropriate, the more so since astronomy is becoming increasingly concerned in its objects and methods with physics, that the Royal Astronomical Society should have recalled its association with geodesy by inviting Prof. N. E. Norlund, president at the recent London meeting of the International Council of Scientific Unions, to deliver the annual George Darwin Lecture before the Royal Astronomical Society on May 14.

Prof. Nórlund took as his subject the astronomical determination of longitudes and azimuths. He derived a general expression for the error in a longitude determination as a function of the zenith distances of the two groups of stars observed with the transit, and showed that a corresponding expression held for the azimuth determination provided the polar distances of the groups were substituted for the zenith distances. Graphical representation of this expression showed that for the maximum attainable accuracy a considerable freedom in the choice of stars was permissible, and Prof. Nórlund showed how this freedom might be utilized to minimize the unavoidable systematic errors due to level, the positions of the stars and personal equation. This discussion in its turn naturally led to a discussion of the separation of the 'Laplace points', where the geodetic triangulation is adjusted by such astronomical observations.

Prof. Norland concluded that with stars chosen in accordance with the foregoing considerations and with the methods of observation used in Denmark, a separation of as much as 250 km. was allowable. This separation is determined by the necessity of keeping the labour of observation and adjustment to a minimum and if the occasion had permitted, many fellows of the Society would have been interested in hearing Prof. Norlund's reactions to the alternative procedure of occupying more 'Laplace points' with the simpler observational procedure made possible by the prismatic astrolabe, or an astrolable attachment to a theodolite.

The lecture was characterized by a number of asides on the technique of observation, and some of the results thereof. None excited greater interest than the concluding remarks on the longitude of western Greenland. An important piece of evidence for Wegener's hypothesis of continental drift has been the fact that longitude determinations in Greenland between 1823 and 1870, and between 1870 and 1907 showed evidence of a westerly movement of the area amounting to 9 metres per annum in the first period and 32 metres per annum in the second. Under Prof. Nörlund's direction, the Danish Geodetic Survey has occupied stations in western Greenland at two epochs separated by seven years, and in that period there has been no change of longitude. There can therefore be little doubt that Wegener's suspected movement is simply the result of errors in the early determinations of longitude.

Nitrogen Transformations in the Soil

IN his presidential address to the National Academy of Sciences, India, on January 15, Prof. N. R. Dhar gave a very comprehensive account of his work on nitrogen transformations in the soil, various aspects of which have recently been described in NATURE (137, 462, 629, 1000; 138, 648, 1060; 1936). Further evidence was provided of increases both in soil nitrogen content and in crop yield following the application of molasses, and striking results were reported in the reclamation of alkali land by molasses on the practical scale. Other carbohydrate-rich materials, and the sodium salts of fatty acids, were also shown to promote nitrogen fixation. Cow dung had a double action, not only supplying extra nitrogen but also leading to nitrogen fixation as well. With more highly nitrogenous materials, however, such as oil cake or sulphate of ammonia, a loss of nitrogen from the soil took place, especially if it was exposed to sunlight. This loss was reduced when leaves or cow-dung were also added, while molasses converted the loss into a gain, nitrogen fixation occurring in spite of the presence of much available nitrogen.

Many experiments were described on the influence of sunlight on ammonification, nitrification, nitrogen fixation and the loss of nitrogen from soils. Prof. Dhar has shown both in the laboratory and in the field that exposure to sunlight accelerates these processes, but it is necessary to point out that the heating effect of the long wave-lengths was present as well as the possibly photochemical effect of the short wave-lengths. Soils exposed to full sunlight were compared with soils that were either shaded or kept in a dark room. The higher temperature of the exposed soils would be expected to cause, on the average, greater microbiological activity, and although the author observed that the temperatures were often above the optima for bacteria in pure culture, it is unsafe to argue from this to mixed soil flora which were subject to the fluctuations between day and night temperature.

This point is raised because, while Prof. Dhar's results are undoubtedly of great interest, the *a priori* objection to the occurrence of an important amount of photochemical activity in soils in the field, based on their opacity to light, is such a real one that experiments on the subject require especially stringent examination.

Science News a Century Ago

Warwickshire Natural History and Archæological Society

THE first anniversary meeting of the above Society was held on May 23, 1837, when the Council's report was read. Though some interesting addresses had been delivered, the Council regretted not having been favoured with communications so much desired by them and so easily furnished by observant naturalists, relating to the different branches of natural history. The collections in geology and mineralogy had been greater than had been anticipated. Most of the objects had come from the cabinets of members. The sole purchase was that of a series of mountain rocks from the British Isles collected by the late Dr. Rowley, late master of University College, Oxford. The zoological collection was daily increasing. It contained about 300 birds. The curators were extremely anxious to complete and classify the collection of British birds and quadrupeds. (*Analyst*, 7, 92).

Carl Ernst Adolf von Hoff (1771–1837)

ON May 24, the eminent German geologist, Carl Ernst Adolf von Hoff, died at the age of sixty-five years. Born on November 1, 1771, von Hoff was educated at Jena and Göttingen, and at twenty years of age became a secretary in the diplomatic service of the Government of Gotha, and during the Napoleonic era held various posts. In spite of the unrest of the times, he pursued the study of geology with great zest, in 1801 founded a geological journal and became acquainted with Werner, Goethe and Humboldt. In 1818, the Royal Society of Sciences in Gottingen, acting on a suggestion of the physiologist Blummbach, offered a prize for the best "investigation of the changes that have taken place in the earth's surface conformation since historic times, and the application which can be made of such knowledge in investigating earth revolutions beyond the domain of history". This led to the writing by von Hoff of his "History of the Changes in the Surface of the Earth", published during 1822–41, which placed him in the front rank as an original thinker. Carl von Zittel, speaking of this work, said : "The fact that von Hoff's meritorious work was not properly valued, and was put in the shade by Lyell's epoch making book, which appeared almost simultaneously, is easily explained by the circumstance that the modest German man of science derived his material mainly from books, that his position did not allow him to examine in the field the questions which he discussed, and that he enriched science by no new facts ; he faced the problem as an historian, and not as an observer" (see NATURE, 72, 123, June 8, 1905).

The Royal Society

AT a meeting of the Royal Society on May 25, 1837, the concluding portion of Sir David Brewster's paper on the "Absorption of Light" was read, after which Thomas Andrew Knight (1759–1838) read a paper "On the Hereditary Instinctive Propensities of Animals", in which he referred to his observations on terriers, spaniels and retrievers ; and Captain Beaufort communicated a paper entitled "On Meteorological Deductions from Observations made at the Observatory at Port Louis in the Mauritius, during the years 1833–34–35 by John Augustus Lloyd, Esq., Surveyor-General of that Island, F.R.S." The observations, from which the results recorded in the paper were made, were nearly 50,000 in number, and were taken four times each day at the hours of 8 a.m., noon, 4 p.m. and 8 p.m. The observations were those of the barometer, hygrometer, rain gauge and the appearance of the atmosphere.

End of the Euphrates Expedition

ACCORDING to the *Annual Register* for 1837, "On May 28 the *Pembroke*, 74, arrived at Plymouth with the surviving officers and men of the Euphrates expedition. There appears no doubt, notwithstanding the disasters which have attended this preparatory expedition, that with steamers adapted for the purpose and when the navigation of the river is a little better known, that the passage from Bussorah to Beles may be made in twenty days ; and when the river becomes known in fifteen days. Beles is about 100 miles from the Bay of Antioch over which distance the mail bags might be rapidly conveyed to a steamer. The passage from Bussorah to Bombay would take a good steamer 10 days. When the whole scheme was brought into existence, communication between Bombay and England might be fairly calculated at not exceeding fifty days."

John Ericsson's Screw Propeller

ON May 28, 1837, the packet sailing ship *Toronto* of 630 tons burthen and drawing 14 ft. 6 in. of water was towed down the River Thames by the experimental steamboat *Francis B. Ogden* fitted with Ericsson's screw propeller. The *Francis B. Ogden*, the largest boat built so far for trial with a screw propeller, was named after the United States Consul at Liverpool, and was 45 ft. long, 8 ft. beam and drew 2 ft. 3 in. It was fitted with an engine having two cylinders 14 in. diameter, 12 in. stroke working with steam at 50 lb. per sq. in. She had been built at Wapping. "The new propelling apparatus", said the *Mechanics' Magazine*, "consists of two short cylinders made of wrought iron, and supported by arms of a peculiar form, which are placed entirely under water at the stern ; and made to revolve in contrary directions about a common axis. To the outer periphery of each cylinder, there is attached a series of spiral planes or plates, which may, we understand, be placed at any desired angle, according to the effect sought to be obtained, whether it be great speed or great propelling power."

Fires in London

ACCORDING to *The Gentleman's Magazine* of May 1837, of 564 fires which occurred in and around London in the previous year, the following were the causes so far as could be ascertained. Accidents of various kinds, scarcely avoidable, 11 ; apparel taking fire on the person, 2 ; bed curtains set on fire by accident, 71 ; accidents with candles, 57 ; cases of palpable carelessness, 18 ; charcoal fires, portable, 2 ; children playing with fire, 6 ; fires kindled on hearths, 5 ; defective or foul flues and chimneys, 72 ; fumigation, 9 ; sundry gas accidents, for the most part occurring from gas-fitters, during the progress of repairs, 38 ; gunpowder, 1 ; heating of hay, lime, etc., 7 ; sparks from lamps, 2 ; linen incautiously hung before fires, 31 ; ovens overheated, 6 ; loose shavings ignited, 13 ; sparks from fire, 7 ; defective setting of stoves, etc, 28 ; application of fire heat to various purposes of trades and manufactures, 34 ; tobacco smoking, 1 ; unknown, 95 ; wilful, 8 ; window curtains catching fire, 35.

University Events

CAMBRIDGE.—The Gordon Wigan Prize in Chemistry for 1936 is divided equally between A. E. Alexander, of King's College, and T. P. Hughes, of Gonville and Caius College.

LONDON.—Prof. A. M. Carr-Saunders, Charles Booth professor of social science in the University of Liverpool, has been appointed director of the London School of Economics and Political Science as from October 1, in succession to Sir William Beveridge.

OXFORD.—E. J. Bowen, University College, and J. W. Wolfenden, Exeter College, have been appointed University demonstrators in chemistry for four years as from October 1. Dr. B. G. Maegraith, Exeter College, has been appointed University demonstrator in pathology for four years from May 1.

M. A. Jennings, Lady Margaret Hall, has been elected to the Schorstein research fellowship in medicine for 1937.

H. Field, New College, has been granted the degree of D.Sc. for his work in anthropology. Prof. J. C. Moir, Oriel College, has been given the degree of M.A. by decree.

The amount subscribed in the first three months to the University appeal for approximately a million pounds is £355,845.

Societies and Academies

Paris

Academy of Sciences, April 12 (*C.R.*, 204, 1093–1144).

LUCIEN CAYEUX: Signification of the disturbances recorded by the phosphates of Hodna (Algeria) during and after their deposit.

CHARLES MAURAIN: Possible influence of mechanical actions (vibrations) and magnetic disturbances on the earth's magnetic field, and its anomalies.

EMILE MATHIAS: Curvature of the diameter of densities.

JULIUS WOLFF: Invariant domains in conformal representation.

JOSEF L. KRAMES: A remarkable class of space movements. Symmetrical viration.

RENÉ DUGAS: Dirac's mechanics and the last multiplier in the sense of Jacobi.

ARCADIUS PIEKARA: The phenomenon of positive electrical saturation.

JULES FARINEAU: Spectrographic study of the conductivity electrons of magnesium and silicon.

MAURICE PARODI: Study of some borates and some oxides in the extreme infra-red

JULES DUCHESNE: Calculation of the vibration frequencies of the molecule N_2O_4.

ANDRÉ GUINIER: An arrangement for obtaining very intense diffraction diagrams of crystalline powders with a monochromatic radiation.

ANDRÉ MERCIER: The theory of β-radioactivity.

JULES GUÉRON: The general trend of the evolution of aqueous solutions of ferric chloride.

MLLE. MARGUERITE FROLLO: The petrographical study of the radiolarian complex of the Mesozoic formations of the Eastern Carpathians.

GABRIEL LUCAS: The Palæozoic of the Ghar Rouban region (Algero-Moroccan frontier).

EUGÈNE WEGMAN: Genesis of the alkaline rocks of Julianehaab (Greenland).

WILLIAM HENRI SCHOPFER: The nitrogen metabolism of a micro-organism, considered from the point of view of allometry.

ROBERT ECHEVIN: The influence of calcium carbonate on the growth of the radish.

MLLE. MARIE THÉRÈSE GERTRUDE: The determinism of the morphogenic action exercised by the aquatic medium in plants.

HENRI GAUSSEN: The evolutionary equilibrium and the germinal influence in the Abietineae.

ANDRÉ TOURNADE and MARC CHEVILLOT: Concerning the Philippeaux-Vulpian experiment.

MAX LAFON: The biometrical study of cystine deficiency in the rat.

R. HERPIN: The periods of fixation of the animal organisms determining the fouling of ships' hulls.

Rome

Royal National Academy of the Lincei (*Atti*, 24, 99–171; 1936).

E. SOLER: Geophysical work carried out by the Institute of Geodesy of the Royal University of Padua in the Vesuvian region in 1934–35.

A. RUSSO: Chondriome increment and activation of metabolism.

C. PAUC: Curvature in metrical spaces.

C. MINELLI: Continuous bent beam stressed axially, with a bending rigidity which is variable linearly along each span.

E. GUGINO: Trajectories of variational problems.

G. BERNARDINI and D. BOCCIARELLI: Energy and intensity of groups of neutrons emitted by Po + Be (2).

G. TEDESCHI: Causes of the evolution of oxygen from lead accumulators at rest.

L. MONTI: Oxidizing action of selenium dioxide (2).

G. CENTOLA: Researches on the process of stabilization of nitrocellulose.

R. SAVELLI: Some manifestations of the reducing power of vegetable tissues (1). Development and adaptation of some plastids (2).

G. CASALAINA: An eleochloroplast with a positive Ciaccio secretion.

A. AGOSTINI: Statistical studies on the variability of the goatsucker (*Caprimulgus e. europæus* L).

T. PERRI: Correlative processes of determination and of growth of the lens-forming rudiment in Amphibia (3). Experiments on *Bufo viridis*, *Bufo vulgaris*, *Rana agilis*, and *Rana esculenta*.

(*Atti*, 24, 175–238; 1936).

U. CISOTTI: Behaviour at the boundary of well-known analytical integrals.

L. TONELLI: Equations in the problems of Mayer.

U. MORIN: Ensemble of linear spaces contained in an algebraic hypersurface (1). Unirationality of the algebraic hypersurfaces of the fourth order (2).

B. SEGRE: Topological invariants relative to the united points of the regular transformations between superposed varieties (1). A complement to the correspondence principle, for correspondences with zero valence on the algebraic curves (2).

R. L. GOMES: A correction of the note on the operator *S*—Schrodinger's operator.

G. B. BONINO and R. MANZONI-ANSIDEI: Raman spectrum of thiophene.

G. PICCARDI: Presence of molecular hydrogen in sunspots (1).

G. SCAGLIARINI and G. AVONI: Colour reaction between nitroprusside and glutathione.

M. FENOGLIO: Natural neutral and basic hydrated carbonates of magnesium.

C. LENTI: Osmotic pressure of the colloids of vitreous humour.

L. SANZO: Rearing of a pelagic larva of *Cerianthus* up to the stage of acquiring definite characteristics.

C. KOCH, B. SCHREIBER and G. SCHREIBER: Attempts to graft tissues in the vitreous humour of the guineapig's eye.

S. MINZ and E. SERIANNI: The action of adrenaline and of atropine on experimental alcoholæmia.

(*Atti*, 24, 239–313; 1936).

L. TONELLI: Equations in the problems of Lagrange.

G. A. MAGGI: Notable complement of Love's conditions (at the wave-front of a succession of electro-magnetic waves) and its applications.

B. SEGRE: A complement to the correspondence principle, for valency correspondences with united points of any multiplicity (2).

R. CACCIOPPOLI: Inverted functional correspondences: general theory and applications to some nonlinear functional equations and to Plateau's problem.

G. ARRIGHI: Dynamics of the deformable body with variable mass (1). Motion of a compressible fluid of variable mass with forces derived from a potential (2).

L. CESARI and F. CONFORTO: The equation of the three moments for a continuous bent beam stressed axially, with a bending rigidity which is variable linearly along each span.

M. MAGGINI: Attempts at photo-electric photometry of planetary surfaces.

E. SEGRÈ: Selector of velocity of slow neutrons.

G. PICCARDI: Presence of molecular hydrogen in sunspots (2).

G. B. BONINO: Molecular symmetry of thiophene (1).

G. SCAGLIARINI: Action of nitroprusside on pyrroles.

G. REVERBERI: 'Total' segmentation in the fragments of the fertilized egg of Ascidians.

C. JUCCI: Rearing of *Reticulitermes lucifugus* in sample tubes.

A. CAPPELLETTO: Development of the embryo in rarified air (1). Growth of tadpoles.

C. LENTI: Modifications of basal exchange in high mountainous regions.

Washington, D.C.

National Academy of Sciences, *Proc.*, 23, 133–187, March 15.

D. F. POULSON: Chromosomal deficiencies and the embryonic development of *Drosophila melanogaster*. By observation of living eggs, and by means of sectioned material, it is concluded that sections of the X-chromosome are essential for certain specific processes in embryonic development. The larger the section missing, the earlier and more general are the effects.

C. W. METZ: Deficiencies and structural variations within the giant chromosomes in relation to the problem of gene structure. A review of recent investigations.

K. V. THIMANN and G. W. BEADLE: Development of eye colours in *Drosophila*: extraction of the diffusible substances concerned. Water extracts of wild-type larvæ, made in a nitrogen atmosphere, contain substances which, when injected into test larvæ, are capable of changing vermilion and cinnabar eye colour towards wild type. The substances are probably neither protein nor enzyme in nature.

G. W. BEADLE: Development of eye colours in *Drosophila*: fat bodies and Malpighian tubes as sources of diffusible substances. Extract of fat bodies is capable of affecting the eye colour of genetically vermilion flies; extract of Malpighian tubes has a similar effect on genetically cinnabar flies.

B. R. COONFIELD: The regeneration of plate rows in *Mnemiopsis leidyi* Agassiz. There are eight such rows in the body of this ctenophore, and rapid regeneration following natural or experimental injury takes place in the sequence healing, stretching of remaining parts of canal and concentration of mesogleal cells in the wound area, fusion of parts of canal and formation of plates above the new canal.

E. U. CONDON: Immersion of the Fourier transform in a continuous group of functional transformations.

H. WALLMAN: Lattices and bicompact spaces.

J. L. WALSH: Curvature of orthogonal trajectories of level curves of Green's function.

W. A. SETCHELL and N. L. GARDNER: *Iridophycus* in the northern hemisphere. Brief descriptions and a key are given.

H. C. YIN: Effect of auxin on *Chlorella vulgaris*. Measurement of individual cells after experiments lasting 2, 3 or 10 weeks showed that pure heteroauxin (β-indole-acetic acid) promotes cell enlargement in this alga as it does in higher plants. No conclusive effect on total growth was observed in cultures containing 0·001–0·01 mgm./c.c. of heteroauxin, and higher concentrations had injurious effects.

F. L. WHIPPLE and J. L. GREENSTEIN: Origin of interstellar radio disturbances. Jansky has observed continuous electromagnetic disturbances of wavelength 14·6 metres which appear to come from an extra-terrestrial source approximately coinciding with the galactic centre in Sagittarius. A theoretical investigation indicates that this radiation is unlikely to be caused by thermal agitation of charged particles in interstellar space.

I. ROUSE: New evidence pertaining to Puerto Rican prehistory. Three expeditions from the Peabody Museum have investigated Puerto Rica, the last in the summer of 1936. Evidence has been obtained of an early period when no pottery was used. The succeeding pottery period can be divided into three periods, Crab (painted), Intermediate (undecorated) and Shell (incised). A single people probably inhabited the region, gradually changing their pottery and food habits under the influence of neighbouring peoples.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 24

Royal Society of Arts, at 5.15.—Sir Gwilym Gibbon: "The Public Social Services".

University College, London, at 5.30.—Dr. D. McKie: "Development of Theories regarding Combustion and Respiration in the 18th Century".*

Imperial College of Science and Technology, at 5.30.—Prof. I. M. Heilbron, F.R.S.: "The Chemistry of the Carotenoids and Vitamin A" (succeeding lectures on May 25 and 26).*

Royal Geographical Society, at 8.30.—L. Wager. "The Kangerdlugssuak Region of East Greenland".

Tuesday, May 25

Eugenics Society, at 5.15—(at the Royal Society, Burlington House, Piccadilly, W.1).—Dr. R. R. Kuczynski: "Future Trends in Population".*

University College, London, at 5.30.—Dr. F. G. Young: "The Development of certain Aspects of Metabolism during the 19th Century".*

Wednesday, May 26

Warburg Institute, at 5.30.—Dr. R. Klibansky: "Religion and Science in the Twelfth Century".*

Birkbeck College, London, at 6.—Sir Arthur Eddington, F.R.S.: "The Reign of Relativity 1915–1937" (Haldane Memorial Lecture).*

Royal Society of Arts, at 8.15.—Prof. H. D. Kay: "The Biochemistry of Milk Secretion".

Thursday, May 27

Royal Asiatic Society, at 4.30.—Sir Arnold Wilson: Burton Memorial Lecture.

University of Oxford, at 5 (in the Examination Schools).—Dr. Joseph Needham: "Integrative Levels, a Revaluation of the Idea of Progress" (Herbert Spencer Lecture).

Royal Aeronautical Society, at 6.30.—Dr. Theodor von Kármán: "Turbulence" (Wilbur Wright Lecture).

Friday, May 28

University of Oxford, at 5—(in the University Museum).—Dr. B. F. J. Schonland: "The Lightning Discharge" (Halley Lecture).

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant in H.M. Nautical Almanac Office—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (quote C.E. 3157/37) (May 29)

Principal of the Cardiff Technical College—The Director of Education, City Hall, Cardiff (May 29).

Principal of the Croydon Polytechnic and Evening Institutes—The Education Officer, Education Office, Katharine Street, Croydon (May 29).

Lecturer in Botany, University Demonstrator in Botany and University Demonstrator in Plant Physiology in the University of Cambridge—Dr. A. D. Imms, Department of Zoology, Downing Street, Cambridge (May 31).

Lecturer in Mechanical Engineering in the Technical Institute, Gainsborough, Lincs.—The Principal (May 31).

Assistant Lecturer in Mathematics in King's College, London—The Secretary (June 1).

Assistant Lecturer in Physics in the University of Manchester—The Registrar (June 12).

Lecturer in Botany in the University of Reading—The Registrar.

Official Publications Received

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1710 (2342). Tests on Two Streamline Bodies in the Compressed Air Tunnel. By Dr. R. Jones, D. H. Williams and A. F. Brown. Pp. 6. 1*s*. net. No. 1715: A New Form of Biplane. By H. B. Irving and A. S. Batson. Pp. 44+4 plates. 7*s*. net. No. 1720 (2218). Preliminary Calibration of the 24-foot Wind Tunnel, R.A.E., with a Short Description of the Tunnel. By W. G. Jennings, A. Terry and P. J. Pearsall. Pp. 9+4 plates. 2*s*. 6*d*. net. No. 1721 (1247): The Pressure Distribution and Forces on Thin Aerofoil Sections having Sharp Leading and Trailing Edges, and moving with Speeds greater than that of Sound. By Dr. S. G. Hooker. Pp. 18. 2*s*. 6*d*. net. No. 1723 (1875b): The Influence of Differential Aileron Control on Wing Flutter. By R. A. Frazer. Pp. 20. 3*s*. net. No. 1724 (1944): Full Scale and Model Resistances of a Southampton II Hull. By E. T. Jones, L. Johnston and J. Hanson. Pp. 26+1 plate. 4*s*. net. No. 1725 (2323). Turbulence Measurements in Flight. By J. E. Serby and M. B. Morgan. Pp. 7+1 plate. 1*s*. 6*d*. net. No. 1726 (2302): An Analytical Comparison of Model and Full Scale Spinning Experiments on a Bristol Fighter. By R. P. Alston and J. Cohen. Pp. 14. 2*s*. net. No. 1727 (2337): The Effect of Blade Twist on the Characteristics of the C. 30 Autogiro. By J. A. Beaven and C. N. H. Lock. Pp. 28. 4*s*. net. No. 1728 (2397): Note on Wind Tunnel Tests on a Parasol Monoplane with Zap and Split Flaps. By J. H. Hartley and W. H. Curtis. Pp. 14. 2*s*. net. No. 1729 (2062): Wind Tunnel Tests of High Pitch Airscrews. Part 2: Variations of Blade Width and Blade Section. By C. N. H. Lock and H. Bateman. Pp. 40. 5*s*. 6*d*. net. No. 1730 (2122): The Flight of a Helicopter. By H. B. Squire. Pp. 24. 3*s*. 6*d*. net. No. 1732 (1809): Note on Effects of Landing Flaps on Stability and Control. By S. B. Gates. Pp. 6. 1*s*. net. No. 1733 (2610). A New Form of Dash Pot with a Large Range of Damping. By Dr. A. S. Halliday. Pp. 2+1 plate. 9*d*. net. No. 1737 (2338): Abstract—Notes on the Optimum Stiffness of Thin Shells. By Dr. H. Roxbee Cox. Pp. 2. 6*d*. net. No. 1738 (2041): Abstract—Boundary Layer Growth. By Dr. S. Goldstein and Dr. L. Rosenhead. Pp. 2. 6*d*. net. No. 1739 (2139). Abstract—Note on the Velocity Distribution in the Wake behind a Flat Plate placed along the Stream. By Dr. L. Rosenhead and J. H. Simpson. Pp. 2. 6*d*. net. No. 1743 (2418): Rolling Experiments on a "Puss Moth" Model. By A. S. Batson, J. H. Warsap and H. J. Gummer. Pp. 5. 1*s*. net. No. 1745 (2165). Abstract—On the Static Pressure in Fully-developed Turbulent Flow. By A. Fage. Pp. 4. 9*d*. net. No. 1747 (2104): Further Measurements of Ground Interference on the Lift of a Southampton Flying Boat. By J. L. Hutchinson. Pp. 6. 1*s*. net. No. 1750: Reports and Memoranda published between 1st April 1935 and 30th November 1936. Pp. 8. 1*s*. 3*d*. net. (London: H.M. Stationery Office.) [264

Other Countries

University of Illinois: Engineering Experiment Station. Bulletin No. 288: An Investigation of Relative Stresses in Solid Spur Gears by the Photoelastic Method. By Paul H. Black. Pp. 32. 40 cents. Bulletin No. 289: The Use of an Elbow in a Pipe Line for determining the Rate of Flow in the Pipe. By Wallace M. Lansford. Pp. 36. 40 cents. Bulletin No. 290: Investigation of Summer Cooling in the Warm-Air Heating Research Residence. By Prof. Alonzo P. Kratz, Prof. Maurice K. Fahnestock and Seichi Konzo. Pp. 140. 1 dollar. Bulletin No. 291: Flexural Vibrations of Piezoelectric Quartz Bars and Plates. By Prof. J. Tykocinski Tykociner and Marion W. Woodruff. Pp. 36. 40 cents. (Urbana, Ill.: University of Illinois.) [264

Field Museum of Natural History. Anthropology, Memoirs, Vol. 2, No. 3: Archæological Explorations in Peru. Part 3: Textiles of the Early Nazca Period. By Prof. Lila M. O'Neale. (Second Marshall Field Archæological Expedition to Peru.) Pp. 117–218+plates 32–68. 3.50 dollars. Anthropology, Memoirs, Vol. 2, No. 4: Archæological Explorations in Peru. Part 4: Canete Valley. By Prof. A. L. Kroeber. (First Marshall Field Archæological Expedition to Peru.) Pp. 219–274+plates 69–90. 1.50 dollars. Anthropology Series, Vol. 25, No. 1: Skeletal Material from San José Ruin, British Honduras. By Wilfrid D. Hambly. (Field Museum—Carnegie Institution Expeditions to British Honduras.) (Publication 380.) Pp. 20. 30 cents. (Chicago: Field Museum of Natural History.) [294

Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band 72, Abh. 1: Geologische Probleme um die Gebirge zwischen Engadin und Ortler. Von Rudolf Staub. Pp. iv+115+3 plates. (Zurich: Gebruder Fretz A.-G.) [294

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 47: Interseasonal and Intraseasonal Changes in Size of the California Sardine (*Sardinops cærulea*). By Frances N. Clark. Pp. 28. Fish Bulletin No. 48: Fishing Localities for the California Sardine, *Sardinops cærulea*, 1928–1936. By Frances N. Clark. Pp. 11. (Terminal Island, Calif.: California State Fisheries Laboratory.) [294

U.S. Department of the Interior: Geological Survey. Bulletin 860-C: Geology and Fuel Resources of the Southern Part of the San Juan Basin, New Mexico. Part 3: The La Ventana–Chacra Mesa Coal Field. By Carle H. Dane. Pp. v+81–166+plates 39–55. 40 cents. Bulletin 880-B: Recent Mineral Developments in the Copper River Region, Alaska. By Fred H. Moffit. (Mineral Resources of Alaska, 1935.) Pp. ii+97–109. 5 cents. Professional Paper 186-H: Inferences about the Origin of Oil as indicated by the Composition of the Organic Constituents of Sediments. By Parker D. Trask. (Shorter Contributions to General Geology, 1936.) Pp. ii+147–157. 10 cents. Water-Supply Paper 789: Surface Water Supply of the United States, 1935. Part 9: Colorado River Basin. Pp. 174. 25 cents. (Washington, D.C.: Government Printing Office.) [294

Bulletin of the American Museum of Natural History. Vol. 69: Horned Ruminants of North America. By Childs Frick. Pp. xxviii+669. (New York: American Museum of Natural History.) [294

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The Special Areas and the Location of Industry

Industrial Survey of South Wales

THE necessity for close attention to the location of industry has in recent months received repeated emphasis, and nowhere more than in the three volumes* comprising the Second Industrial Survey of South Wales, undertaken for the National Industrial Development Council of Wales and Monmouthshire by Prof. H. A. Marquand and a staff of assistants with the aid of a grant from the Commissioner for Special Areas. The First Industrial Survey of South Wales was made for the Board of Trade by University College, Cardiff, in 1931, and was designed merely to determine the surplus of labour attached to the existing industries of South Wales. Nevertheless, valuable work was done, and the significant reference in the present report to the difficulties which were experienced, simply because the limited resources of the College made it impossible to keep continuously up to date the information which had been prepared and collected in the Survey, will not be overlooked by those who appreciate the value and significance of such research.

The subsequent report of Lord Portal in 1934 was in no sense a survey but rather a collection of recommendations as to Government policy, and its information on industry and employment was restricted to the eastern section of the coalfield. The present survey, on the other hand, was designed to supply an answer to three specific practical questions:

(1) What is the present state of employment in the various industries in South Wales, and the probable future of employment in those industries?

(2) What facilities can the region offer to new industries which may be established within it?

(3) What new industries can most profitably be introduced into the region and where can they best be located?

To each of these questions a volume is devoted, and if the thoroughness with which the Survey has been conducted has inevitably meant a bulky report, the report is none the less a model of the type of guidance required by Government and industry in the day-to-day and detailed task of reconstruction. It is authoritative, balanced, practical and constructive, and outside the region itself, the main findings of the Survey merit the careful consideration of administrators and business men who may be affected. A wide range of concrete problems is examined with detachment and common sense, and the consistent regard for sound economic principles, combined with the impressive grasp of industrial problems and technique which it displays, give it claims on the attention of all who are interested in Great Britain's industrial future. For the general reader, an admirable summary and survey of the report has been issued by Political and Economic Planning (PEP); but the scientific worker will at least turn to the first and third volumes of the full report, if the interest of the second volume with its detailed survey of facilities is mainly for industrialists considering possible locations for factories.

The first volume of the report, which discusses the size and distribution of the population of South Wales and attempts to forecast its probable future development, in itself powerfully supports Sir Josiah Stamp's latest plea for the study of population questions. The Survey shows that while there has been some recovery from the depths of the depression of 1930–33, a mass of chronic unemployment remains which is peculiar to this and other depressed areas which have not developed large new industries to compensate for the contraction of basic activities such as coal mining and steel making.

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* The Second Industrial Survey of South Wales. (Published on behalf of the National Industrial Development Council of Wales and Monmouthshire.) Vol. 1: Industries. Pp. 500. 15*s*. net. Vol. 2: Facilities. Pp. 295. 10*s*. 6*d*. net. Vol. 3: Development. Pp. 404. 10*s* 6*d*. net. (Cardiff: University of Wales Press Board; London. Oxford University Press, 1937.)

Coal mining is by far the most important industry in South Wales, accounting for more than a third of the insured workers, although fourteen years ago it accounted for half. While the number of miners wholly unemployed remains at about its peak level, the number temporarily unemployed has been greatly reduced. The report estimates that there is a surplus of about 80,000 workers in the area, 70,000 of whom are from the mining industry, and a considerable proportion of this surplus consists of men too old to obtain employment on commercial terms. This is one of the important factors to which special attention is directed in the report.

This surplus is attributed partly to the inevitable results of technological development and partly to the growth of economic nationalism. Recognizing that it is an essential foundation of a rising standard of living that such commodities as steel, ships or bricks should be produced by a diminishing number of workers, and also that it is desirable that new and more economical methods of satisfying essential needs should be developed if possible, the report emphasizes the importance of re-absorbing the displaced labour after an interval in new industries and services as a normal remedy. Moreover, the case for State action to stimulate the introduction of new industries is strengthened by the fact that the over-expansion of the heavy industries, although probably unavoidable, was due to the needs of the State itself.

The problem, in fact, is not merely one of dealing with the hard core of unemployment by alleviating the lot of some thousands who have been unemployed for a prolonged period, but also the much larger problem of regional development. Even if employment in the heavy industries were fully restored, areas like South Wales would remain relatively depressed because of low wages, the large number of dependants per wage earner and the scarcity of employment for female labour. Throughout the report, emphasis is laid on the dangers of piecemeal or haphazard action, and the case for deliberate consideration by the State of regional development and the planned location of industry, as opposed to the almost accidental influence exerted in the past, is admirably argued. Only as the location of industry is considered in relation to long-term advantage can we hope for a successful policy, and the need for a careful statement of the theory of location is evident even if practical action and policy cannot wait for such a statement.

The present report, however, directs attention to several factors to be considered in arriving at decisions in the meantime. Thus, it indicates that technical developments have diminished the importance of location near coalfields or proximity to raw materials, and increased the strength of the pull exerted by other forces. The tractability, rather than the cheapness, of labour is now the important factor. At the same time the influence of local rates tends to increase, even though derating has removed much of the handicap under which the depressed areas laboured in competition with the south-east and south-west of England before 1929.

The review of industries and population leads to the conclusion that further State aid in encouragement of new industries in South Wales would be economically justified. Some transfer of labour to other parts of Great Britain should continue, but the main emphasis is laid on the introduction of new industries. Some such industries merely need certain inducements to overcome unjustified prejudices against location in South Wales. Some may need the assistance which the establishment of trading estates could give. The success of all, however, depends upon the width of the market to which they can easily have access, and it is for this reason that an improvement in the transport services connecting the region with the rest of England is so desirable.

The second and third volumes of the Survey are in fact mainly devoted to the examination of questions involved in the introduction and development of new industries. The second volume, which outlines in some detail the existing facilities, is naturally chiefly of interest to the industrialist considering a definite step in that direction ; but the third volume, which examines the new industries which might be established, and discusses the improvements in facilities necessary for their success, has a much wider interest and in particular a number of claims upon the attention of scientific workers.

The detailed treatment of labour supply and demand which occupies half this third volume alone emphasizes the necessity for some rational treatment of the problem, if only to minimize the amount of waste in cross-travel and to deal with the needs of the 20,000 older men of fifty to sixty-five years of age who are unlikely to be employed again. Some extension of the social service club system might be of vital assistance in restoring a sense of function to these men, by enabling them to use their creative powers to supplement their family income. The removal of any deterrents to their migration and reunion with other members of their family in a new district is another promising and constructive line of approach to this problem of the growing preponderance of the middle and older age groups among the wholly unemployed in the Special Areas.

It is, however, in the third and fourth chapters of this volume that the scientific worker will find the material of most immediate concern to himself. In its discussion of possible new industries, the report lays special stress upon the possibilities of the plastics industry, and argues a strong case for consideration. If the manufacture of all or most types of plastics were undertaken on an economic scale in South Wales, in a few years the industry might provide as much employment in the region as it gives the whole country now. As a means of providing employment, the plastics industry is far superior to schemes for oil from coal or low-temperature carbonization, or synthetic nitrogen, though the report emphasizes the desirability of locating such plant in an area so much less vulnerable to attack than Billingham.

The soundness of the survey is indeed well illustrated by the way in which this question of the plastics industry is discussed. If the industry is introduced at all, it is highly desirable that a range of new materials as complete as possible should be made in the region, because plastic materials are competitive to some extent with each other as well as with other materials. Any one particular type of plastic material may easily be driven out of the market by a new, better and cheaper material made elsewhere.

Part of the value of the plastics industry to South Wales would lie, however, in the assistance it could give to other industries in the area by using products obtained in the area and by stimulating other industries such as the establishment of a new chemical industry, the paint industry, the electrical industry and many light industries. The question, as the report insists, needs considering in relation to a far-reaching policy of industrial location, and to discuss with the industry as a whole the possibility of giving a fair trial to such a region as South Wales is a manifest responsibility of the Government, in keeping with its recognized responsibility for securing fair play for British trades overseas.

In an admirably balanced review of possible improvements in facilities, a convincing case is urged for a Severn bridge scheme as well as for the improvement of railway services. Tourist development has hitherto been amateurish and piecemeal, and offers a distinct field, particularly in Pembrokeshire and the Gower Peninsula. A national park in the Vale of Neath is also proposed, while the threat which ugly and random development present to the amenities of South Wales once more attests the need for planned development.

The present investigation in itself accordingly underlines its own very modest and restrained recommendations in regard to research. The trading estates should provide for their tenants some form of market research and economic advisory service. A far better service should also be available than now exists to provide information and guidance on wider problems common to the whole region, at the very least on those affecting the basic industries. As a manufacturing region, South Wales suffers severely from the absence of such services as the economic research sections in the University of Pennsylvania or the University of Manchester perform for their respective regions. Subsidization of university research on these problems might yield very valuable results for very small expenditure.

No one can study this report or even the admirable summary and commentary on it issued by Political and Economic Planning without realizing the important function which dispassionate scientific inquiry can fulfil as a basis for action. The long-range planning of industry is indeed only possible in the light of the knowledge so acquired. Repeatedly in this admirable survey the necessity for considering the problems of the Special Areas in relation to the whole problem of national development or recovery appears, as does the futility of any narrow or rigid treatment of the boundaries of the areas in regard to financial or other facilities for development or planning. Scientific workers who have the patience to study these volumes for themselves cannot but be strengthened in their conviction that science has its own special contribution to make to the solution of these difficult problems.

Aspects of Palæogeography

(1) Die bionomische Einteilung der fossilen Meeresböden

Von Hermann Schmidt. (Fortschritte der Geologie und Palæontologie, herausgegeben von Prof. Dr. W. Soergel, Band 12, Heft 38.) Pp. vi+154. (Berlin: Gebrüder Borntraeger, 1935.) 16 gold marks.

(2) Geomorphologie der feuchten Tropen

Von Karl Sapper. (Geographische Schriften, herausgegeben von Alfred Hettner, Heft 7.) Pp. vi+154+4 plates. (Leipzig und Berlin: B. G Teubner, 1935.) 6 gold marks.

(3) Géologie stratigraphique

Par Prof. Maurice Gignoux. Deuxième édition entièrement refondue. Pp. vii+709. (Paris: Masson et Cie., 1936.) 95 francs.

(4) Paläogeographie und Tektonik

Von Prof. Dr. Franz Kossmat. Pp. xxiii+414+5 plates. (Berlin: Gebrüder Borntraeger, 1936.) 18.20 gold marks.

(5) Die Entwicklung der Kontinente und ihrer Lebewelt

Von Theodor Arldt. Zweite, vollständig neubearbeitete und erweiterte Auflage. Pp. 448. (Berlin: Gebrüder Borntraeger, 1936.) 28 gold marks.

THERE can be nothing duller than the detail of stratigraphical geology and, let us hasten to add, nothing more exciting than the vision of the endless succession of past geographies based upon that detail. In the great pile of sedimentary and igneous rocks that make the earth's crust, there lie records of an ever-changing distribution of lands and seas, of the growth and decay of great mountain ranges, of extreme variations in climate and of the continuous succession of life-forms. Each in its own fashion, the five volumes considered here are notable contributions to this science of palæogeography.

(1) In the first book, the advances in hydrobiology are applied to the interpretation of facies, that is, the sum of all lithological and palæontological characters of a sediment. The various lines of attack in the study of facies-differences are critically examined, and then the foundations of a bionomic classification of sea bottoms established. The oxygen content of the bottom waters is taken as the most important factor. Two chief classes of bottom conditions, sweet and stagnant, are developed and their subdivisions viewed in the light of modern oceanography. These bionomic concepts are then applied to the interpretation of the sediments of the stratigraphical column. The book concludes with a study of special facies problems, such as those of the flysch, black clays, etc., and of aspects of adaptive morphology of sea animals. Throughout are given comments upon the habitat and significance of a great number of common fossils, and the work as a whole is an important contribution to that branch of palæogeography which the author calls palæohydrobiology.

(2) Prof. Sapper's small volume, though largely concerned with the development of land forms in wet tropical regions, deals also with certain topics of great interest to the palæogeographer. Of these, one only can be mentioned here, and that is the complete confirmation of the view that coarse unweathered arkoses, so often taken as indexes of arid or semi-arid conditions, are typically developed in humid tropical areas. It may be observed, in passing, that Sapper's book should be read by all British geologists, as it supplies a much-needed corrective to the notions of many of them concerning the scale of erosional processes.

(3) The first edition of Prof. M. Gignoux's "Géologie Stratigraphique" has been a standard and invaluable text-book in Britain for a decade. This largely rewritten and expanded second edition is more than a text-book, for, by its wealth of references and inclusion of new work, often relatively inaccessible, it will be of value to the specialist as well as to the student. The chief modifications are these. The treatment of the Palæozoic has been remodelled, and includes new data on, for example, the Saar Coalfield, the Russian Carboniferous, and the Permian of Timor and China. Full accounts of North African stratigraphy and tectonics have been added. The history of Gondwanaland has been synthesized. A new treatment of Alpine stratigraphy brings out very clearly the relations between sedimentation and tectonics, and a new introductory chapter deals with these relations on more general lines.

We have in this book a charming presentation of the philosophy of stratigraphical geology. Lately, there seems to have developed a tendency for geologists to show their versatility by the inclusion of passages of music in their writings, and Prof. Gignoux ends with a few bars of Wagner.

(4) In the fourth volume to be noticed here, Prof. F. Kossmat deals with the relationships between palæogeography and the tectonic shaping of the earth's surface. He is concerned not so

much with the fluctuations of the margins of the continental masses during successive periods of earth history, that is, with palæogeography in a narrow sense, but more with the movements of the crust which gave rise to such fluctuations. Changes in the successive mountain belts of geological time are to be traced step by step.

The first part of the book gives a rather compressed summary of the geological history and facies observations for the whole world, and this is followed by a tectonic analysis of the major divisions. Two kinds of continental masses are separated, the circumarctic controlled by its folded margins, and the high plateaux of Gondwanaland. Finally, more general topics are discussed—among these being the polar asymmetry of the earth's crust, critical times in earth history, the cause of earth movements and many others. Throughout the work there are many new observations and, in part, new interpretations that will be of interest to tectonic geologists.

(5) The last volume before us forms the first part of the second edition of Prof. T. Arldt's great work dealing with the distribution of present and past life. At the beginning the question of the permanence of continents and oceans is asked, and the whole work will provide an answer to this question. After a stimulating essay on the methods of palæogeography, the author begins his heavy task by an exceedingly detailed examination of the distribution of present and Tertiary forms of life in the Australasian, South American and Madagascar regions, and this examination takes up the greater part of the volume.

Among this mass of detail there are several more general sections of interest to the palæogeographer, in which conclusions are drawn concerning connexions by land-bridges between the various regions dealt with. Arldt concludes that during the Mesozoic these regions were connected with the northern land masses. The first bridge to collapse was that between Australia and India, then that between India and Madagascar was broken, and finally that between South and North America. The equatorial connexion between the three regions dealt with lasted much longer, and junctions with the northern land masses, that had been severed in Eocene times, wére re-established in the Pliocene. It seems, therefore, that land-bridges, in spite of Wegener and still more orthodox schools, are not yet a lost cause in palæogeography.

H. H. R.

David Gregory

David Gregory, Isaac Newton and their Circle
Extracts from David Gregory's Memoranda, 1677–1708. Edited by W. G. Hiscock. Pp. ix+48. (Oxford: W. G. Hiscock, Conway, Squitchey Lane, 1937.) 10*s*.

THIS is one of the MSS. of David Gregory, preserved at Christ Church, Oxford, accompanied by some brief notes of the editor, Mr. Hiscock, who seems to have done them very well. The interest of this publication centres around the name of Newton. It is only by making available the views of his contemporaries that we can realize Newton. To print an account is very much the most effective way of making it available. If a thing is written down, it remains, and if it is printed, many people read it. Their views, even if diverse, and even if negligently formed, congeal about something common to all. It may be compared with the short issue of Stukeley's account, recently reviewed in NATURE (138, 617; 1936).

Reading the book through, one finds many differences from modern practice. One realizes, for example, that anti-Christ was a real person to them, and that they knew nothing at all about chemistry, and had not the means to produce any high temperatures, otherwise than by burning glasses. Newton was, in fact, the first of the moderns; he understood exactly the basis our conventions rest upon. We owe to him very much more than is usually ascribed; we owe him the whole direction of modern investigation.

The present transcript consists of personal notes about all sorts of subjects, most of them dated, for the use of David Gregory. Gregory's relations with Newton are well known, and they seem to have suffered from no cloud. Newton does not directly figure in these memoirs, but there are many references to him, and some important ones —one, for example, that Mr. Hiscock considers so important that he has photographed it and produced it as a frontispiece. It serves to emphasize Newton's conception of matter; it relates to the question of matter being proportional to weight. To quote two statements that strike us, from the text: "3 March 1698/9 . . . And its as universally received in England that the winters are milder as it is that the summers are colder" and "May 1708. Algebra is the Analysis of the Bunglers in Mathematicks. Sir Isaac Newton".

R. A. S.

Contemporary American Philosophy

(1) A World of Chance:
or, Whence, Whither and Why? By Prof. E. G. Spaulding. Pp. xxxiv+293. (New York: The Macmillan Co., 1936.) 12*s*. 6*d*. net.

(2) The Logical Structure of Science
By Prof. A. Cornelius Benjamin. (Psyche Monographs, No. 9.) Pp. 344. (London: Kegan Paul and Co., Ltd., 1936.) 10*s*. 6*d*. net.

(3) Personal Realism
By James Bissett Pratt. Pp. xi+387. (New York: The Macmillan Co., 1937.) 15*s*. net.

(1) OF these three books, all by American philosophers, the first is concerned with the ultimate structure of the universe, the second with the nature of scientific thought and the third with metaphysical conclusions derived from a realistic epistemology. The first, by Prof. Spaulding of Princeton, is a further development of the new realism with which he has been identified and is, primarily, a defence of the thesis that ontological contingency is a logical necessity. Prof. Spaulding holds that there is no ultimate unity except the unity of totality, and his 'ultimates' or 'irreducibles' consist of five properties—possibility, contingency, propertiness, ultimacy and reality. Each of these is an instance of itself as well as of the other four; and, in order to obtain this finality, he deliberately violates the theory of types. Prof. Spaulding asserts that, while all existing entities are possibilities and all possibilities realities, not all possibilities are realized in Nature. He maintains that in the structure of reality, shot through with chance and indeterminism, Nature is but a chance instance which *is* but need not be, that there is no necessity for the existence of even that objective realm of possibilities one of which is realized as Nature, and, finally, that the whole of reality, including logical entities and values, is contingent.

The new development in Prof. Spaulding's philosophy consists largely in a synthesis of the results of research in symbolic logic, in the physical sciences, emergent evolution and the theories of knowledge and values. But here, quite apart from the possible complications arising from his violation of the theory of types in arriving at his ultimates, there is an epistemological chasm which, to the reviewer, he does not appear to have bridged satisfactorily even by his theory of external relations. In another instance of the theory of types, namely, the interpretation of the indeterminacy principle which asserts that nothing can be observed as it really is because observation disturbs that which is observed, Spaulding refutes the argument by declaring that this again leads to an infinite regress For, if observation disturbs that which is observed, then that in turn becomes the observed to another observation, and so on, indefinitely. Thus he arrives at knowledge by refusing to accept an infinite regress.

Whether or not there are positive advantages to be gained by this freedom for postulation, Prof. Spaulding's method is undoubtedly a very interesting contribution to contemporary philosophy.

(2) Although mistrustful of labels, Prof. Benjamin calls himself a critical positivist and bases his inquiry into the nature of science upon the firm conviction that all philosophy and science must start with the given, which is subdivided into the realms of the clearly given and the obscurely given. The task of science is to symbolize the total realm of the given by discovering the relations connecting the clearly given with the obscurely given. Thus, in his view, methods of construction and reduction are essential; but he differs from the positivists in insisting that not all constructions and derivations should be given an unreal status. Hypothetical entities are not to be denied, but are to be relegated to the realm of the obscurely given.

In Prof. Benjamin's philosophy, an occurrent takes the place of an event, an object, or any other term representing the basic subject-matter of science. An occurrent has form and content, and genuine knowledge consists in being aware of an occurrent, of a symbol for the occurrent and also of a symbol for the relation between the two. In a careful argument he shows that if one of these is lacking, there is no science in the strict sense.

There is much of interest in Prof. Benjamin's thesis including, in particular, his operational theory of meaning. It is to be hoped that his tentative solutions of these problems will inspire the criticism and discussion which he invites.

(3) Prof. J. B. Pratt is one of the seven American authors of the famous "Essays in Critical Realism" which appeared in 1920. The present book is the outcome of his further deliberations on the problems of epistemology which were the subject of the earlier work and, more particularly, on the metaphysical consequences to be drawn from them. So far as epistemology is concerned, Prof. Pratt is still a critical or—as he now prefers to term it—dualistic realist, inasmuch as he

maintains that at least three factors are necessary in the knowledge situation, namely, the conscious subject, the mental content and the object. It is in the metaphysical conclusions that he parts company with some of his erstwhile colleagues. For Prof. Pratt is of the opinion that in many cases the naturalistic consequences which were drawn were unjustified, and that the doctrine of knowledge espoused by the group led "to the conception of a partial independence and spontaneity of mind and of the reality of a substantial self"

While it is obvious that, in working out his conclusions, Prof. Pratt has studied with great care the latest developments in logical and philosophical doctrine, yet, to the reviewer at least, there is a distinct flavour of 'other days' in his writing which is reminiscent of the pre-symbolic epoch when 'metaphysics was metaphysics'. But he is consistently suggestive rather than dogmatic; and even in the final chapter where his "over-beliefs" take the form of a spiritual pantheism, he only claims for them, as for the rest of his conclusions, a "balance of probability". A. v. Z.

Musical Instruments and their Distribution

Origine des instruments de musique: introduction ethnologique à l'histoire de la musique instrumentale. Par André Schaeffner. (Bibliothèque musicale.) Pp. 406 + 32 plates. (Paris: Libr. Payot, 1936.) 50 francs.

A COMPREHENSIVE account of the musical instruments and their distribution has been wanted for a long time by ethnologists and others, so this work on the simpler musical instruments by M. Schaeffner is very welcome. The author admits that it is not exhaustive; it is evident that he has done his best to cover the ground, but as might be expected, specialists in certain areas are acquainted with instruments that are not alluded to by Schaeffner. For example, there are on the Sepik River, New Guinea, drums without a tympanum which are struck on the ground or on the surface of water. Fig. 2 is drawn from a photograph which shows a *sede* lying on the ground, so Schaeffner supposed that it was played while resting on the ground, but it is played only on vessels, *lakatoi*, while on the great trading expeditions, *hiri*, of the Motu peoples. The remarkable *temes naainggol* of Malekula, described by Deacon, have also been overlooked.

The author begins with "origines corporelles": singing and other sounds are produced by the mouth and its parts, but the mouth may also act as a resonator in playing the musical bow or the jew's harp. Hand-clapping, striking various parts of the body with the hands and tapping the Adam's apple to produce a tremolo, and stamping with feet are primitive methods for the production of music or rhythm, of which definite appliances may be regarded as extensions. These are innumerable, but the author has contrived to describe or refer to a very great number, and the variations and affinities of the main types are clearly stated. The author criticizes the groupings of Hornbostel and Curt Sachs and gives in an appendix an elaborate classification of his own. This recognizes: (1) Instruments with a solid vibrant body (*a*) not susceptible of tension, (*b*) flexible, (*c*) susceptible of tension, either a cord or a membrane. (2) Instruments directly dependent upon air vibration or wind instruments. There are also chapters on organology of the theatre; on instruments derived from, or associated with, work and play; instruments employed in religion and magic; the evolution of music; primitive polyphony; evolution and diffusion of instruments.

While admitting the provisional utility of the stratigraphy of Curt Sachs in which he reconstructs, layer by layer, the successive diffusion of instruments across the world, to which Hornbostel had made corrections in details so far as Africa is concerned, Schaeffner points out that there is a danger in linking material objects such as musical instruments with a chronology, itself hazardous, of phenomena of social organization which do not yet admit of a uniform interpretation. He agrees with R. H. Lowie who says, "In this department of culture, as in others, contacts with other groups are significant: African music excels because of the Negro contacts with Egypt, India and Indonesia. The Negro deserves credit for adapting and using his instruments, but not for creating them" ("An Introduction to Cultural Anthropology", 1934, p. 208).

Owing to the absence of an index, it is rather difficult to find an account of any particular instrument; also it would have been a help if the legends of the photographs had references to their respective pages, and if references to pages had been added to the classification in the appendix to this excellent book. A. C. HADDON.

Wild Nature's Day

By Frances Pitt. (The 'Greenjacket' Books.) Pp. 200+27 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 3*s*. 6*d*. net.

MISS FRANCES PITT has done great service for her generation, in her endeavours to show the entrancing interest to be derived from the study of birds and beasts in their native wilds. There are very few who can compare with her in her ability to captivate those who have a kindly feeling for these creatures, but little or no time for first-hand observations of their ways. In this, her latest book, she has, we venture to think, surpassed all her previous efforts. Herein she presents the creatures of her choice as they are to be found during morn, noon and night. Even those who may claim to have more than a passing knowledge of the birds and beasts she describes will find something new that is worth knowing about their ways.

From a book as full of charm as this, it seems impossible to choose passages for special mention; for once the attempt was made whole pages would have to be quoted. Of the three parts into which the little volume is divided, perhaps the first and the last will be most enjoyed, since few of us are energetic enough to rise at daybreak, as Miss Pitt has a habit of doing, to note the gradual awakening of the birds; and the homeward journeys of creatures such as the badgers! Again, few of us are enthusiastic enough to stay out, when night has fallen, to watch the habits of bats and badgers, and others which hunt while the world sleeps; or to find out where the birds "go to bed"!

This is a book professedly written for boys and girls—we would add 'old, and young', for it is surely one of the best of its kind ever written. In a way that few other natural history books have ever done, it will arouse an interest that will last a lifetime.

W. P. P.

Index Generalis 1937:

the Year-Book of the Universities, Libraries, Astronomical Observatories, Scientific Institutes, Museums, Academies, Learned Societies. Issued under the direction of Dr. R. de Montessus de Ballore. Pp. vii+BE232+US232+F180+2500. (Paris: Masson et Cie., 1937.) 275 francs.

THE new edition of this annual handbook, indispensable to universities, research institutes, libraries, etc., maintains the high standard achieved by the previous edition. Nearly two thousand pages are devoted to the constitution of the universities, technical institutions and other educational establishments throughout the world. Such information contains the officers, professors (with their subjects), number of faculties and students, etc. This is followed by more than seven hundred pages describing the constitution, staffs, etc., of astronomical and other observatories, museums, academies, institutions and learned societies. Valuable information concerning the most important libraries is also included. Altogether there are 6,500 entries.

Appended is a useful list of men of science and others who wish to exchange their publications with other workers in the same field. This list has been extended. A list of publishers is given; but the section dealing with Great Britain, at any rate, is of little value, for several well-known publishers are omitted. A new feature in this edition is a list of Nobel laureates since the foundation of the prizes in 1901. The index of names contains 95,000 entries, which make reference an easy task.

This volume, as a book of reference, is invaluable to workers in all branches of academic life.

The Engineer's Year-Book of Formulæ, Rules, Tables, Data and Memoranda for 1937:

a Compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas, Aero, Mine and Metallurgical Engineering. Originally compiled by H. R. Kempe and W. Hanneford-Smith. 43rd. Annual Issue, revised under the direction of L. St. L. Pendred. Pp. lxi+xiv+2676. (London: Morgan Bros. (Publishers), Ltd., 1937.) 31*s*. 6*d*. net.

WE welcome the forty-third edition of this annual. The editor has picked out the sections on machine tools, metallurgy, aeronautics, paints and varnishes for revision, and the names of the contributors are a surety for the accuracy of the information given. We are so familiar with this work that we have long ceased to consider its unwieldiness. But it is an outsize in handbooks, and so it is probable in the future that it will split into two or more volumes, suffering what physicists call atomic disintegration.

The editor tells us that the forty-second edition is sold out and that this is not due to the astuteness of the publisher in estimating the probable demand or because intensive sales methods are used. He infers that because it goes well it gives the kind of information the purchaser needs. A survey of the book shows that his deduction is probably correct. The descriptive sections, a useful feature of this year book, contain full particulars of various products of a number of engineering firms.

Leçons de zoologie

Par Prof. M. Prenant. Prochordés: Amphioxus, Tuniciers. (1. Ascidies). Pp. 71+3 plates. 15 francs. (2. Pyrosomes), (3. Doliolides), (4. Salpes), (5. Appendiculaires). Pp. 49. 12 francs. (Actualités scientifiques et industrielles, 379, 380.) (Paris: Hermann et Cie., 1936.)

THE Protochordates have been dealt with in a general way by Prof. M. Prenant in these two brochures. *Amphioxus* and the simple and compound Ascidians in one (No. 379) and *Pyrosoma*, the Salps and the Appendicularians in the other (No. 380). Each is a straightforward and well-illustrated account of the animals indicated in the title, prepared in the light of present-day knowledge. Both are well indexed and after each group is a select bibliography of most important monographs and recent memoirs relating to it. The numerous illustrations are all in the form of text figures and quite clear. The two publications constitute a useful addition to a well-known series.

Montserrat and the West Indian Volcanoes*

By Sir Gerald Lenox-Conyngham, F.R.S.

ABOUT the beginning of 1934, Montserrat began to be troubled by earthquakes and tremors. They became very severe and numerous in May and again in December. In 1935 they were worse still; much damage was done to buildings and naturally a great deal of anxiety was engendered in the minds of the inhabitants. In the autumn of 1935, the Governor received a petition from the leading members of the population praying that steps should be taken to determine, if possible, whether there was danger of a volcanic eruption.

This anxiety was very natural, for by the inhabitants of that region the terrible events of 1902 are well remembered. In that year on May 7 the Soufrière of St. Vincent burst into eruption and on the following day Mt. Pelé in Martinique did so too. From both of these volcanoes there poured what the French have called a *nuée ardente*, and what other observers have called the "Great Black Cloud". That from Mt. Pelé swept down upon the town of St. Pierre with such violence and such deadly effect that in a few minutes the whole town and its 30,000 inhabitants were destroyed. In St. Vincent the death roll was not so great because, fortunately, there was no large town in the area over which the cloud flowed.

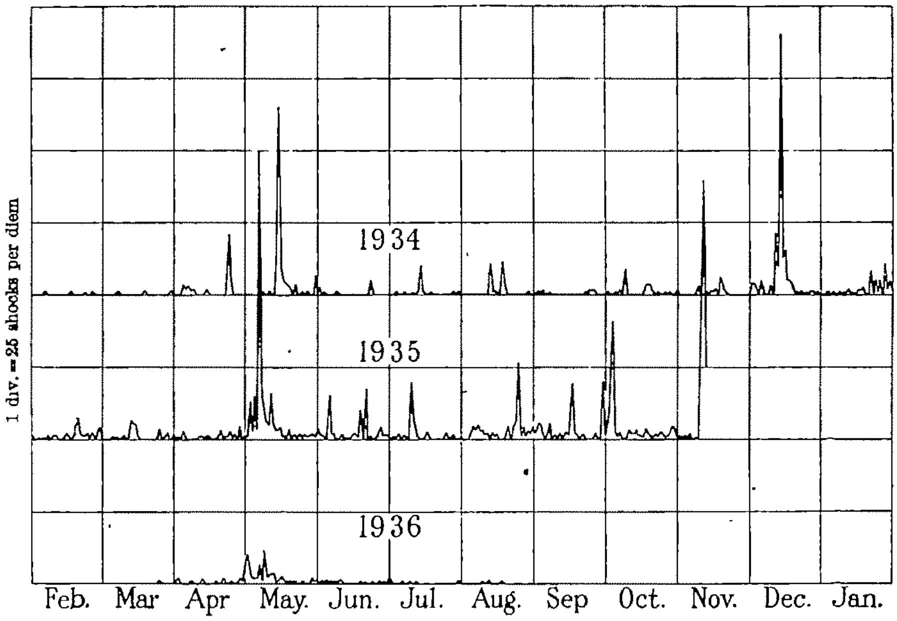

Fig. 1.

NUMBER OF SHOCKS PER DIEM.

The island of Montserrat is wholly volcanic. It contains no less than six volcanic cones; of these four lie more or less in a straight line running from north to south and give the island that serrated appearance which is the origin of its name.

The only map of the island is one made by the Hydrographic Department of the Navy in 1867. A recent geological survey of the island, made under great difficulties because of the absence of an accurate topographical map, shows that the most recent of the volcanic cones is the one called Soufrière Hills or Chance's Mountain, which dominates the town of Plymouth. The island was discovered by Columbus in 1493 and was first colonized by the British in 1632. We know that there has been no volcanic eruption in the island since it has been known to Europe, and from the evidence of the erosion that has taken place since the last eruption we may conjecture that that eruption belonged to a much earlier date. But the island has undoubtedly in the past been the scene of repeated volcanic outbursts, and as we know nothing at all of the causes which determine the time and place of an eruption, it would be extremely rash to assert that there will never be another, and certainly the experiences through which Montserrat had passed had been very alarming. Fig. 1 gives the daily number of tremors from February 1934 to November 1935 and again from March to August 1936. As many as 100 were recorded in one day in May 1935, and three other days were nearly as bad, so that the people of Montserrat had ample cause for apprehension.

The result of the petition mentioned above was that the Governor referred the matter to the Colonial Office and that the Colonial Office consulted the Council of the Royal Society. It was decided to send out an expedition consisting of a geologist and a physicist to see what they could find out. The geologist selected was Mr. A. G. MacGregor, of the Geological Survey, and the physicist was Dr. C. F. Powell, of the University of Bristol. An invitation was also sent to Dr. T. A. Jaggar of the Volcano Observatory of Hawaii asking him to visit Montserrat and give the members of the expedition the benefit of his great experience. This invitation he accepted. He paid his visit during the months of May and June and made a valuable report. The island was also visited several times by Mr. Perret. He is a volcanologist of long experience who has been spending a part of each year since 1929 in Martinique, observing the course of events since the eruption of September 16 of that year. Mr. Perret has made several very helpful reports.

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* From a Friday evening discourse delivered at the Royal Institution on March 12.

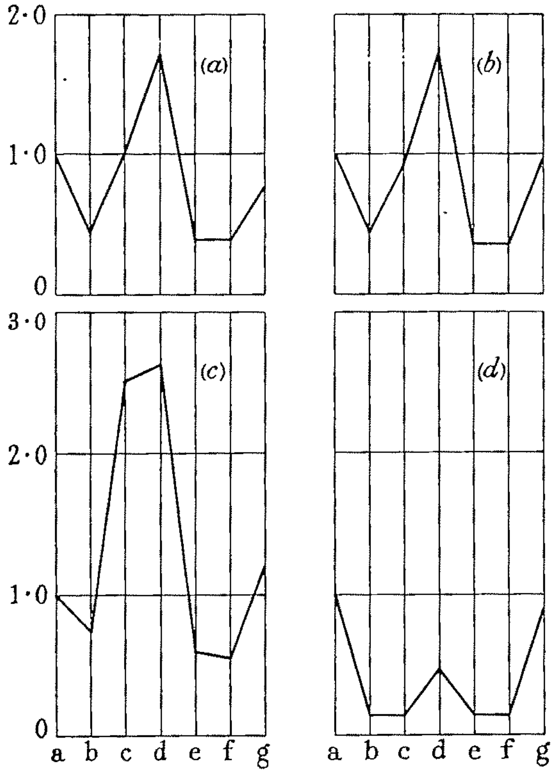

Fig. 2.

It is worth noting that there is a recurrence of activity in May of each of the years 1934, 1935 and 1936. This may be accidental, for three years do not constitute a long enough period for the establishment of a cycle, but it may be noted that the eruptions of 1902 also began in the month of May, so that there is some evidence of an annual crisis. Unless, however, one can connect a cycle which seems to be indicated by the observations with a physical cause, it is necessary to be careful, and only the most unimpeachable evidence derived from long periods of observation ought to be accepted.

Some careful and trustworthy observers are convinced that a lunar period, similar to that which is to be discerned in the tides, is to be observed in the behaviour of volcanoes, and the action of these tidal forces has sometimes been described as 'trigger action.' That seems an inappropriate term. The essence of a trigger action is that the application of a small force of one kind releases a large force of a different kind. But the action of tidal forces would be to produce a small increase —or diminution—of pressure of the same kind as that to which the crust of the earth is already subjected. There is no question of the release of a different kind of force. To call the effect of such a force as the tidal one a 'last straw' effect is legitimate. It is similar in action to the proverbial last straw. The character of the 'last straw' is its smallness. It does not have any effect unless the load which has already been imposed has very nearly overcome the strength of the 'camel's back'. These tidal forces are small; they will not produce any visible effect unless the pre-existing stresses are on the point of causing a fracture. If then it can be established that there is a cycle of earthquakes corresponding with the tidal period, it is strong evidence that at all times fracture is very nearly but not quite taking place. In the case of Montserrat, the evidence of an annual cycle is much too weak at present for it to be safe to venture on any inferences.

The Royal Society Expedition left England early in 1936 and was equipped with a number of Jaggar shock-recorders and a Wiechert seismograph. The shock-recorders were designed by Dr. Jaggar, mentioned above. They are simple, satisfactory instruments, not very sensitive but well adapted for recording the sharp, local shocks which were likely to occur. These instruments were in Dr. Powell's charge, and his plan was to erect the shock-recorders at a number of places well distributed over the island so as to obtain information as to the relative severity with which the shocks were felt in the several localities, and thence to deduce the whereabouts of the epicentres.

Dr. Powell made use of his instruments as follows: he noted first that the distribution of amplitude for shocks coming from the same focus should be constant and independent of the individuality of the recording instruments. Thus, taking the amplitude of the movement recorded at a selected station as unity, the amplitude at each of the other stations will be expressed by its ratio to this standard amplitude. If these ratios are plotted, as in Fig. 2, where the ordinates are the ratios and the letters represent the stations, they form a pattern, and it is reasonable to suppose that all shocks emanating from the same focus will produce the same pattern.

Then to determine the position of the focus which corresponds to a given pattern, we assume that the amplitude of the waves produced by an earthquake decreases inversely as the distance from the focus. We can estimate the position of the focus corresponding to each of the patterns. The results are shown in the map (Fig. 3). The open circles represent the positions of the epicentres and the shaded ones the positions of the instruments. The epicentres all lie on a belt which crosses the island from south-west to north-east and is rather less than four miles wide.

It is difficult to form any idea of what was going on during the long period of 30 months, during which these frequent tremors occurred. The nature of one of the great tectonic earthquakes, such as that in California in 1906, or in India in 1934, is in general outline clear enough. But these long-continued series of volcanic shocks, with their periods of greater and less activity, are manifestations for which it is hard to account.

Looking at the West Indian region as a whole, there is no apparent system in the way in which eruptions and earthquakes occur. Below is a list of the more important of such events since the beginning of the nineteenth century compiled for the most part by Dr. Jaggar.

1802	Eruption	Guadeloupe
1812–14	Eruptions	St. Vincent
1831	Submarine Eruptions	near Barbados
1837–38	Eruptions	Guadeloupe
1842	Greater Earthquake affecting many islands	
1843	Submarine Eruption	near Guadeloupe
1851	Eruption of Mont Pelé	Martinique
1867	Great sea wave after submarine earthquake. Felt in Grenada and elsewhere	
1880	Activity	St. Vincent & Dominica
1897–99	Earthquakes	Montserrat
1902–04	Eruptions	St. Vincent & Martinique
1906	Earthquakes	St. Lucia
1907	Earthquake	Jamaica
1918	Earthquake	Puerto Rico
1929–32	Eruptions Mont Pelé	Martinique
1930	Series of Earthquakes	Nevis
1934–36	Series of Earthquakes	Montserrat

No system or sequence is discernible in these events, but the records are not very complete and they are not based on instrumental observations. If each island were equipped with a recording instrument, there would be a fair prospect of movements being detected which might otherwise escape notice, and these movements might give some clue to the way in which the forces, whatever they are, traverse the region.

There is another line of approach to this problem. It seems to be generally agreed that the Lesser Antilles are oceanic islands which have grown as submarine volcanoes from the broad top of a tectonic arc. The islands are therefore only symptoms. The volcanoes have their origin in the tectonic arc, and it is its nature and origin that are of interest to us.

The West Indian island arc is by no means the only one of its kind, and no one who has made the comparison can fail to be struck by the general similarity between the West Indian and the East Indian island arcs. This similarity, however, would not be of much interest if it were not for one special circumstance. It is this. It was a Dutchman, Dr. Vening Meinesz of the Dutch Geodetic Commission, who invented the only successful method, so far, of making determinations of gravity at sea, and these East Indian islands are Dutch possessions. It was not unnatural, therefore, that Dr. Vening Meinesz should see, in the waters surrounding these islands, not only an interesting region for a gravity survey, but also a region in which he would be among his own people and where he could rely on being allowed to call where he liked. His method can only be carried out on a submerged submarine, and as a submarine is essentially a ship of war, foreign harbours cannot be visited without some preliminary negotiation.

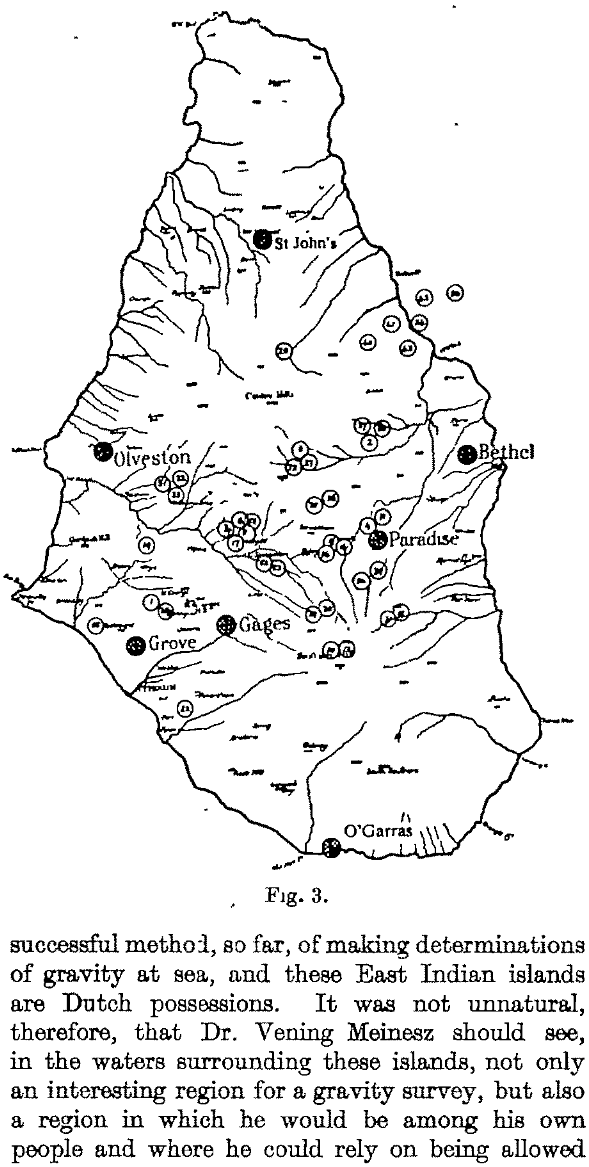

Fig. 3.

Dr. Meinesz made a number of cruises among these islands in the years 1929-30 and determined the value of gravity at more than two hundred places. He discovered, quite to his surprise, that there is a continuous belt of negative gravity anomaly on the convex or outer side of the island chain. This line of negatives tells us something about the structure. It shows that along that line the less dense outer layer of the crust has been pressed downwards and has displaced the denser rock below. Dr. Meinesz has drawn a diagram (Fig. 4) to illustrate his conception of the state of things. In the diagram the less dense material of the outer layer of the crust is displacing the denser magma, and it is only by the exertion of continuous pressure that this state of things can be made to persist. If the pressure were withdrawn, gravitational forces would push this root up until it was in floating equilibrium, and the gravity anomalies would disappear. The gravity anomaly then shows that there is a state of strain, that there is abnormal lateral pressure directed across the line of negative anomaly, which runs parallel to the island arc.

It is much to be desired that a similar gravity survey should be made of the West Indian region, and it is very satisfactory to learn that this has been undertaken by the United States Navy.

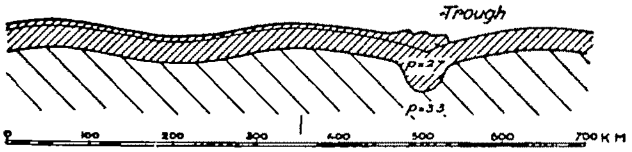

Fig. 4.

There is another feature of these island arcs which I think deserves attention, and that is their curvature. In July 1903 a paper by Mr. Philip Lake entitled "The Circular Form of Mountain Chains" appeared in the *Geological Magazine*. In it and subsequent papers by the same author, the cause and nature of these arcs were discussed, and what follows is largely derived from them.

Whenever we see an arc of a circle on the surface of a sphere we cannot fail to perceive that it is the intersection of a plane with that surface, and when the arc is marked by a mountain chain or by a festoon of islands—by marks, that is to say, of force of some kind—it is natural to think of the plane as a thrust plane and to imagine that forces acting in that plane have been the cause of the formation of the islands or mountains as the case may be. If this is so, then there must have been some slipping of the matter above the plane on the matter below it. There will be a fault, and the dip of the fault can easily be shown to be equal to the radius of the circular arc.

Mr. Lake examined the arc formed by the Himalayas and suggested that its form is due to the fact that there is a thrust plane at its base. It is easy on a globe to find the position of the centre, or, to speak more correctly, the pole of the arc, and then to measure the distance from the pole to the arc in degrees of great circle. Making this measurement, Mr. Lake found that the radius was 14°, and concluded that this must be the dip of the basal thrust plane. In 1919, Mr. C. S. Middlemiss made the first actual measurements of the dip of the Main Boundary fault of the Himalayas. He found it to be between 12° and 15°. This Main Boundary Fault is the principal line of separation of the older tertiary rocks of the Himalayas from the younger rocks that lie along the foot of the mountains.

One cannot doubt that the great earthquakes which from time to time cause so much devastation in the Gangetic plain are the result of movement of the newer rocks on the older or of fracture resulting from the pressure of the one upon the other, but we need not expect that those earthquakes will find expression in movement along the visible faults, for the movement is much deeper. Mr. Middlemiss, for example, writing of the great earthquake of April 5, 1905, says that the earthquake was due to "a sudden rupture or release of strain occurring . . . where the strain was specially great owing to resistances to the well established forward march of the over-thrusting foot of the Himalayan range".

It appears, then, that the mountain arc is due to the overthrusting of the advancing range: that the real seat of the thrust is deep down under the alluvium, that the form of the arc is determined by what is going on down in those depths and that therefore, since the radius of the arc is 14°, the dip of the plane along which the thrust is taking place should also be 14°. It is probable that there are a number of fault planes parallel to the fundamental one, and since at the place where we can examine the matter we find a dip of 14°, we may reasonably infer that the fundamental thrust plane has this inclination also, which corroborates the evidence given by the radius of the arc.

Until, however, we know the results of the gravity survey made by the U. S. submarine, further conjecture on the West Indian problem would be premature. If by gravity observations we can arrive at some idea of the position of the point at which the front of the overriding rock is in contact with the old overridden rock, and if we know the slope of the plane which divides the one from the other, and if also we can form some estimate of the amount of deformation of the dense magma below by the intrusion of the lighter material which has been forced down into it, we shall arrive at some kind of picture of the structure that lies below these volcanic arcs, and that will at any rate be a step in the right direction.

Recent Crystallography*

By Sir William Bragg, O.M., K.B.E., P.R.S.

ALTHOUGH some of the considerations already discussed are admittedly provisional, they show how the knowledge of protein structure is steadily increasing, how, in fact, the examination of the structure can be looked on as a branch of crystallography. The X-ray methods furnish measurements of distances and angles which suggest the possible forms of the proteins in space, forms which must obey certain geometrical conditions. Some of these are carried over from examinations of other organic molecules ; others are derived from direct X-ray measurements of the proteins themselves. It then becomes of great interest to connect the physical form with biological properties.

Quite recently a remarkable discovery by Dr. Stanley, of the Rockefeller Institute at Princeton, has shown that a certain virus, which causes disease in tobacco plants, is a protein. Its composition falls within the protein limits already quoted. Its molecular weight has been found by Svedberg to be of the order of 17 millions. It has reactions to polarized light which show that it is crystalline, and that the great molecule is needle-like in form. The conclusions follow from the fact that a solution of the virus shows when disturbed the effect known as 'streaming double refraction'. When minute crystals are suspended in a liquid medium they normally point in all directions. If the suspension is examined between crossed Nicol prisms, the field is dark. But if the suspension is so disturbed that the particles in any region are arranged to point in the same direction, or at least so that on the average they point more in one direction than another, the whole behaves like a single crystal, and illumination appears in the field. The very beautiful display of this effect by a suspension of the needle-like crystals of vanadium pentoxide has been known for some time.

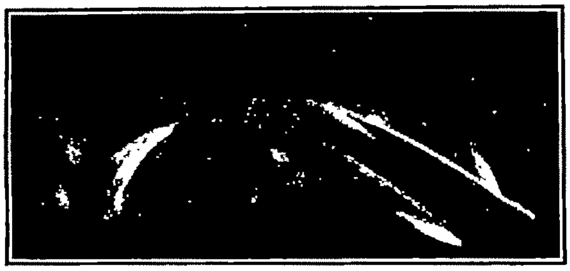

Fig. 3.

WAKE OF A GOLDFISH SWIMMING IN A DILUTE SOLUTION OF PROTEIN FROM A SAP INFECTED BY TOBACCO VIRUS, OBSERVED BETWEEN CROSSED NICOLS.
(*Photo by Ramsey and Muspratt.*) (By courtesy of J. D. Bernal.)

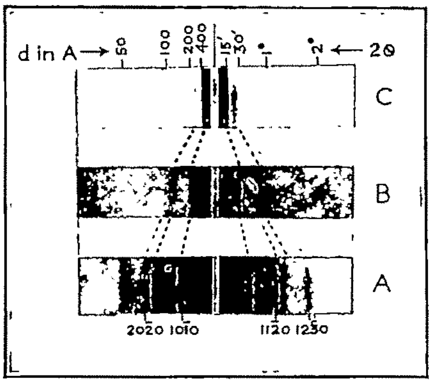

Fig. 4.

X-RAY PATTERNS OF DRY GEL (A), WET GEL (B), AND 13 PER CENT SOLUTION (C).
(By courtesy of J. D. Bernal.)

The disturbance of the liquid by stirring of any kind produces whirlpools in which layers of the liquid slide past one another in shearing motion. Any long rigid particle lying across the general direction of flow is moved forward more slowly at one end than at the other. In consequence it tends to set itself parallel to the stream. But the conditions are unstable. If it continues its rotatory motion past the position of parallelism, it undergoes a further rotation of 180°. On the whole, however, one may expect the periods of parallelism to be much longer than those in which the particle lies across the stream. This effect can be shown by allowing glycerine to move along a narrow glass tube, carrying with it short lengths of a fine fibre.

In a whirlpool, therefore, the rod-like crystalline particles tend to set themselves tangentially to the whirl. A beautiful illustration of this effect is given in Fig. 3, which is reproduced from a communication to NATURE[2], by Bernal and others. A small fish is moving in a virus suspension between crossed Nicols. The movements of the tail leave vortices behind them and the crystalline needles of the virus follow the movement of the liquid in spirals approximating to circles. The field shows bright spots arranged at the corners of a cross ; because the line of movement makes an angle of 45° with the planes of the crossed Nicols at four points.

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* (*Continued from p.* 866.)

Bernal and his collaborators have been able to obtain X-ray diffraction photographs of the virus. These are shown in Fig. 4. The pure virus in a suspension stronger than 2 per cent separates into layers which are sharply distinguishable. One of these (*B*) is "an extremely soft gel well orientated and with much higher birefringence, 0·007, than the liquid.. The outer part of this wet gel shrinks by 50 per cent and forms a layer of higher refractive index, but lower birefringence, 0·003". These two layers give respectively the photographs *A* and *B* of Fig. 4. Photograph *C* is obtained from a 13 per cent solution in which the crystals are orientated by flow along a narrow tube. A similar set of lines is found in the three cases, indicating a hexagonal arrangement, such as would naturally be found in an arrangement of long rods put side by side. In *A* they are at a distance, rod to rod, of 152 A.; in *B*, 210 A. In *C* the distance is more vaguely defined, as one would expect, and ranges from about 300 A. to 470 A.

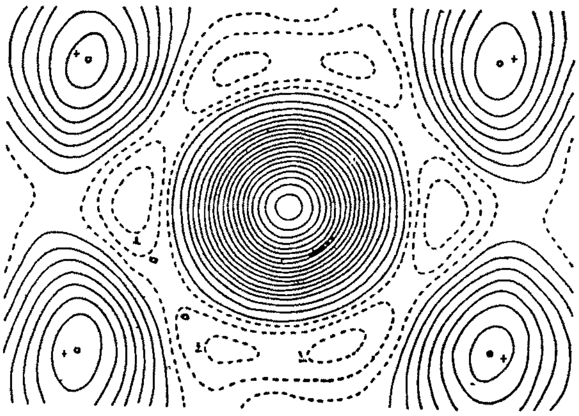

Fig. 5.

THE CENTRAL PORTION OF A MOLECULE OF NICKEL PHTHALOCYANINE, SHOWING THE ELECTRON DENSITY OF THE NICKEL ATOM, PROJECTED ON THE PLANE OF THE DIAGRAM.

(J. M. Robertson.)

Besides these evidences of regularity in the side to side placing of the molecules, there is evidence in other photographs of much narrower spacings, which do not vary with the condition of the material and the arrangement of the molecules side by side. They refer obviously to regularities within the molecule. The length of the spacing is given as $3 \times 22{\cdot}2 \pm 0{\cdot}2$ A., a result in close agreement with measurements of Wyckoff and Corey on the tobacco virus and on a variety of it known as the *aucuba* virus. It is very remarkable that this virus, though a crystalline protein, appears to be capable of multiplying itself and of generating an anti-body, and to be liable to mutation.

Brief reference may be made to a few other examples of the development of crystallography by means of the X-ray methods, supplemented now by the methods of electron diffraction.

Dr. J. M. Robertson has investigated in much detail the nickel phthalocyanine. The shadow picture contains a beautiful display of the electron distribution in the nickel atom, projected upon the plane of the diagram. The central part of the molecule containing this atom and its immediate surroundings is shown in Fig. 5. The contour lines of the nickel atom are drawn so that from line to line there is a difference of two electrons per square Angström unit. In the other part of the figure the difference is one electron per unit area. The accuracy is high, and the figure must give a fairly accurate representation of the distribution of the electrons in the nickel atom. It can be represented closely by an empirical formula of the form Ae^{-kr^2} where r is the distance from the centre of the atom.

Applications of the new crystallographic tools to the study of practical problems of metallurgy and engineering have been numerous and important. As an example may be taken the study of the effects of cyclic stress upon a mild steel, recently described by Gough and Wood[3]. It is well known that metal structures can in certain cases be fractured by a sufficient application of intermittent or cyclic stresses; that, to use the technical term, they become fatigued. Gough and Wood establish the important point that "the application of cycles of a safe range of stress (strain) is unable to cause *progressive* damage to the state

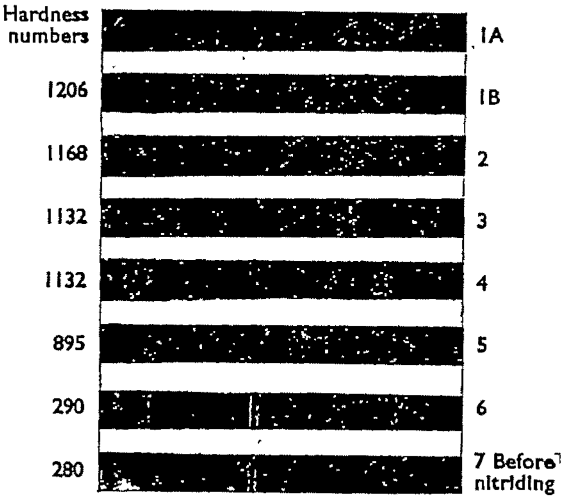

Fig. 6.

X-RAY PHOTOGRAPHS TAKEN AT DIFFERENT DEPTHS IN A NITRIDED STEEL: THE FIGURES ON THE LEFT REFER TO THE HARDNESS. THE TOP FIGURE SHOWS THAT AT THE VERY SURFACE IRON NITRIDES HAVE BEEN FORMED.

(From the Report of the National Physical Laboratory, 1933, by permission of the Controller, H.M. Stationery Office.)

of the structure". The X-ray powder photographs of a piece of mild steel show no change during the imposition of cyclic stresses of 9 tons to the square inch, up to 10^7 repetitions. This is just within the safe range of stress. But when the stress is increased to 9·7 tons, which lies outside the safe range, there is a gradual change. The X-ray photographs show that the crystal grains are being broken up into powder consisting of far smaller crystal portions, and the structure fractures after about half a million cycles or so. Thus the progressive deterioration of the specimen takes place only when a certain safe load has been exceeded.

In this case the appearance of the X-ray photograph indicates the condition of the material. In a number of instances the photographs are now used in this way; the spacings of the crystal planes which are determined by the positions of the lines are not in question. Thus the series of photographs of Fig. 6 shows the conditions of a steel at various depths below the surface when ammonia at 500° C. has been passed over it. The diffuse character of the lines shows that the crystallites have been broken up. Close to the surface the fragments are so small that the material is practically amorphous. At the surface itself iron nitrides have been formed. The physical effect is a very marked hardening, as indicated by the hardness numbers in the diagram. The whole effect is contained within a quarter of a millimetre from the surface. These photographs are due to Dr. G. Shearer, of the National Physical Laboratory.

Diffuseness in the photograph may also be caused by any distortion of the lattice, such as occurs when a specimen is severely strained. This is found to be the case, for example, in the operation of wire drawing.

One of the most remarkable developments of X-ray crystallography is the advance in our knowledge of the internal condition of an alloy. The 'order-disorder' theory, as it is termed, has been especially studied in the Manchester laboratories, and has been described by W. L. Bragg[4].

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[2] NATURE, 138, 1051 (1936).

[3] *Proc. Roy. Soc.*, A, 154, 510 (1936), plates IX, X.

[4] *Proc. Roy. Soc.*, A, 145, 699 (1934).

Obituary Notices

The Right Hon. Lord Conway

LORD CONWAY, whose death on April 18 at the age of eighty-one years will be widely regretted, was a many-sided man. He had very varied interests. He was a professor and lover of art; he was a collector of art treasures; he was a politician; and he was a mountaineer. In no one line did he achieve real greatness. But he always and everywhere derived keen enjoyment out of life and he had the knack of conveying his enjoyment to others. Everybody liked him.

Perhaps it was in mountaineering that Conway found his chief enjoyment. Among the mountains his love of beauty found an ample field. As he climbed not as an exercise in gymnastics but in order to get the real feel of the mountains from close contact with them, he was able to develop his true fundamental self among them. He climbed the Alps "from end to end". But not content with them, he ventured farther afield and travelled among the supreme mountains of the world. In the full maturity of his climbing powers, he set out for the Himalaya in search of a fairly accessible 25,000 ft. peak. He was not the first from Europe to attempt Himalayan peaks. Some forty years before him, the Schlagentweits had climbed to at least 22,000 ft. and more recently Graham had reached 23,000 ft. on Kabra. But Conway's expedition to the Karakoram Himalaya was the first to direct the attention of the world to the glory of the Himalaya. He chose as the scene of his operation what is perhaps the finest part of the whole range—the region of the Karakoram Himalaya. For sheer sublimity of natural beauty it is unsurpassed. It lies beyond the forest-class zone of lower altitudes. Here there is nothing but bare rock and ice and purest snow. All is of sternest grandeur. There are several peaks of 24,000 ft. and 25,000 ft. in height, four of 26,000 ft., one of 27,000 ft. and supreme over all, K_2—28,250 ft.—second only to Mount Everest itself in altitude but far nobler in aspect.

Here Conway was in his element. It was not in his nature to strive after records on climbing. Indeed, years after, he took no interest in attempts on Everest; to climb a mountain merely because it happened to be the highest in the world made no appeal to him. What really moved him in the Karakoram region was the glory of the mountains. There where even the valley bottom was higher than the summits of the Alps—there surrounded by peaks of towering grandeur—he felt his whole soul uplifted towards them. He entered into the spirit of the mountain. In his writings he tried to convey something of his own enjoyment; and he was successful. Others responded to the call. Since his time, German, Italians, and French, as well as other British have gone there too.

Conway was also a man of deep religious feeling. No such true lover of beauty, and especially of sublime mountain beauty, could help being religious. He could not help being in love with such beauty, which aroused in him such an ecstasy of delight.

FRANCIS YOUNGHUSBAND.

Sir George Hart, K.B.E., C.I.E.

WE regret to record the death, at Barberton, Transvaal, on April 16, of Sir George Hart, formerly inspector-general of forests to the Government of India. Born on April 14, 1866, he was educated at St. Paul's School and at the Royal Indian Engineering College, Coopers Hill. He joined the Indian Forest Service in 1887, and was posted as assistant conservator in the Punjab, where he served until 1906, when he was transferred to the Central Provinces as conservator of forests. Two years later, he went to Bengal as conservator, and in 1910 was re-transferred to the Central Provinces as chief conservator. In 1913 he was appointed inspector-general of forests, in which capacity he served until 1921, when he retired. He was made C.I.E. in 1911 and K.B.E. in 1919. On retiring from India he settled down at Coolmore, in the White River district, Transvaal, where he stayed until his death.

Hart's service covered an important and interesting period in the history of Indian forestry. Before his arrival, much pioneer work had been done in the way of saving the forests from destruction. Reservation and demarcation had made progress, and protective measures had been begun. Working-plans operations were being extended, and he took his full share in pushing on this important work. In the Punjab, large irrigated plantations, rendered necessary by the demand for timber and fuel in the canal colonies, were in process of creation and development.

At the time Hart assumed the duties of inspector-general of forests, forestry was more centralized under the control of the Government of India than it became some years later; and although the functions of the inspector-general were purely advisory, he was able to exercise considerable control in working-plans matters, and thus on the management of the forests in the different provinces. He also exercised direct administrative control over the Forest Research Institute and College at Dehra Dun. Hart's term of office as inspector-general covered the War period, when the forest department's energies were taxed to the utmost in supplying timber for military purposes.

Hart will be remembered as a sound practical administrator rather than as a scientific investigator, for although his interest in science was by no means negligible, his strong point was the confidence which his personality inspired both in his Government and in those serving under him.

Prof. A. W. Borthwick, O.B.E.

THE death on April 19 of Albert William Borthwick, in spite of the fact that he had been in ill-health for some time, came as a shock to his many friends and admirers, perhaps more especially in Scotland, where he played a not inconsiderable part in the progress of forestry; which cause had no more ardent or more enthusiastic supporter during the past quarter of a century.

Prof. Borthwick was born on October 16, 1872, the third son of the late Mr. W. H. Borthwick, of Crookston and Borthwick Castle, Midlothian, a descendant of ancient stock, dating back to the Scottish barony of 1452, now extinct or dormant. He was educated at Madras College, St. Andrews, and the University of St. Andrews, where he graduated B.Sc. in pure science, obtaining first-class honours in botany, physiology and mathematics. After graduation, he proceeded to Germany and passed four years in studying forestry and forest botany at Munich. On returning to Scotland he was appointed assistant to the professor of botany, the late Sir Isaac Bayley Balfour, and lecturer in plant physiology, at the University of Edinburgh. On the inauguration of the degree of B.Sc. in forestry at the University in 1910, Dr. Borthwick was appointed lecturer in forest botany. At the same time he lectured on forestry in the East of Scotland College of Agriculture and also gave the course in this subject at the Royal Botanic Gardens.

Dr. Borthwick did not remain at the University. In 1915 he was appointed chief advisory officer to the Board of Agriculture for Scotland. During the War, he served on the committee for the Supplies of Home Timber. From the Scottish Board, on the inauguration of the Forestry Commission in 1920, Dr. Borthwick was transferred to the Commission as chief research and education officer, and visited Canada as one of the representatives of the Commission at the meeting of the Empire Forestry Conference held in that Dominion. In May 1926, he was appointed to the new chair of forestry established in the University of Aberdeen, which he held to his death.

Borthwick's chief and best work was probably done in research. He was a first-class forest botanist, and this enabled him to play so great a part in advising private owners of woodlands, whose requirements at the time were chiefly on that border line where sylviculture and forest botany came into close affinity. He had another invaluable trait. He possessed in a high degree the power, at conferences of experts and others with varying interests in forestry, of assembling opposed points of view and placing them in a light which resulted in a general acceptance.

For some years Prof. Borthwick edited the *Journal* published by the Royal Scottish Arboricultural (now Forestry) Society, and was president for a period. He was unmarried. He was made an O.B.E. after the Great War.

E. P. STEBBING.

WE regret to announce the following deaths:

Mr. J. H. Field, C.S.I., formerly director of observatories in India, on May 19, aged sixty-four years.

Prof. Albert Griffiths, formerly professor of physics in Birkbeck College, University of London, on May 24.

Prof. S. H. Langdon, F.B.A., professor of Assyriology in the University of Oxford since 1919, on May 19, aged sixty-one years.

Mr. J. D. Rockefeller, senior, founder of the Rockefeller Institute for Medical Research and of the Rockefeller Foundation, on May 23, aged ninety-seven years.

News and Views

Prof. A. M. Carr-Saunders

As announced in NATURE of May 22, p. 896, Prof. A. M. Carr-Saunders, Charles Booth professor of social science in the University of Liverpool, has been appointed director of the London School of Economics and Political Science. The University of Liverpool showed remarkable discrimination fourteen years ago in selecting for the newly established chair of social science a trained scientific investigator with an alert and critical mind. Prof. Carr-Saunders had already earned a considerable reputation as a writer and scholar of distinction, and his books bore evidence of wide reading and culture. Before he went to the Liverpool School of Social Studies, it was a small and struggling department: he leaves it one of an important group which has become the School of Social Sciences and Administration, attracting students and visitors from all parts of the world. He has done more than any single man to arouse Government and people to the importance of the impending decline in population and to call for more serious investigation into its causes. He has also been a pioneer in the study of the professions: What standards should be required of those who enter them, and what ties should bind the members of a group together? In seeking answers to such questions, Prof. Carr-Saunders has shown himself to be no dilettante theorist. Under his inspiration, a new Division of Public Administration has been added to the Liverpool School, and it is turning out a steady stream of young men who in the future will occupy important administrative posts in the country. There is indeed scarcely any department of university life upon which he has not left an enduring mark. The secret of this amazing capacity to play a leading part in so many important affairs lies in a habit of steady and systematic application to everything he takes in hand.

Linnean Society: Awards and Elections

AT the anniversary meeting of the Linnean Society of London held on May 24, the president, Dr. W. T. Calman, delivered his presidential address entitled "James Eights, a Pioneer Antarctic Naturalist". The Linnean Gold Medal was presented to Dr. F. F. Blackman, formerly reader in botany in the University of Cambridge. In making the presentation, the president said that the modern period of research on some of the fundamental problems of plant physiology began with the medallist's "Experimental Researches in Vegetable Assimilation and Respiration" in 1896. These "Researches", carried on with the aid of students, now number twenty-one, and recently a new series, "Analytical Studies in Plant Respiration", has been added. In 1905 Dr. Blackman published a paper entitled "Optima and Limiting Factors", which is a landmark in the study of the influence of external factors on physiological processes. His work, characterized by the invention of accurate and ingenious experimental methods, has influenced, directly or indirectly, a great part of the research on plant physiology in Great Britain, and it has been given to few to have so deep an influence on a whole generation of workers. The Trail Award of the Society, "to encourage study that throws light on the substance known as Protoplasm, or the physical basis of life" was made to Dr. C. F. A. Pantin, Harding lecturer in zoology in the University of Cambridge, for his work on the mechanism of amœboid movement showing that the protoplasmic changes involved are fundamentally similar to the processes which go in cilia and in muscle. The following were elected officers of the Society for the year 1937–38: *President*, Mr. John Ramsbottom; *Treasurer*, Francis Druce; *Secretaries*, I. Henry Burkill and Martin A. C. Hinton; *New members of Council*, I. Henry Burkill, Miss M. L. Green, Dr. H. S. Holden and Prof. F. E. Weiss.

Foreign Members of the Linnean Society

THE following have been elected foreign members of the Linnean Society: Dr. Reinhard Dohrn, director of the Marine Biological Station, Naples. Dr. Dohrn is the son of the founder of the station, the reputation and popularity of which have steadily increased under his government. The Great War and the years which succeeded threatened its existence; its survival was entirely due to the self-sacrificing enthusiasm of Dr. Dohrn. Dr. Herman Augustus Spoehr, director of sciences at the Carnegie Institution's Division of Plant Biology, Stanford University, California. Dr. Spoehr's work has been mainly on the physiology of plants, his first researches being concerned with photosynthesis; his text-book on "Photosynthesis" published in 1926 is of high merit. His study of photosynthesis and the nutritive problems of cacti opened up several lines of research; he has published results on the colloid behaviour of plant protoplasm, the reduction of carbon dioxide by ultra-violet light, growth and imbibition, the chemistry of leaf pigments, together with a series of papers on respiration—some of them in collaboration with other workers. Prof. Erik Anderson Stensiö, director of the Riksmuseets Paleontologiska Avdeling, Stockholm, distinguished for his researches upon Old Red Sandstone fishes. His success has been largely due to his admirable fertility in inventing new methods for the development of these fossils: by such means he gained a great deal of information about the nervous system, blood supply and mucus circulation in these ancient organisms, all matters of great morphological significance.

Prof. Nils Everherd Svedelius, director of the University Institute at Uppsala, who has been associated with the University for more than forty years. He is well known for his contributions to the knowledge of the taxonomy, morphology and life-histories of marine algæ, the majority of these being written in German and English. As befits a successor of Linnæus in so old a University as Uppsala, he has written on the history of botany. His writings on the taxonomy and morphology of various flowering plants include studies on *Juncus*, Gentianaceæ and the so-called sea grasses. He has travelled extensively in pursuit of his special interests in geographical distribution, algæ and cytology. He is treasurer of the Swedish Linnæan Society. Dr. Richard Woltereck, for many years professor of zoology in the University of Leipzig, and until recently director of the Zoological Institute, Ankara, Turkey. Prof. Woltereck has a world-wide reputation as a limnologist. He organized and was the first director of the Freshwater Biological Station at Lunz in Austria, and by his editorship of the *Internationale Revue der Gesamtes Hydrobiologie und Hydrographie* since its commencement in 1908, has rendered invaluable service to all students of aquatic biology.

Royal Astronomical Society: New Associates

THE recent election of Dr. B. Lyot and Profs. J. H. Oort and Shajn as associates of the Royal Astronomical Society is significant not only as a recognition of their contributions to astronomy, but also as emphasizing the modern tendency of the Society to give this honour for research rather than for official position alone. Ever since Lockyer's and Janssen's successful detection of prominences without an eclipse, the possibility of the daylight photography of the solar corona has exercised astronomers. It has, however, been left to the young French astronomer Lyot, one of the new associates, working with exquisitely designed though inexpensive apparatus, to detect the corona on the Pic du Midi by its polarized light, then afterwards to photograph the inner bright part, and finally to obtain high dispersion spectra in the visible and infra-red of its characteristic emission lines of unknown origin. Fully as distinguished in another field is Prof. Oort of Leyden. In addition to his numerous contributions to stellar statistics, he is especially known for his quantitative formulation of Lindblad's hypothesis of galactic rotation, a formulation which in Oort's hands has greatly clarified our ideas on stellar motions and our knowledge of the structure of the galactic system. Prof. Shajn is a representative of the growing school of young Russian astronomers. His work has been characterized especially by its versatility; he has made contributions of outstanding merit in fields so wide apart as the disturbing action of the earth on meteoric orbits and the study of complex multiplets in stellar spectra.

Museums of India

THE report on the museums and art galleries of India issued by the Museums Association, of which an account appears in another column of this issue of NATURE (see p. 934) will stand in the eyes of future generations as a grave indictment of an administration which has failed to appreciate the cultural needs of the population at large, outside a narrow view of educational and social policy, and at the same time has neglected its opportunity, not to say its duty, to preserve permanently a fully representative record of the material culture of the past and present civilizations of India. To say this is not to ignore either the many difficulties, financial and other, which have confronted past administrators as obstacles in the way of formulating a coherent and comprehensive policy for the provision of museums, or the efforts towards more adequate provision, such as were made under Lord Curzon, or the valuable system of local museums instituted recently in connexion with the work of the Archæological Survey; but these, except in the instance of the last-named, are matters of past history.

IT is the absence of any sign of a progressive attitude towards the provision and utilization of the museum as an instrument in raising the general cultural level, admittedly low, of the population of India that constitutes the gravest element implicit in the indictment. The lack of adequate financial support, as well as of systematic allocation of the funds available, the inadequacy, in every sense, of staff, and the failure to formulate any general policy, which would conduce to efficiency of management within, and consultation and co-operation outside the four walls of the individual museum, grave defects as they may be, are no more than symptoms of apathy, no doubt an unconscious apathy, in the higher authorities responsible for direction and control. Now that attention has been directed forcibly to this far-reaching lapse in the public policy of India, it will be the duty—and a test—of the new regime to set about its remedy with all dispatch.

Antiquities from Essex at the British Museum

AN exhibition of exceptional interest of antiquities from Essex is now on view in the Prehistoric Gallery of the British Museum (Bloomsbury). The objects were found on a site between Rainham and Upminster, about fourteen miles from London Bridge, and are lent by Mr. G. T. Carter with the permission of the Newbury Park Gravel Pit Co., from the excavation works of which they were derived. In part, the great interest of the discovery lies in the fact that all periods of prehistoric and early historic culture in Britain are represented from palæolithic to Saxon times. The finds include palæolithic hand-axes, polished neolithic axes of a type common in the Thames area, pottery of the Early Bronze Age, the most noteworthy example being a small beaker, of reddish ware, decorated with bands of lines and dots, and pottery of the Late Bronze Age, the Early Iron Age and the period of Roman occupation. This succession in evidence of occupation on one and the same site on the estuary of the Thames is of peculiar interest to the archæologist; but the remarkable feature of the discovery is the occurrence of Saxon relics, and more especially of a cemetery, at this point. This is the first instance recorded of a Saxon settlement in the marsh and forest area of south Essex between London and Southend. The absence of cinerary urns and signs of cremation point to a probable date not prior to the sixth century B.C. Nor does there appear to be any ground for connecting this settlement with the East Saxons of the coastal area from Colchester to Ipswich. It is thought to belong to an estuarine Saxon group scarcely differing from that on the north coast of Kent. The finds, of which a selection is shown, include two remarkable curved drinking horns of olive green glass, both broken, but one of which it has been found possible to reconstruct, bronze brooches and rings, wooden buckets with bronze mounts, shield bosses, spearheads, a sword of iron and Roman coins, pierced for use as pendants. The levels of the pit in which the antiquities were found are shown in photographs. The finds will be on view for two months.

Tuberculosis in Wild Voles

TUBERCULOSIS among wild animals living in their natural state is almost unknown, and the announcement by Dr. A. Q. Wells of the Bureau of Animal Population, Oxford, of the discovery of this disease among wild voles is of great interest and, it may be, importance (*Lancet*, 1, No. 21, 1221, May 22, 1937). Since last February, Dr. Wells has found in 134 voles caseous lesions, like those of tuberculosis, in which bacilli having the peculiar and characteristic 'acid-fast' staining reaction of the tubercle bacillus were present. In addition, cultures made from the lesions yielded growths resembling those of the tubercle bacillus, and guinea pigs inoculated with the material developed tuberculosis. The voles had been sent from seven different stations in the British Isles, so that the disease seems to be wide-spread among these animals and not a chance occurrence in one locality, and the existence of tuberculosis among them may be of importance in the spread of this disease to domestic animals and to man. The wild vole (*Microtus agrestis*), known as the short-tailed field or grass 'mouse', is a common rodent in meadows, and several sub-species occur in the north. It is of interest in respect to ecology and distribution, for the animals are subject to wide fluctuations in population, increasing over a period of three to four years, and then suddenly decreasing to a low figure in one or two months, and it has been surmised that the decrease may be caused by the occurrence of some epidemic disease among them.

A New Ceramic

EXPERIMENTAL work extending over a period of years at the Mellon Institute of Industrial Research has resulted in the production of a new laboratory table top material made of a porous, non-warping ceramic body that is impregnated with bituminous substances and then heated under special conditions to form coke in the pores. Unusually high resistance to thermal shock is imparted to the material because artificial cordierite, a mineral that has a very low thermal expansion, is used in making up the ceramic body. The material can be polished to velvety smoothness, and possesses sufficient hardness to resist scratching and abrasion, ample structural and impact strength, denseness that prevents absorption of liquids, resistance to solvent action and chemical attack, and the ability to withstand perfectly the effect of rapid heating and cooling. Thus "Kemite", as it has been called, has none of the disadvantages of the commonly used table-top materials. While Kemite was developed primarily as a laboratory table-top material, it can be fabricated in complicated shapes of large size without joints. When high resistance to thermal shock is not required, cordierite is not used in the ceramic body, and ware made from the non-cordieritic body is called 'Karcite'. Kemite should prove useful for vats, tanks and other apparatus, because of its resistance to the action of chemicals and its low thermal expansion. In the electrical industry, the basic body, properly impregnated, can be employed for switchboard panels, specially moulded parts and complex shapes, and as an insulating material.

Broadcasting an Eclipse

THE National Geographic Society, Washington, claims that the broadcasting of a series of programmes before and during the eclipse of June 8–9 from one of the (normally) uninhabited islands of the Phœnix Group will be the first instance of broadcasting "from a desert island". It will not be the first eclipse which has been broadcast from an eclipse camp, as Dean Eve broadcast to Canada the total eclipse of 1932 from a camp at Magog, but it will probably be the first time when an announcer and two engineers of a national broadcasting company have formed part of an eclipse expedition to a foreign country. The scientific details of the eclipse expedition arranged by the National Geographic Society were published in NATURE of April 24, p. 698; but one or two points of general interest may be added here. The duration of totality at noon will be longer than at any other eclipse over a stretch of 1,238 years; unfortunately, it takes place at a point 1,500 miles from the nearest land. A special self-bailing boat will be used to take the equipment ashore, and the U.S. naval seaplane tender will stand by the island during the expedition's stay ashore. A complete black and white motion picture record of the eclipse will be made and colour 'movies' may also be taken.

Development in the Arctic

RECENT economic developments in the Siberian Arctic lands bear some testimony to Mr. V. Stefansson's contention of a 'friendly arctic'. A paper in the *Geographical Journal* of April by Mr. H. P. Smolka describes some of the recent Soviet schemes on the Yenisei, Khatanga and other rivers, where a few years ago a little native fishing and hunting were the sole interests. Igarka, 600 miles up the Yenisei, and some distance north of the Arctic Circle, is now a city of 14,000 inhabitants with well-built timber houses and timber roads. There are schools, theatres and other amenities, and the whole town is flood-lit in winter. The one interest is timber, which is exported by the river in late summer. Work goes on all the year round, and the inhabitants rarely suffer from cold even with temperatures of − 35° C. A modern port is being built. Norilsk, farther north than Igarka, is being built for new coal mines on the Pyasina River and is being connected by a 70-mile railway to its port of Dudinka, another new growth 400 miles up the Yenisei River. Nordvik, at the mouth of the Khatanga River, in nearly lat. 70° N., is an even more amazing growth. It was started last year as a town for the new salt mines. With these urban growths there are developing also experiments in arctic agriculture. In lat. 68° N., onions, radishes and cabbages have been grown in the open, and tomatoes, cucumbers and asparagus in hothouses. Experiments are being made in growing vegetables in electrically heated and lighted subterranean chambers, the current being provided by windmills.

Central Water Advisory Committee

THE Minister of Health has appointed a Central Water Advisory Committee under the chairmanship of Lord Milne. The following have been appointed to serve on the Committee: Sir Albert Atkey, Mr. E. T. L. Baker, Mr. H. K. Beale, Mr. R. Beddington, Mr. John Chaston, Lieut.-Colonel E. J. Clarke, Mr. A. E. Cornewall-Walker, Sir Robert Doncaster, Lieut.-Colonel A. P. Heneage, Capt. R. T. Hinckes, Mr. S. R. Hobday, Mr. J. E. James, Mr. E. W. Cemlyn Jones, Sir David Owen and Mr. D. Verity. The Committee's terms of reference are to advise the Government Departments on questions relating to the conservation and allocation of water resources; on any questions which may be referred by the Departments with respect to matters arising in connexion with the execution of, or any proposed amendment of, the enactments relating to water; and to consider the operation of the enactments relating to water and to make to the Government Departments such representations with respect to matters of general concern arising in connexion with the execution of those enactments, and with respect to further measures required, as the Committee thinks desirable. Any communications concerning the work of the Committee should be addressed to the Secretary, Mr. A. Titherley, at the Ministry of Health.

American Tour of British Research Organizations

BETWEEN twenty and thirty American executives and bankers are making a rapid tour of Great Britain, France and Germany to study European research organization at first hand lasting from May 24 until June 30. The tour is being arranged under the auspices of the American National Research Council by Mr. Maurice Holland, the director of the Division of Engineering and Industrial Research of the Council. The tour in Great Britain has been arranged in co-operation with the Department of Scientific and Industrial Research, and visits will be made to the National Physical Laboratory, the Building Research Station and the Fuel Research Station. The party will also spend a day at the Shirley Institute, the headquarters of the Cotton Research Association at Didsbury, and will be able to visit the laboratories of the Leather, the Boot and Shoe and the Rubber Research Associations. The party is visiting the research laboratories of several large firms. A visit is also being paid to the Cavendish Laboratory at Cambridge. During the tour, about thirty-five laboratories will have been visited, covering eighteen different fields of industrial research.

Scottish Science and the Industrial Revolution

FOR his inaugural address as regius professor of natural history in the University of Aberdeen, delivered on April 21, Prof. L. Hogben took for his subject "The Theoretical Leadership of Scottish Science in the English Industrial Revolution". In this he showed how eminent men trained in the biological sciences stimulated the progress of chemistry and physics, and thereby influenced the growth of various industries at the end of the eighteenth and the beginning of the nineteenth centuries. The Industrial Revolution was, of course, bound up with the development of the textile, iron and coal industries, but more especially with the introduction of the steam engine and to a lesser extent with the rise of the chemical industry. The part played by Watt and Murdock in the improvement of the steam engine is well known, but Prof. Hogben showed how to men such as Joseph Black, James Keir, John Roebuck and Francis Horne—all graduates of medicine—can be traced some of the advances in industry. Black's connexion with Watt is familiar to all, while Roebuck not only endeavoured to assist Watt, but also had a principal share in establishing the Carron Iron Works, and was a pioneer in the manufacture of sulphuric acid. The address contains some interesting notes on the early members of the Royal Society of Edinburgh when James Hutton and John Playfair were leaders of Scottish science, and it recalls that Hutton, though generally regarded as one of the fathers of modern geology, yet is also remembered as the founder of a manufactory for sal ammoniac. In concluding his review of the subject, Prof. Hogben said that "The restricted class basis of English education could not supply the theoretical leadership which its industrial expansion demanded. It had to rely largely on a fund of personnel from Scotland".

Flood-lighting and Broadcasting during the Paris Exhibition

DURING the Paris Exhibition, it has been arranged that some four hundred monuments and buildings in the smaller villages of France and in the open country will be flood-lighted by five mobile units carrying flood-lighting equipment. Each of the lorries will carry generating plant, and will be manned by three men. It will carry ten spotlights of 3 kilowatts each and ten floodlights of 1½ kilowatts.

There will also be apparatus for the production of chemical smoke, as well as an amplifier and a loud speaker installation permitting lectures or music, which will be broadcast during the displays. According to the *Electrician* of May 21, all the services of the Government broadcasting system will be transferred to the radio pavilion at the Paris Exhibition. For this purpose, three large studios with mixing desks and control room, two smaller studios for speakers and announcers, and a television studio are being installed. There will also be an installation for the registering and rebroadcasting of records. The installations will be entirely enclosed in glass so that the public can see all the equipment in operation and yet all risk of noise or crowds interfering with the operations will be prevented. As the stations are broadcasting all day, it will be possible for the public to see at least some part of the installation in operation at all hours of the day. The lighting tour has been organized to extend until the end of October. The general control of the whole system will be centred in a room near the entrance to the pavilion. It will have connexions with both French and foreign stations. In many places, the local authorities are being asked to provide flood-lighting for other buildings of interest.

Modern Applications of Psychology

DR. C. S. MYERS, in a paper before the Royal Society of Arts on March 10 on "Industrial Psychology and the Modern World", began by showing the indebtedness of this most recent application of psychology to the educational and medical applications that had preceded it. The field covered by it is very wide, since it is concerned with all grades of occupational life, with industrial relations, personnel management and with all the environmental conditions that can hinder or further the happiness, health and efficiency of those engaged in industry. Already the pioneer work done in England is being developed and adapted by many other countries. By a scientific study of individual differences and of the requirements for success in particular occupations, the industrial psychologist has been able to develop a technique which enables him to direct an entrant into the occupation for which he seems most fitted, and also to help the employer to select from a number of applicants those with the fundamental requirements. The young person is thereby saved from much futile groping and the attendant sense of failure. When, however, the right selection has been made, it becomes necessary to train the beginner in the right methods, instead of letting him pick up for himself methods that might be good or might be bad. In this field, the industrial psychologist has made a special study of the best movements and methods of work that should be taught, and of the suitable methods of teaching the required movements. He has also much to offer to management, and could prevent the unnecessary friction resulting from those in authority having more knowledge of the machinery and of the materials involved than of the human beings for whom they are responsible.

British Speleological Society

ALTHOUGH the British Speleological Society has been in existence for a brief period only, having been formed at Derby two years ago, there is evidence that the organization has fulfilled its purpose and indeed has prospered exceedingly under the presidency of Sir Arthur Keith in the announcement that it proposes to institute a museum of its own. The object of the Society is to co-ordinate the exploration and excavation of caves and potholes, and as was evident from the very successful first conference held at Buxton last year, much useful work on these lines has already been done. The Society now proposes to take over Cragdale, Settle, as its headquarters, and a museum will be formed to house photographs of underworld scenery, geological specimens, human and animal remains as well as other relics of cave man. A speleological library will also be formed and housed in the new headquarters. The second Speleological Conference and exhibition of photographs, surveys, prehistoric remains, geological specimens, etc., from British and foreign caves will be held in the University of Bristol on July 23–26. Further information can be obtained from the deputy secretary of the British Speleological Association, University College, Hull. On July 27–August 8, there will be a conducted tour to some of the more important caves in Germany, Austria and Czechoslovakia. Further information can be obtained from Mr. C. R. Hewer, Tallin, Kiriku Poik 4, Estonia.

Charles Darwin and the Modern Theory of Tropisms

PROF. BOYSEN JENSEN's new book upon "Growth Hormones in Plants" directs attention to the conclusion drawn by Charles Darwin "that when seedlings are freely exposed to a lateral light, some influence is transmitted from the upper to the lower part, causing the latter to bend". Prof. N. Cholodny writes to the Editor from Kiev pointing out that a passage from "The Power of Movement in Plants" (1880) refers to the localization of phototropic sensibility in the tip of the coleoptile of *Phalaris* in these terms: "These results seem to imply the presence of some matter in the upper part which is acted on by light, and which transmits its effects to the lower part". Prof. Cholodny points out that this passage might be interpreted as foreshadowing modern theoretical interpretations of the same tropic phenomenon as due to the movement of growth-regulating substances or hormones.

Health Resorts of Britain and the Empire

THE British Health Resorts Association has issued its official handbook for the current year ("British Health Resorts: Spa, Seaside, Inland". Edited by Dr. R. Fortescue Fox. With a Foreword by Sir Kingsley Wood, Minister of Health. London: J. and A. Churchill, Ltd. 2*s*. 6*d*. net). The handbook follows the lines of previous editions, but the whole of the material has been carefully revised, and new information is given in a condensed form as regards the sunshine and rainfall in many resorts. A valuable chapter on climatology has been contributed by

Mr. L. C. W. Bonacina. A synopsis of the attractions offered by British resorts during the 'invalid's winter' is included, and the principal spas and climatic resorts of the British Commonwealth overseas are also mentioned.

Fauna of the North Sea

LIEF. 30 of "Die Tierwelt der Nord- und Ostsee" contains a mixed bag of monographs, dealing with nemertine worms (Hermann Friedrich), halophile and halobionic Hemiptera (Håkon Lindberg), and the Anthozoa included in the sea anemones and Alcyonaria (F. Pax). Short diagnoses of the characters of species and of their distribution are supplemented by accounts of the morphology, physiology, development, variation and biology in general of larger groups. Parts of this ambitious and very useful work have been appearing at the rate of slightly less than three a year since 1925, and there are still many to follow.

A Forestry Herbarium

THE forestry herbarium collected by the late Prof. A. H. Henry, formerly professor of forestry at University College, Dublin, has now been made available for inspection and reference at the Botanic Gardens, Glasnevin, Dublin. The collection comprises more than nine thousand specimens and was presented to the nation by Mrs. Henry on the death of her husband. Since then, Mrs. Henry has devoted much time to the work of classification and arrangement so as to make the collection readily accessible for reference purposes. This unique collection is a tribute to the memory of a distinguished scholar, and the admirable arrangement accomplished by Mrs. Henry enhances that tribute.

The Cerne Giant: A Correction

It would appear that the announcement of the impending sale of the Cerne Giant (see NATURE, May 22, p. 876) was due to a misunderstanding. The sale of Cerne Abbas property, which will take place on June 16, will include the remains of the famous Abbey and an Elizabethan farm-house; but the well-known hill 'carving' is not for sale. The Cerne Giant, we are reminded by the secretary of the National Trust, was presented to the National Trust in 1920 by Mr. A. E. Fox Pitt-Rivers and an endowment provided for its upkeep by Sir Henry Hoare.

The Night Sky in June

ON June 21 at 20^h, the sun enters the sign Cancer (the summer solstice). In the latitude of London, the length of night from sunset to sunrise is then only $7^h\ 26^m$. The moon is new on June $8^d\ 20{\cdot}7^h$ and full on June $23^d\ 23{\cdot}0^h$. On June 8, a total eclipse of the sun takes place and is visible in equatorial regions of the Pacific, but although the path of totality (of maximum breadth 153 miles) extends over nearly one hundred degrees of terrestrial longitude, there are very few possible land sites to which expeditions can be sent. The duration of totality at the noon point is $7^m\ 4^s$, making this eclipse the longest that has occurred for more than a thousand years. Of the planets visible during June, both Mercury and Venus are morning stars. On June 6, Mercury is at greatest elongation 24° west, and Venus at greatest western elongation (46°) on June 27. Venus is in conjunction with Uranus on June 18 at 11^h, when the two planets are separated by 2·7°. Mars is conspicuous low in the south as the sky darkens. The planet decreases in brightness from magnitude $-1{\cdot}7$ to $-1{\cdot}2$ during the month. On June 20 at 10^h, Mars is in conjunction with the moon and is then only 0·1° northwards of the latter (geocentric positions). The circumstances produce an occultation of Mars by the moon, the phenomenon not, however, being visible from the northern hemisphere. Jupiter rises in the evening twilight and souths about 2^h in the middle of the month; on June 25 at 21^h it is in conjunction with the moon. Saturn rises soon after midnight in mid-June; on June 4 at 2^h conjunction occurs with the moon. The apparent breadth of the minor axis of the ring system is $3''$–$4''$. At 22^h in mid-June, the bright star Regulus is nearing the western horizon; Arcturus has passed the meridian, Spica and Antares are low down in the south, while Vega, Altair and Deneb are conspicuous eastwards of the meridian. The maximum of the Scorpiid meteors is due about June 4, the radiant point being nearly midway between α Scorpii (Antares) and η Ophiuchi. An ephemeris for the comet Grigg-Skjellerup, is given in the *B.A.A. Handbook* as follows:

	R.A.	Dec (N.)
June 4	$9^h\ 36{\cdot}3^m$	23° 36′
„ 8	10 04·5	25 53
„ 12	10 36 0	28 02
„ 16	11 10 3	29 51
„ 20	11 46·8	31 10
„ 28	13 01·2	31 50

Commonwealth Fund Fellowships

THE following appointments, among others, to Commonwealth Fund fellowships tenable by British graduates in American universities for the two years beginning September, 1937, have been made: Dr. J. B. Bateman, King's College, London, and University of Cambridge, to the University of Pennsylvania, in biophysics; D. M. Douglas, University of St. Andrews, to the University of Minnesota, in medicine; J. A. Downes, Imperial College of Science and Technology, London, to the University of California, in zoology; Dr. R. N. Jones, University of Manchester, to Harvard University, in chemistry; N. F. McGrath, University College, Oxford, to the University of Chicago, in political science; Wilfred Merchant, Corpus Christi College, Oxford, to the Massachusetts Institute of Technology, in engineering; Dr. Arthur Porter, University of Manchester, to the Massachusetts Institute of Technology, in physics; H. O. Puls, University of Reading, to the Massachusetts Institute of Technology, in physics; Dr. F. D. Richardson, University College, London, to Princeton University, in chemistry; Dr. B. V. Rollin, Wadham College, Oxford, to the University of California, in physics; J. D. Spillane, University of Wales, to Columbia University, in medicine; B. D. White, Queen's College, Oxford, to the University of Minnesota, in economics; D. M. de R. Winser, Corpus Christi College, Oxford, to Yale University, in physiology.

THE following has been appointed to a fellowship tenable by candidates from the British Dominions: I. F. G. Milner, University of New Zealand, and New College, Oxford, to the University of California, in international relations. The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: W. I. B. Beveridge, University of Sydney, of the Council for Scientific and Industrial Research, Australia, to the Rockefeller Institute, Princeton, in veterinary science; W. J. Blackie, University of New Zealand, of the Department of Agriculture, Fiji, to Yale University, in biochemistry; E. T. A. Edwards, University of Sydney, of the Department of Agriculture, New South Wales, to the University of Wisconsin, in agriculture; Robert Galetti, Balliol College, Oxford, of the Indian Civil Service, Madras, to Stanford University, in agriculture; B. W. Wilson, University of Cape Town, of the Railways and Harbours Administration, South Africa, to the University of Illinois, in engineering. The following have been appointed to fellowships tenable by candidates holding appointments in the Home Civil Service; J. L. Blake, University College, University of London, of the Patent Office; R. N. Quirk, King's College, Cambridge, of the Mines Department.

Announcements

SIR FREDERICK GOWLAND HOPKINS has been elected president of the Association of Scientific Workers in succession to Dr. W. H. Eccles.

WE regret the omission from the Coronation Honours list printed in NATURE of May 15 of the name of Mr. C. S. Wright, director of scientific research at the Admiralty, who was appointed C.B.

DR. SYDNEY SMITH has been appointed works manager at the Wellcome Chemical Works, Dartford, the chief works of Messrs. Burroughs Wellcome and Co. It will be recalled that the previous holder of this post was Dr. H. A. D. Jowett, who met his death in a motor-car accident last August (see NATURE, Aug. 29, 1936). Dr. Smith has been associated with Messrs. Burroughs Wellcome and Co. for twenty-three years, and during that time has made highly important contributions to the study of the alkaloids of ergot and the glucosides of *Digitalis*.

IT is announced in *Science* that at the dinner of the U.S. National Academy of Sciences held on April 27, the following medals were awarded: James Craig Watson Medal to Prof. E. W. Broun, emeritus professor of mathematics in Yale University, for his work on lunar theory; Henry Draper Medal to Dr. C. E. Kenneth Mees, director of the Research Laboratory of the Eastman Kodak Company, for his work on the theory and perfection of photographic processes and materials; Agassiz Medal to Prof. Martin Knudsen, professor of physics in the University of Copenhagen, for his work on physical oceanography; Mary Clark Thompson Medal to Prof. A. W. Grabau, professor of palæontology in the National University of China and chief palæontologist to the Chinese Geological Survey, for his work on Chinese palæontology.

THE centenary of the Liverpool Medical Institution will be celebrated on May 30–June 1, when Prof. R. E. Kelly will deliver a presidential address on surgery a hundred years ago, and the Hugh Owen Thomas and Robert Jones memorial library of orthopædic surgery will be opened.

A SESSIONAL meeting of the Royal Sanitary Institute will be held at Newcastle-upon-Tyne on May 28, when a discussion on the difficulties of nutritional assessment will be opened by Dr. H. E. Magee of the Ministry of Health, Dr. G. C. M. M'Gonigle, medical officer of health of Stockton-on-Tees, and Dr. J. C. Spence, honorary assistant physician to the Royal Victoria Infirmary, Newcastle-upon-Tyne.

AN International Congress of Medicine applied to Physical Education and Sport will be held in Paris on July 11–17 under the presidency of Profs. Carnot and Latarjet. The subjects for discussion will be physical education in and after the school period, education and control of sport, and incidents and accidents of sport. Further information can be obtained from Dr. Collet, 45 rue de Clichy, Paris.

AN International Congress on Occupational Diseases and Industrial Welfare will be held in Paris on June 1–6 under the presidency of Dr. V. Balthazard, professor of forensic medicine in the University of Paris. Further information can be obtained from the Secretary-General of the Congress, Dr. G. Haussen, Institut Médico-Légal, Place Mazas, Paris, XII^e.

THE seventh English-Speaking Conference on Maternity and Child Welfare will be held at the British Medical Association House on June 1–3 under the presidency of the Minister of Health, and will be attended by 600 delegates. Further information can be obtained from the Honorary Secretary, Miss J. Halford, Carnegie House, 117 Piccadilly, W.1.

PROF. LOWELL J. REED, professor of biostatistics in the Johns Hopkins School of Hygiene and Public Health, has been appointed dean of the school in succession to Dr. Allen W. Freeman.

THE headmaster of a boys' secondary school in London desires to obtain issues of NATURE regularly two or three weeks after publication, for use by his senior students. We shall be glad to know the name and address of any reader or subscriber who would be willing to supply such copies at a reduced rate.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 931.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Isotopic Weight of ^{12}C

IN my last letter[1] I directed attention to the uncertainty in the value of this constant, which is particularly unfortunate as it is the most important sub-standard in the determination of isotopic weights by the mass-spectrograph. Since then I have been to great pains to make further measurements of it by as many independent methods as possible. The following is a summary of all my results in the order in which they were obtained.

(*a*) The doublet $O—CH_4$ was measured using a cylindrical discharge tube and varying the position of the doublet on the spectrum to minimize the effect of any local disturbances in the fields of the instrument. The results were used in fixing the fundamental isotopic weights[2].

(*b*) These measurements were repeated using a large spherical discharge tube[1].

The objections to the use of the $O—CH_4$ doublet to determine the isotopic weight of carbon are: (1) It is so wide (more than 22 units of packing fraction) that the effect of uncertainty in the absolute value of the dispersion coefficient may be serious. (2) The value obtained is dependent to the extent of about one third on the isotopic weight of ^1H. (3) The fact that one line is atomic and the other molecular may possibly cause asymmetry.

(*c*) The analogous doublet $CO—C_2H_4$ was measured. This is not so easy or accurate, but eliminates objection (3).

(*d*) The fortunate occurrence on one plate of a particularly well-matched doublet $^{40}A—C_3H_4$ gave a useful check, for the values of the isotopic weight of ^{40}A show no serious discrepancy.

(*e*) The mass of ^{12}C was compared directly with that of ^{16}O by means of the close ratios $O{+}{+} : C \sim C : OH_2$ by artificial doublets made by applying electric fields in the ratio $3 \sim 2$. This is the method by which the packing fraction of ^{12}C was originally measured[3]. It reduces errors due to (1) and (2) each to about a third, but unfortunately the technical difficulty of controlling the intensity of the OH_2 line makes it somewhat unreliable.

(*f*) The ratio $O{+}{+} : C$ was now measured against $A{+}{+}{+} : A{+}{+}$. These artificial doublets were easier to produce, and gave very consistent results. The particles concerned are all atomic, the results are independent of hydrogen and of any reasonable error in the absolute dispersion coefficient as the ultimate difference is only 3 units of packing fraction.

(*g*) By long running with dry gases containing argon, the OH_2 line had been reduced to such an extent that three well-matched natural doublets $^{36}A{+}{+}—OH_2$ were obtained. In each of these the very faint intermediate line due to ^{18}O was clearly visible, enabling a provisional value for it to be found as given below. ^{36}A had already been paired with C_3, so that the packing fraction of C could be calculated from that of OH_2.

(*h*) As a further check, the ratios $^4He : C{+}{+} \sim A{+}{+}{+} : A{+}{+}$ were compared, there being no serious disagreement in the isotopic weight of He.

The accompanying table gives the mean values of the packing fraction of ^{12}C deduced from these experiments in estimated order of their reliability. My figures for the isotopic weights of hydrogen, helium and argon have been used in the calculations, and the appropriate small corrections for the mass of the electron have been applied in the case of artificial doublets.

	Method	Number of independent observations	Packing fraction of ^{12}C deduced
(*a*)	$O—CH_4$	14	2·96
(*b*)	$O—CH_4$	13	2·97
(*c*)	$CO—C_2H_4$	18	2·91
(*f*)	$O{+}{+} : C \sim A{+}{+}{+} : A{+}{+}$	15	2·91
(*g*)	$^{36}A{+}{+}—OH_2$, $^{36}A—C_3$	3,6	2·99
(*e*)	$O{+}{+} : C \sim C : OH_2$	18	3·11
(*h*)	$He : C{+}{+} \sim A{+}{+}{+} : A{+}{+}$	5	3·00
(*d*)	$^{40}A—C_3H_4$	1	3·0

These results justify the value 2·96 which I have been using, and enable its probable error to be reduced. The following are the values deduced:

Symbol	Packing fraction	Isotopic weight
^{12}C	2·96	12·00355 ± 0·00015
^{18}O	3·2	18·0057 ± 0·0002
^{36}A	−6·10	35·9780 ± 0·0010

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May 6.

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[1] NATURE, 138, 1094 (December 26, 1936).

[2] NATURE, 137, 357 (February 29, 1936).

[3] *Proc Roy Soc*, A, 115, 499 (1927).

Temperature Equilibrium of C-Neutrons

THE slow neutrons leaving a block of paraffin wax, containing a source of fast neutrons, mostly possess thermal energies. The existence of such thermal neutrons has been established by the discovery[1] that the temperature *T* of the paraffin has an influence on the activities induced in various elements. Since the neutrons penetrating a screen of cadmium do not show this effect[2], cadmium may be used to discriminate between the slowest neutrons (C-neutrons[3]) and the faster ones.

The dependence on temperature of the absorption of C-neutrons has been studied by a number of investigators[4]. If the C-neutrons are in thermal equilibrium with the paraffin, their absorption in boron, lithium and silver should be proportional to $1/\sqrt{T}$ because the capture cross-section for slow neutrons of these elements should be inversely proportional to neutron velocity (the $1/v$ law[5,6]). (In the case of silver the $1/v$ law has been checked experimentally[7].) While the results of Preiswerk and v. Halban[2] were not in direct disagreement with the $1/\sqrt{T}$ law, other investigators obtained definitely smaller variations with temperature than this law predicted.

TABLE 1

T	80°	195°	290°	415°
μ_T/μ_{290}	1·50±0·05	1·25±0·04	1	0·89±0·04
$\sqrt{(290/T)}$	1·9	1·22	1	0·84
μ_T/μ_{290} calc.	1·71	1·21	1	0·84

In an investigation of this question, we have obtained the relative values, given in the accompanying table, of the absorption coefficient μ of silver for C-neutrons emerging from a paraffin block at different temperatures. The neutrons were counted by a boron-lined ionization chamber connected to an amplifier and mechanical counter. At the three higher temperatures, the $1/\sqrt{T}$ law is seen to be nearly fulfilled; μ^{80}, however, is distinctly too small. For boron and lithium absorbers the values of μ^{80}/μ^{290} were found to be the same as for silver.

In discussing these results, the following points must be considered:

(1) The energy spectrum of C-neutrons includes—apart from the thermal neutrons—a tail of faster neutrons (tail neutrons) extending to the absorption limit of the cadmium screen ($\sim$ 1 eV.[4]).

(2) The H nuclei in the paraffin are very inefficient in slowing down neutrons below the lowest hydrogen oscillation energy, that is, below 0·1 eV. On account of this, the neutrons are crowded in the region below 0·1 eV. We may try to estimate this effect by treating the neutrons as if they were colliding with free particles of mass 14 (CH_2-nuclei).

(3) The number of collisions required to bring a neutron from 0·1 eV. down to room temperature is about ten (estimated according to ref. 2), and as many as ten more collisions are needed to bring it down to 80° K. On the other hand, the mean number of collisions suffered by a slow neutron before emerging from a paraffin block is about 100. (We obtained this figure by studying the influence of small amounts of boric acid on the intensity of neutrons slowed down in water under similar geometrical conditions to those in our temperature experiments.) It follows that neutrons spend a considerable part of their life between the cadmium absorption limit and thermal energy; correspondingly, a considerable fraction of the neutrons leaving a paraffin block have energies in this region. Therefore the C-group is inhomogeneous, especially at low temperatures.

(4) The mean life of neutrons in paraffin, if limited only by capture in the paraffin, is independent of temperature; it is not affected by the zero point oscillations of the protons.

Taking these points into account, we have calculated quite roughly the relative mean absorption coefficients of C-neutrons. While the exact theory of slowing down must consider collisions with bound protons, the present treatment using the idea of 'CH_2-nuclei' can at least be taken as illustrative of the trend of the results to be expected. Since the experimental results deviate from the $1/\sqrt{T}$-law in roughly the same way as the calculated ones (see Table 1.), we believe that our explanation is correct in principle and that there is no reason whatever to doubt the $1/v$ law as a result of such experiments.

The experiments are being continued and a detailed account is to appear soon.

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JØRGEN KOCH.
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Copenhagen.
April 14.

[1] Moon, P. B., and Tillman, J. R., NATURE, **135**, 904 (1935).

[2] Preiswerk, P., and v. Halban, jun., H., NATURE, **136**, 1027 (1935).

[3] Fermi, E., Amaldi, E., *Ric. sci.*, A, VI/2, 544 (1935).

[4] Fomin, V., and others, NATURE, **138**, 326 (1936). Fink, G. H., *Phys. Rev.*, **50**, 738 (1936).

[5] Frisch, O. R., and Placzek, G., NATURE, **137**, 357 (1936).

[6] Weekes, D. F., Livingstone, M. S., and Bethe, H. A., *Phys. Rev.*, **49**, 471 (1936).

[7] Rasetti, F., and others, *Phys. Rev.*, **49**, 104 (1936).

Structure Types of Protein 'Crystals' from Virus-infected Plants

FURTHER work on preparations of proteins from virus-infected plants tends to confirm and extend the conclusions expressed in our previous letter[1]. We had there shown that both concentrated solutions of these proteins and the material prepared from them by drying gave orientated paracrystals. We have now succeeded in preparing the 'crystals' of Stanley and Wyckoff in an orientated form, after trying unsuccessfully a number of methods, such as flow orientation. The method finally used was that of forcing mother liquor out of the 'crystals' by centrifuging in an unglazed porcelain tube, in a saturated atmosphere. The resulting mush was orientated by rolling between glass slides, at 0° to avoid evaporation, becoming completely transparent in the process. It was mounted in a sealed brass case with bubble thin lindeman glass windows and examined by X-ray and optical methods without loss of water. It proved to be practically indistinguishable—in water content (50 per cent), optics and X-ray pattern at low and high angles—from the preparation previously called wet gel. On being allowed to dry, it likewise turns into a horny mass giving similar X-ray photographs to 'dry gel', though fainter and with slightly larger spacings, probably due to internal strain. The X-ray pattern obtained from the unorientated crystals shows all the main lines given by Wyckoff and Corey[2] for their crystals, and we have been able to assign all but four very weak lines on these photographs to definite spots given by the orientated gel. There can therefore remain little doubt that their 'crystals' are substantially identical with ours and with our previously described paracrystals.

As many deductions have already been drawn from the crystalline nature of these proteins, it is important to state precisely in what sense the word 'crystalline' should be used in respect of them on the basis of interpretation of X-ray photographs. Normally, crystallinity presupposes an indefinite repetition of identical units in three-dimensional space. These proteins appear not to possess this degree of regularity. The degree of regularity which seems to be the only one consistent with the X-ray evidence has thus far not been described, though it has been predicted theoretically as one of the types of liquid crystal. The long molecules of the protein are packed with a perfect hexagonal two-dimensional regularity at right angles to their length, but there is no evidence of regularity of molecular arrangement in the direction of their length. None of the reflections in directions other than at right angles to the molecular length is due to the packing of the molecules, but rather to regularities within them, as shown by the fact that such reflections persist unchanged when the molecules are in dilute solution. Lines observed by Wyckoff refer not to the regular packing of equivalent molecules but to regularities within the molecule. They can only be said to be evidence for crystallinity if by that it is understood that each molecule is itself a crystal. The relatively small lateral dimensions of the molecules, 150 A., can only permit of imperfect diffraction effects in these directions as shown by the diffuseness of the spots, while the great length of the molecule is indicated by the extreme sharpness of the reflections from planes perpendicular to its length. A complete interpretation of this intramolecular pattern has not yet been possible; but a rough survey indicates that the molecule is made of piles of submolecules of dimensions 22 A. × 20 A. × 20 A., somewhat smaller than the normal protein molecule, and themselves divided into nearly identical units with half these dimensions.

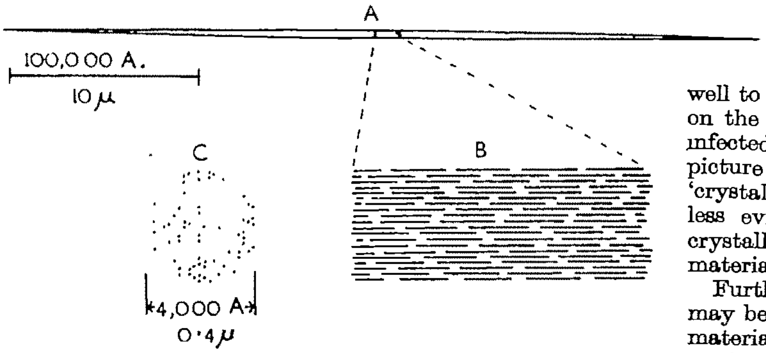

Fig. 1. DIAGRAMMATIC.
A. TYPICAL 'CRYSTAL'. B. LONGITUDINAL SECTION.
C. TRANSVERSE SECTION.

RELATIVE INTENSITIES OF INTERMOLECULAR REFLECTIONS OBTAINED FROM VARIOUS VIRUS STRAINS.

$h^2 + k^2 + hk$	$hkil$	Tobacco mosaic	Enation	Aucuba	Cucumber 3	Cucumber 4
1	$10\bar{1}0$	*s*+	*w*–*m*	*m*	*m*	*w*
3	$11\bar{2}0$	*s*	*s*	*s*	*m*	*w*–*m*
4	$20\bar{2}0$	*m*	*m*	*w*–*m*	*w*	*vw*
7	$21\bar{3}0$	*m*–*s*	*m*–*s*	*m*–*s*	*s*	*s*
9	$30\bar{3}0$	*vvw*	0	0	0	0
12	$22\bar{4}0$	0	*vvw*	0	*m*–*s*	*m*
13	$31\bar{4}0$					

The microscopic appearance of the Stanley 'crystals' is quite consistent with their liquid crystal character, for although fairly long, about 40 μ, they are extremely thin, about 0·4 μ thick, and have gently tapering ends. This is quite different from the prismatic or pyramidal forms of true protein crystals and more like the 'micro tactoids' observed in colloidal solutions of the fibrous type. On pressing they readily fuse together into a homogeneous mass, emphasizing their partially liquid nature. Their most probable internal arrangement is that shown in Fig. 1. This arrangement would also serve very well to explain the observations of R. J. Best[3] on the formation of mesomorphic fibres from infected sap. A further consequence of this picture of the internal structure of these 'crystals' is that their formation furnishes even less evidence than is provided by ordinary crystallization as to the homogeneity of the material.

Further light on the structure of the protein may be given by comparative study of similar materials. We have so far examined three strains of tobacco virus: mosaic, enation and aucuba, as well as two varieties of cucumber virus prepared by Bawden and Pirie[4]. The intramolecular patterns resemble one another very closely, but interesting and significant differences appear in the intermolecular patterns. All three varieties of tobacco virus show the same intermolecular distance in dry gels prepared in the same way, but show consistent differences of relative intensity of the different lines (see Table). The cucumber virus protein shows even more marked intensity differences and also a different intermolecular distance, 146 A., 4 per cent smaller than that of tobacco virus. There was no marked difference in spacing between the two cucumber strains.

The significance of these observations is that all the protein molecules have substantially the same general shape and size and are made of similar sub-units, but that these are arranged somewhat differently in the various tobacco virus strains and more markedly so in the cucumber virus. These results indicate the possibility of deriving a system of classification of viruses on the basis of their X-ray patterns.

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[1] Bawden, F. C., Pirie, H. W., Bernal, J. D., and Fankuchen, I., NATURE, 138, 1051 (1936).

[2] Wyckoff, Ralph W. G., and Corey, Robert B., *J. Biol. Chem.*, 116, 51 (Nov. 1936).

[3] Best, R. J., NATURE, 139, 628 (1937).

[4] Bawden, F. C., and Pirie, N. W., NATURE, 139, 546 (March 27, 1937).

Acquired Immunity against the 'Y' Potato Virus

Two years ago, thanks to Messrs. Sutton and Sons, Ltd., I obtained a couple of plants of *Schizanthus retusus*. At the base of each grew a mass of axillary shoots, forming a sort of 'witch's broom'. The plants were otherwise healthy, vigorous and in full bloom.

Sap inoculations were made from these axillary shoots to young schizanthus plants, tobaccos, and daturas, as well as grafts to older schizanthus plants. The daturas remained unaffected; the tobaccos developed a dull vein clearing, followed by a faint mottle and a weakly-developed vein-banding on the older leaves, all characters of Kenneth Smith's 'Y' virus in a weakened form. Such a variant I had long sought as a basis for protective inoculation of the potato. *Passage* through schizanthus induced a further weakening of the virus, as judged by its reaction on tobacco, in such manner that if the normal reaction were valued at 10, the weaker might be assessed so low as 3, though it was more often recorded as between 4 and 6. It was shown[1] that this new strain protected tobaccos against further infection with the normal 'Y' virus.

As the new strain of the virus was insufficiently attenuated to serve as a protective inoculation for potatoes, further attempts at reduction were made. Root fibres of tobacco plants, infected with the weak and strong forms of 'Y' respectively, were set up under sterile conditions in Erlenmeyer flasks, containing nutrient fluid, and incubated at room temperature, 22° C., 35° C., and 40° C. After about a week the virus extracted from the cultures was generally reduced, and it made little difference whether the cultured root had come from a plant infected with the common or the weak strain of 'Y', nor did the temperature greatly affect the process, though on the whole the best results were obtained at the higher ones. Nearly a hundred such strains have been obtained, most of which, when compared on tobaccos with the full 'Y', were valued at figures so low as 1 and 0·5; they have remained unaltered for three months.

In every single case it has been shown that the weak form affords complete protection against later inoculation with the normal 'Y' in tobacco. In the potato, variety "President" and "Up-to-Date", the weak strains produce a much reduced reaction—a mottle in the upper leaves, and in some cases a few fine streaks of necrosis on the under surface of some of the veins, whilst two or three lower leaves may drop. Second year symptoms in the glasshouse may be so slight as almost to escape observation. It has not been sufficiently established as yet, though it appears most probable, that the weak form protects in the potato, as in the tobacco, against subsequent infection with the strong virus.

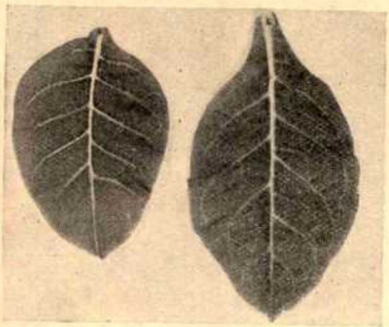

Fig. 1.

LEAVES FROM TOBACCO PLANT OF SAME AGE AND SIZE, AT THE VEIN-CLEARING STAGE; INOCULATED WITH THE COMMON 'Y' VIRUS (LEFT); A MUTANT FORM (RIGHT).

The possibility of inducing an immunity against one of the most destructive viruses met with in the potato field, is thus brought appreciably nearer.

Köhler[2,3] described what he thought to be weak forms of 'Y', but found that they did not protect against the common 'Y'. They were in fact infectious with the 'A' virus. In a communication just received[4] he reports that he has found a form of 'Y' which does protect; it is obvious from its reaction on tobacco, that it is of considerably higher virulence than the strains described above.

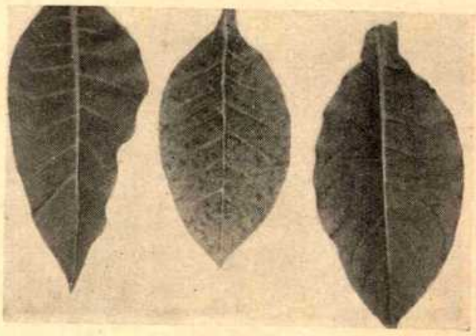

Fig. 2.

LEAVES FROM TOBACCO PLANTS OF SAME AGE AND SIZE, AT THE VEIN-BANDING STAGE; UNINOCULATED (LEFT); INFECTED WITH THE COMMON 'Y' VIRUS (CENTRE); AND A MUTANT FORM (RIGHT).

It should be stated that the weak 'Y' virus here described was not responsible for the 'witch's broom'.

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[2] Köhler, E., *Phytopath. Z.*, 7, 1 (1934).

[3] Köhler. E., *Phytopath. Z.*, 10, 1 (1937);

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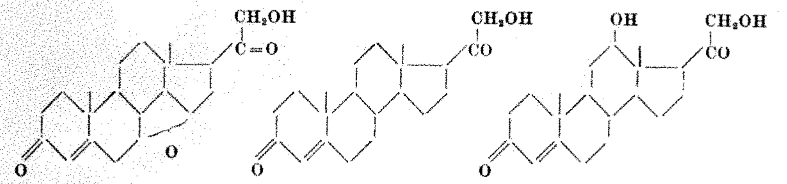
Partial Synthesis of a Crystallized Compound with the Biological Activity of the Adrenal-cortical Hormone

IN a letter to NATURE, Laqueur, Reichstein *et al.*[1] reported the isolation of a new crystallized compound in pure form which they named corticosterone (m.p. 180°–182° corr.) and which possesses the biological activity of the adrenal cortical hormone.

The empirical formula of corticosterone is $C_{21}H_{28-30}O_4$ and the structure which suggested itself is given in formula (I)[2]. This structure is chiefly based upon analogy with five pure compounds of the C_{21}-O_5-series (*A*, *C*, *D*, *E* and *Fa*) isolated from adrenals, the structures of which were definitely proved by degradations which furnished androstane as an end product. Only the function and position of one oxygen was left open. In consideration of the fact that corticosterone has a reducing group, gives the cholestenone band ultra-violet absorption spectrum and by chromic acid oxidation yields not a ketone of the C_{19}-series like the above mentioned compounds but an acid with 20 carbon atoms, no other formula was possible if the analogy were to be maintained. Function and position of the last (inert) oxygen is again left open.

Meanwhile, it seemed of more practical interest to check this assumption by synthetic models rather than by degradation experiments. Starting with stigmasterol and following a series of degradations and synthetic reactions, 21-oxy-progesterone (II) was prepared. The details will be given later. If formula (I) is correct, this compound differs from corticosterone only by the absence of the fourth oxygen, and can therefore also be called 'desox-corticosterone'. It shows striking resemblance with corticosterone. Its reducing capacity and the cholestenone-like ultraviolet absorption spectrum are in accordance with the function of the three oxygen atoms. But the chief point is that it has definite cortical hormone activity on adrenalectomized dogs and rats as shown by Prof. E. Laqueur in Amsterdam*. The minimal necessary daily dose is not yet exactly established, but it is certain that the activity is not less than one third of that of corticosterone. The crystals have m.p. 136°–138°, which possibly may be raised a few degrees when greater amounts are prepared. The important fact, however, is that this compound represents the first substance with high cortical hormone activity prepared from inactive material.



(I) (II) (III)

In a paper which arrived here a few days ago, Kendall *et al.*[3] state that corticosterone is identical with their compound *B* [4]. They now give the m.p. of the latter as 177°–179° (uncorr.) which is in excellent agreement with our value for corticosterone. Also the biological activity is quite of the same order as that reported by us. Kendall states that this substance has a higher cortical hormone activity than that of any other pure compound so far isolated. The empirical composition is given as $C_{21}H_{30}O_4$ and the structure is expressed in formula (III). While Kendall is thus the first to have published an appropriate structure for corticosterone, it must be pointed out that in his original paper[4], Kendall stated that compound *B* had a melting point 135°–139°, which is more than 40° lower than that now given, and an empirical composition of $C_{24}H_{34}O_5$. Nothing was said of its biological activity, while activity for compound *E* was claimed[5]. It is therefore scarcely possible that his original compound *B* is identical with corticosterone; it may have been a mixture.

On the other hand, we agree with Kendall, that his new results bring considerable evidence for his suggestion that the unknown fourth oxygen is contained in a secondary hydroxy group. If this suggestion can be proved conclusively, there will remain very few positions in which this hydroxy group can be placed. In the meantime, there exists evidence which would suggest its presence at position 11, rather than at position 12.

MARGUERITE STEIGER.
T. REICHSTEIN.

Chem. Institut,
Eidg. Tech. Hochschule,
Zürich.
April 6.

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* The biological tests were made with the acetate.

[1] de Fremery, Laqueur, Reichstein, Spanhoff, Uyldert, NATURE, **139**, 26 (1937).

[2] This formula was not published, but deposited in a Swiss patent filed December 1936.

[3] Kendall, Mason, Hoehn, McKenzie, *Proc. Staff Meet. Mayo Clinic*, **12**, 136 (1937).

[4] Mason, Myers, Kendall, *J. biol. Chem.*, **114**, 613 (1936).

[5] Kendall, Mason, Myers, *Proc. Staff Meet. Mayo Clinic*, **11**, 361 (1936).

Variation of Wind with Height

IN the Professional Note of the Meteorological Office, Air Ministry, referred to in NATURE of April 24 in a Research Item (p. 721) on the "Variation of Wind with Height" at Wadi Halfa, Mr. J. Durward remarks upon an apparent discrepancy of nearly 70° between observation and theory when the results of observations of the winds by means of pilot balloons between 10,000 ft. and 13,000 ft. are compared with the run of the isobars at 4,000 metres as shown on Teisserenc de Bort's map.

I should like to remark that the discrepancy really emphasizes the necessity for further investigation of the meteorology of the equatorial region. Our general ideas of the relation of wind to the distribution of pressure, initiated by Buys Ballot's law, are based on the experience of temperate latitudes. As the equator is approached, the term in the equation depending on the earth's rotation gradually loses its significance and at the equator itself is altogether inoperative. In that region, if air 'comes to rest', it is by, somehow, acquiring a velocity of 1,000 miles an hour in order to keep pace with the ground on which it 'rests', a velocity which in temperate or arctic latitudes would be intolerable.

The equatorial region, therefore, cannot be regarded as amenable to the ideas of the relation of air-motion to the gradient of pressure which are illustrated by our weather-maps. Special investigation is needed to put the meteorologists of the equatorial zone in a corresponding position of advantage.

Special maps are certainly required; but what form the maps should take also requires consideration. Monthly means are not likely to be of much service where the geostrophic effect is negligible. Years ago, Mr. Lempfert and I got a good deal of insight into the working of that effect in the temperate zone by the construction of hourly maps compiled from the available records, and now that records of pressure are required for other purposes besides weather-maps, I have been wondering whether there are enough records in existence of pressure over land and sea to make hourly maps of the equatorial regions, if the records for a single week, for example, could be collected. The demonstration of the diurnal variation of pressure might be a test of the reality of the representation, and incidentally the local divergencies from the smooth curve would no doubt be expressed as weather. I have already an offer from Colombo of any information that is available there, and with the aid of ships and sealing-wax the walrus's idea of talking about many things might be realized!

NAPIER SHAW.

10 Moreton Gardens, S.W.5.
April 28

Aldehyde Mutase

WITH reference to the note by M. Dixon and C. Lutwak-Mann, published in NATURE of March 27, p. 548, on the non-identity of aldehyde mutase with the aldehyde oxidase, I would point out that this fact was first established so far back as 1931 by Michlin and Severin and published in *Biochemische*

Zeitschrift, **237**, 339 (1931) under the title "Über die Nichtidentität der pflanzlichen Aldehydrase und Mutase".

We used the enzyme preparations of peas and potatoes. No traces of mutase was to be discovered in the purified preparations of potato-aldehydrase.

D. MICHLIN.

Biochemical Institute,
Academy of Sciences,
Moscow.
April 15.

WE cannot admit Dr. Michlin's claim to have been the first to show the non-identity of aldehyde mutase with aldehyde oxidase. It is well known from the work of Bernheim and others that the aldehydrase of the potato is a completely different enzyme from the aldehyde oxidase of animal tissues and milk (Schardinger enzyme). The fact that the potato aldehydrase has no mutase activity obviously does not show that the mutase and the Schardinger oxidase are distinct enzymes. Dr. Michlin indeed says in the paper referred to: "It has not yet been possible, as far as we know, to separate the mutase from the aldehydrase or Schardinger enzyme, either in milk or in animal tissues or yeasts. Wieland's supposition, based on kinetic considerations, that the mutase and aldehydrase of milk are identical, has once again been established by Wieland and Macrae." Dr. Michlin himself therefore evidently accepted the identification of the mutase with the Schardinger aldehyde oxidase. We have now separated these two enzymes and proved their non-identity.

M. DIXON.
C. LUTWAK-MANN.

Biochemical Laboratory,
Cambridge.

Two-Dimensional Crystals of Silicon Pentoxide (Si_2O_5)

IT has been shown recently by me that vitreous silica and pumice, which have been considered up to the present as non-crystalline bodies, yield electron diagrams with surprisingly well-defined rings[1].

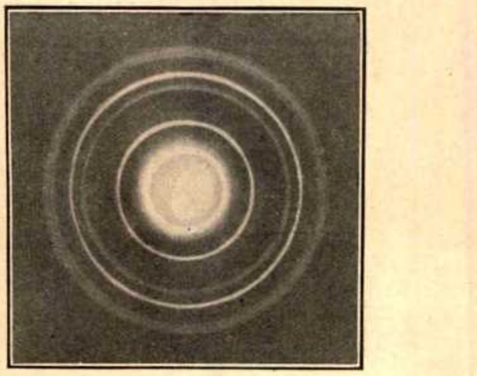

Fig. 1.

Further experiments, which were carried out last year in the Cement Institute, have shown that many other pozzolanic materials yield the same diffraction patterns, the only difference being that the latter did not contain certain rings, which were observed with vitreous silica and pumice. The most striking observation was that exactly the same diffraction pattern was given by every clay, in spite of the low order of symmetry of clay minerals. Such a typical diagram without 'extra' rings is shown in Fig. 1. The following table shows the corresponding Bragg spacings which were found from electron diagrams of some clays and pozzolanes with added pure sodium chloride as a standard substance ($a = 5 \cdot 626$ A.).

Intensities	d	a	hkl
20	4·450	5·138	(100)
15	2·561	5·122	(110)
0·5	2·235	5·162	(200)
5	1·688	5·157	(210)
9	1·491	5·165	(300)
3	1·291	5·164	(220)
3	1·240	5·162	(310)
1	1·120	5·173	(400)
0·5	1·028	5·174	(320)
0·5	0·974	5·154	(410)
0·5	0·895	5·167	(500)
0·25	0·858	5·148	(330)
0·25	0·842	5·145	(420)
Traces	0·808	5·195	(510)
,,	0·720	5·195	(520)

It follows from this table that the constant a, which was found by assuming that the lattice is hexagonal, is closely the same for all reflections and that the third index is zero throughout. This last condition indicates that the crystals in question are two-dimensional. The fact that such reflections are all observed also in the case of pure silica glass, suggests that the crystals are constituted only of silica. It follows from this that the bonds between tetrahedra of SiO_4 are here the same as in silicates of mica type and clay minerals, that is, the crystals have the form of endless firm sheets of composition Si_2O_5. This is confirmed by the close agreement of their parameters taken in orthohexagonal co-ordinates: $a = 5 \cdot 161$ A. and $b = a\sqrt{3} = 8 \cdot 939$ A. with that of some micas and clay minerals. We have, thus, for muscovite, $a = 5 \cdot 17$ A. and $b = 8 \cdot 94$ A.; for kaolinite $a = 5 \cdot 14$ A. and $b = 8 \cdot 90$ A.; and for metahalloysite $a = 5 \cdot 15$ A. and $b = 8 \cdot 90$ A.

The presence of only a few prominent rings in the case of clay minerals, instead of many weak reflections expected by reason of their low symmetry, is readily explained if one remembers that they are unstable at temperatures of 400°–500° C. The effect of cathode rays, which are, of course, partly absorbed by the specimen, would be similar. As to alumina, which is set free at such decomposition, it is probable that it is amorphous, and its influence on the diffraction pattern from Si_2O_5 crystals is as negligible as is that of a celluloid film.

The full account of this work will be published elsewhere.

N. A. SHISHACOW.

Colloid-Electrochemical Institute,
Academy of Sciences,
Moscow, 49.
March 8.

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[1] Shishacow, N. A., NATURE, **136**, 514 (1935); *J. Tech. Phys.* (*Russ.* **5**, 1834 (1935) *Comptes rendus U.R.S.S.*, **1** (10), 15 (1935).

Abnormally High Magnetic Permeability of Nickel Wire obtained by Surface Treatment

A LENGTH of 0·125 in. diameter pure nickel wire was heated to a temperature of 1,150° C. in a steady stream of hydrogen gas by means of an electric resistance furnace, and the maximum value of the permeability was measured periodically when cold. The results so obtained are plotted as Curve I in Fig. 1. It will be seen that the maximum permeability attains a value of 2,100 after about 7 hours. The greatest value for the permeability of nickel previously recorded[1] is 1,400.

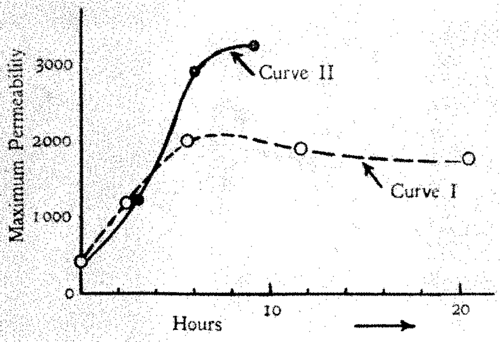

Fig. 1.

A length of nickel wire from the same coil was then electro-plated with copper to a thickness of about 0·003 in. and heated to a temperature of 1,030° C. in a steady stream of hydrogen, and the value of the maximum permeability was again measured at intervals when cold. The results are given in Curve II, Fig. 1. It will be seen that the maximum permeability now reaches the value 3,250. The value of the coercive force when the wire was demagnetized from an induction density of 5,150 gauss was found to be 0·24 oersted and the remanent induction density was 1,270 gauss.

The investigations are being extended to examine the effects of thin coatings of other metals such as aluminium, iron, cobalt.

T. F. WALL.

Dept. of Electrical Engineering,
University, Sheffield.
April 10.

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[1] See *The Engineer*, April 2, 1937.

Rotational Analysis of the '$3A$' Bands of CO

THE so-called '$3A$' bands of CO in the region 2200–2600 A. have been excited with high intensity in a discharge through neon in a Geissler tube with carbon electrodes, and the (0,1), (0,2) and (0,3) bands at 2389, 2489 and 2596 A. have been photographed in the first order of a large 'Hochheimized' concave grating (dispersion 1·3 A./mm.). By fine-structure analysis twelve branches have been detected in each band, the others being weak and overlapped. Of these twelve branches, six form heads, namely, O_3, O_2, P_3, P_2, P_1, Q_1 in order of diminishing wavelengths, and six do not form heads, namely, R_3, R_2, R_1, Q_3, Q_2, S_1. This shows the upper state to be a $^3\Sigma$ state, the rotational constant of which is found to be 1·9563 cm.$^{-1}$ from the average of three times six double combinations for the upper state.

The lines of the (0,1) '$3A$' band extend to the red-degraded (9,18) Fourth Positive band, the upper state for which predissociates[1] at 9·57 V. above the ground state of CO. The rotational analysis of the '$3A$' bands shows that the apparent increases of intensity of some of the Fourth Positive band lines (shown in plate I of the paper cited) behind the point of predissociation are caused by the superposition of certain '$3A$' band lines.

R. SCHMID.
L. GERÖ.

Physical Institute,
Royal Hungarian University for
Technical and Economic Sciences,
Budapest.
March 27.

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[1] Gerö, L., *Z. Phys.*, **100**, 374 (1936).

Structure of $BrSiCl_3$ studied by means of Electron Diffraction

USING a de Laszlo apparatus similar to that used for the study of $HSiCl_3$[1] and $HSiBr_3$[2], we have been able to measure the distances between the atoms of $BrSiCl_3$. These appear to be: Br-Cl = 3·41 ± 0·03 A.; Cl-Cl = 3·39 ± 0·01 A.; Si-Cl = 2·05 ± 0·05 A.; Br-Si = 2·19 ± 0·05 A.

In our work on $HSiBr_3$[2], we mentioned that the accuracy of the distance measurements of atoms in a molecule of this kind is very different for the different atoms involved. The distances between the halogens may be considered as measured with considerable accuracy, but on the other hand the distance between the halogens and the silicon atom is not so accurate. This is due to the fact that small variations of the Cl-Cl or Br-Cl distances affect greatly the positions of the different maxima of the curve giving relative intensity as a function of half diffraction angle; variations of Si-Cl and Si-Br distances have very little effect on this angle.

At the end of our earlier letter, "Geometrical Constitution of Silicichloroform"[1], we gave the following dimensions for angle and height of the pyramid $SiCl_3$: height, 0·65 A.; angle, 113° 30′. These should read: height, 0·62 ± 0·20 A.; angle, 111° ± 4°; as can be calculated from the distances Si-Cl and Cl-Cl given in that letter.

M. DE HEMPTINNE.
J. WOUTERS.

Physical Laboratory,
University, Louvain.

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[1] de Hemptinne, M., and Wouters, J., NATURE, **138**, 884 (1936).

[2] Wouters, J., de Hemptinne, M., and Capron, P., *Ann. Soc. Scientif. Brux.*, **57** (1937).

Fire-Walking

I SHALL be glad to be permitted to supplement the report in NATURE of April 17 on the fire-walking experiments which I organized for the University of London Council for Psychical Investigation. The article records the results of two tests (at Carshalton, on April 7 and 9), but does not mention the third—and final—demonstration with the Indian professional.

This was staged in the grounds of Alexandra Palace on April 20. The trench was 12 ft. long, 4 ft. wide, and 9 in. deep. Some four tons of oak logs were used in preparing the fire. At the time of 'walking', the surface temperature (measured by a representative of the Cambridge Instrument Co., Ltd.) was 800° C. This high temperature (the hottest fire we have managed to produce at any test) was due to the exposed position of the trench, and to the fact that a stiff breeze was blowing.

The first to walk was Ahmed Hussain (weighing 126 pounds), who took four steps in 1·6 sec. His feet were uninjured. Then Mr. Reginald Adcock (weighing 160 pounds), a young Cambridge graduate, walked the trench in 1·8 sec., taking three steps. His feet were not blistered or injured in any way. This was the third occasion on which he has done the fire-walk for us. Both walkers started off with the right foot. The slow-motion film I took of the demonstrators reveals no apparent superiority in walking technique on the part of the professional.

In the report in NATURE of our last fire-walking experiments, it is stated that "two steps with the same foot could only be done without injury by the practised professional". But Mr. Adcock demonstrated to us at Alexandra Palace that he, too, can take two steps with the same foot on a very hot fire without the slightest injury. Although he took three steps against the Indian's four, the time taken was 0·2 sec. longer; and the Englishman weighed 34 pounds more than the Indian. The times were taken by Dr. E. J. Dingwall, and Prof. J. C. Flugel, and I washed and examined the feet of the walkers both before and after the walks.

It is interesting to compare Mr. Adcock's feat with that of Kuda Bux's when the latter gave us his performance at Carshalton on September 17, 1935[1]. Bux walked on a trench 11 ft. long, with a surface temperature of 430° C. He weighed 120 pounds. Each foot was in contact with the embers twice. Adcock's performance surpassed that of the Indian's because the surface of the fire was nearly twice as hot, he walked farther, and the Englishman weighed 40 pounds more—the extra weight being a great disadvantage in fire-walking.

HARRY PRICE.

19 Berkeley Street,
London, W.1.
May 18.

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[1] See Bulletin 2, Univer. Lon Council for Psy. Invest, 1936

Instructional Tours for Students of Forestry

THE review of the future policy of the Imperial Forestry Institute in NATURE of May 1 contains a criticism of the proposal to replace tours of instruction in Germany, France and Switzerland by tours in the Scandinavian countries where forestry has not reached such an advanced or specialized stage. It is pointed out that whereas students in British forestry schools probably receive sufficient grounding in European forestry, those officers whose training has been outside Europe should be given an opportunity of seeing the best examples of organized forestry in countries like Germany, France and Switzerland, where the ecological, economic and sociological foundations have been most fully worked out.

On this point everyone who has kept in close touch with the developments of European forestry in recent times will, I think, be in agreement with the writer. Broadly speaking, it is possible to divide practical instruction in Continental forestry into two parts; (1) the essential grounding in well-established systems, to be obtained in France, Germany and certain other countries, (2) 'extension tours' to countries where forestry is in a less advanced stage. Without a good grounding in the methods covered by (1), extension tours must lose much of their value, and this would apply to the projected tour in Finland, however interesting and instructive it may prove to be on its own account.

In effect, the future policy of the Institute aims at substituting tours of the second category for those of the first, and the fear expressed in the article in NATURE that this may prejudice the chances of giving the essential grounding referred to above to those who have not already received it, is a very natural one. Fortunately, the machinery exists for meeting this difficulty. A good grounding in the fundamental principles of Continental forestry has always been a tradition of the Oxford School of Forestry, and, in order that these principles may be demonstrated on the spot, annual instructional tours have been organized by the School for many years past in France, Switzerland, Germany and occasionally in Austria and Czechoslovakia. Apart from undergraduate members of the School, it has been the regular custom in the past to include on these tours forest officers on leave and others who may wish to take advantage of them. Similar facilities will continue to be afforded in the future, and it is hoped, therefore, that the new policy of the Imperial Forestry Institute will in no way prevent those who desire to do so from obtaining a grounding in, or refreshing their knowledge of, the essential principles of European forestry.

The principal reason for selecting France, Switzerland and Germany for these School tours is that there is probably no region in the world, of similar size, which can show so great a variety of conditions, ideas and methods, whether from the point of view of administration and policy, economic conditions, sylviculture and forest management, extraction and utilization of timber, or any other branch of forestry. Practically all the standardized sylvicultural systems are to be seen, with various modifications to suit different species and conditions. These systems have formed the basis of scientific forestry in India, and their application is being extended to other parts of the Empire; it is therefore important that those entrusted with the management of our vast forest estate should be well grounded in the fundamentals of the subject.

R. S. TROUP.

School of Forestry,
Oxford.
May 3.

THOUGH the study tours of the Oxford Forestry School, and perhaps also those of other schools, offer opportunities to forest officers who have had their training outside Europe to obtain a first-hand acquaintance with some of the standard systems of forestry in France, Germany and Switzerland, the fact remains that the officers in question have to go outside the Institute for these facilities. The disturbing thing is that there is nothing in the declared policy of the Institute to encourage them to do so; rather are such tours criticized on the ground that "the highly specialized forms of forestry seen have little application to average conditions overseas". Prof. Troup says "it is hoped . . . that the new policy of the Imperial Forestry Institute will in no way prevent those who may desire to do so from obtaining a grounding in, or refreshing their knowledge of, the essential principles of European forestry". It is felt that this is not sufficient and that something more positive is required. It was because of the fear that the value of a sound training in European forestry as an equipment for tackling the special forestry problems of the various parts of the Empire is being minimized, that adverse comment was passed upon the policy of the Institute in this particular.

THE WRITER OF THE ARTICLE.

The University of Göttingen

MAY an English university teacher, who is at present enjoying the hospitality of a scientific institute in Göttingen, protest against the article in NATURE of April 24? It is undeniable that the University of Göttingen has suffered serious losses under the Nazi regime, and many features of the present university administration are entirely deplorable. On the other hand, there still remain in Gottingen men of considerable distinction (to mention only four outstanding names: Eucken, physical chemist; Windaus, organic chemist and Nobel prizeman; Prandtl, hydrodynamics; Rein, physiologist), who are continuing in the face of difficulties to maintain a high standard of scientific research and teaching. They are in no way responsible for the present administration; the statement that "Gottingen ceased in 1933 to be a scientific centre" is an unjustified insult and a discouragement which they feel most bitterly. The removal of the Jews from German universities, much as we may deplore it, is now complete and irrevocable. We have already indicated our disapproval with more than sufficient force, and a continuation of the campaign of abuse and boycott serves no conceivable purpose except to irritate the extremists to still further excesses and hurt the feelings of those moderates whose efforts to maintain the standard of academic learning need and deserve all the encouragement we can give.

"Any stick will do to beat a dog with." The anti-Semitic and anti-Catholic literature in circulation here illustrates how pathetically easy it is to make up a plausible case from odd statistics and excerpts, and it is regrettable that English attacks on Germany are beginning to show signs of the same fanaticism and lack of taste. Your anonymous correspondent is perhaps unaware that the speech which he quotes resulted in disciplinary measures being taken by the ministry of Education against Dr. Kahrstedt. The quotation about duelling is scarcely even relevant to the point at issue: an equally distorted view of English academic learning would be gained by a foreigner reading our Press at the time of the Oxford and Cambridge Boat Race. My present colleagues, mostly appointed since 1933, are men of high scientific ability in spite of the "complex apparatus" which apparently should have "prevented them from joining the junior teaching staff", and we do not find ourselves in any way hindered or disturbed in scientific work. Is it too late to make a plea to English universities and periodicals for that dignified tolerance and restraint which we like to regard as a national virtue and which is the only effective counter to political hysteria? Nothing will be gained and much lost by cutting off all contact with an academic society which, in spite of all that can be justly said against it, is still producing, and will continue to produce, positive scientific work of real value.

J. D. LAMBERT.
(Lecturer of Trinity College, Oxford.)

Physikalisch-chemisches Institut,
Gottingen.
May 10.

MR. LAMBERT points out, what has never been doubted, that there are distinguished men of science at Gottingen who are not responsible for the present administration. It cannot be to their advantage that representatives from English universities should fraternize with precisely those officials who are most closely associated with the features which he tells us that he (and implies that his German friends) most deplore.

The figures quoted in the article on Gottingen are not "odd statistics and excerpts"; they are figures carefully gathered by competent, trained and impartial observers who have spent several months on this particular task. The inquiry shows that the careers of approximately one fifth of the scholars and men of science in Germany have been ruined and the scientific opportunities and intellectual integrity of the remaining four fifths have been gravely injured. It must take generations for the profession of learning in Germany to recover the dignity and esteem which it has lost.

The Minister of Education, Herr Rust, has spoken in terms as extreme as Dr. Kahrstedt, so that the disciplinary measures to which Mr. Lambert refers can be intended only for external consumption. Mr. Lambert should read the address given by Herr Rust at the "jubilee" of the University of Heidelberg last year.

Mr. Lambert and certain of his colleagues "do not find themselves disturbed . . . in scientific work". Others are less fortunate. Dismissals continue, and at Gottingen itself a professor of long service and high standing was dismissed a few days before Mr. Lambert wrote.

Mr. Lambert makes no mention of the choice of June 30 for the celebrations both at Heidelberg and Göttingen, or of the association of that day, in every German mind, with the greatest political massacre of modern times. He does not mention the entire failure of the appearance of any *Göttinger Sieben* to protest against the assaults on learning and liberty. He does not mention that more than a fifth of the staff of the University was dismissed with scarcely a word of protest or sympathy.

The difficulty of recruiting staffs for the German universities is as well known in Germany as in England. A special decree was recently issued by the Ministry of Education, and circulated in a confidential leaflet to university teachers expressly forbidding public discussion of this subject.

Mr. Lambert states that "the quotation about duelling is scarcely even relevant to the point at issue". If duelling be compulsory in the German universities, it must effect the recruitment of the staff in very many ways. To mention one only, it must exclude practising Catholics, to whom duelling is forbidden. Nearly one third of the population of Germany is Catholic.

THE WRITER OF THE ARTICLE.

Boltzmann's *H*-Theorem

WHEN Boltzmann first published the celebrated theorem now generally known as the *H*-theorem, he used the symbol *E* (presumably as the first letter of *entropy*), not *H*. It has been suggested that when *H* was first used for this theorem it was intended to be the capital Greek letter *eta*: but the first paper known to me in which *H* is used for Boltzmann's entropy function is one by Burbury[1], who seems to have changed Boltzmann's symbol *E* to *H* for no special reason; later Burbury used *B* for an almost identical function, which he called Boltzmann's minimum function[2]. Boltzmann himself wrote *E* so late as 1893[3], but in 1895[4] he used the letter *H*. This use of *H* must have seemed mysterious to many generations of students, and it would be interesting to know whether any reader can account for its use or give an earlier instance of it.

S. CHAPMAN.

Imperial College,
South Kensington.

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[1] *Phil. Mag.*, 30, 301 (1890).

[2] NATURE, 49, 151 (Dec. 14, 1893) *Phil. Mag.*, 37, 157 (1894).

[3] *Phil. Mag.*, 35, 161 (1893).

[4] *Phil. Mag.*, 51, 414 (1895).

Points from Foregoing Letters

FROM mass-spectrographic measurements of several doublets (atoms and groups of atoms having the same mass/charge ratio), Dr. F. W. Aston has deduced with a greater degree of accuracy the 'packing fractions' and isotopic weights of the atoms of carbon, ^{12}C, oxygen, ^{16}O, and argon, ^{36}A.

The absorption by silver of 'thermal neutrons' (which at a given temperature have energy corresponding to that of thermal agitation of atoms in the surrounding medium) has been determined by Drs. O. R. Frisch, H. von Halban, jun. and Jorgen Koch at several temperatures up to 415°. The authors point out that there is a discrepancy between the observed values and those deduced on the assumption that the absorption is inversely proportional to the velocity of the neutrons. This discrepancy, they consider, may be due to the inhomogeneity of the thermal neutrons, due on one hand to the presence of a certain number with energy greater than the thermal range, and on the other hand to an excess of thermal neutrons of energy less than 0·1 eV.

Drs. J. D. Bernal and I. Fankuchen submit diagrams indicating the structure of the so-called crystalline virus protein prepared by the method of Stanley and Wyckoff. There is a two-dimensional hexagonal regularity at right angles to the long protein molecules, but none in the direction of their length. The molecule is made up of piles of submolecules of dimensions 20 A. × 20 A. × 20 A., somewhat smaller than the normal protein molecule. The structure of the 'crystals' is somewhat like that of the colloidal 'micro tactoids'. The authors also give a table of the inter-molecular distances in several tobacco and cucumber viruses, and suggest that viruses may eventually be classified on the basis of their X-ray patterns.

Methods of preparing an attenuated form of the 'Y' potato virus which affords complete protection to tobacco plants, and partial protection to potato plants against the more virulent form, are described by Dr. R. N. Salaman. To obtain this immunizing preparation, the virus is either passed through a schizanthus plant or is first inoculated into root fibres of tobacco plants, under controlled conditions.

The synthesis of a compound (21-oxy-progesterone) which has activity similar to that of the adrenal-cortical hormone (corticosterone) is announced by M. Steiger and Dr. T. Reichstein. This, the authors state, is the first instance of a substance with high biological activity (tested on dogs and mice from which the adrenal glands have been removed) and brings nearer the final elucidation of the molecular structure of corticosterone.

Sir Napier Shaw directs attention to the fact that our knowledge of the relation between wind and pressure distribution is based on experience in temperate latitudes and is not applicable to equatorial regions. He appeals for further data to enable meteorologists to deal with the latter conditions.

Two-dimensional crystallinity is deduced by N. A. Shishacow in the case of vitreous silica and pumice, from their electron-diffraction patterns, which show well-defined rings. The author gives a table of intensities and Bragg spacings, as deduced from the electron diagrams of some clays and pozzolanes.

When pure nickel wire of diameter $\frac{1}{8}$ in. has been plated with a thin skin of copper and heated to a temperature of 1,030° C. in hydrogen, Dr. T. F. Wall finds that a maximum permeability of 3,250 is attained. When demagnetized from an induction density of 5,150, the coercive force is 0·24 and the remanent induction density is 1,270.

The fine structure of the so-called '3*A*' bands of the carbon monoxide spectrum in the ultra-violet (2200–2600 A. region) obtained by means of a high-intensity discharge between carbon electrodes in neon gas is described by Dr. R. Schmid and Dr. L. Gerö.

The distances between various atoms in the molecule of bromsilicichloroform BrSiCl$_3$, as obtained by means of electron-diffraction measurements, are given by Prof. M. de Hemptinne and J. Wouters. From the nature of the experiments, the accuracy of the determinations is not the same for all atoms, being greater for the distances between chlorine and bromine than between these and silicon atoms.

Details of comparative experiments on fire-walking, under controlled conditions, carried out by an Indian professional and an English amateur are given by Harry Price. Neither suffered injury. Though the professional took four steps to the amateur's three, the slow motion film shows no superiority in walking technique on the part of the professional.

Prof. S. Chapman, referring to the use of the letter *H* by Burbury to designate, in 1890, Boltzmann's entropy function (for which Boltzmann himself had used the symbol *E*), inquires if any reader can account for the use of the letter *H* in this context at an earlier date.

Research Items

Anthropometry of Beaver and other Indians of Canada

In the third of a series of reports on the physical characters of Canadian Indians of Athapascan stock, Mr. J. C. Boileau Grant analyses observations of Beaver Indians made by himself in 1929, and compares them with measurements of Sekani and Carrier Indians made by Mr. Diamond Jenness in 1923 (*Nat. Mus. Canada, Bull.* 81, Anthrop. Series, 18). Out of 185 individuals measured by Mr. Grant only pure Beaver, 35 men and 13 women, are considered. The Sekani and Carrier number 35 men and 31 women. Taken as a whole in one group, these people are short in stature, broad-headed with very high cephalo-facial index, ranging by tribes from 96·2 to 98·4 for the men, and from 95·5 to 96·4 for the women. A notable feature is the high percentage of eyes of a lighter shade among the Carrier and Sekani Indians. The principal measurements and indices (men) are as follows: Beaver—stature, 168·3; cephalic index, 80·5; cephalo-facial index, 96·8; facial index, 82·9; nasal index, 70·6. Carrier and Sekani—stature, 169·7; cephalic index, 81·4; cephalo-facial index, 96·2; facial index, 84·5; nasal index, 70·5. Compared with measurements of Chippewayan, they show that the Chippewayan are shorter in stature, have a lower cephalic index, a longer head, and a greater cephalo-facial index. A further notable feature in the observations of the Beaver is the high percentage of the *A* group in the blood group observations, which is remarkable in view of the stress laid on their racial purity. Of forty observations, twenty-one were *O* and nineteen *A*, which is quite at variance with observations made among the Chippewayan in 1928 (80 per cent, 10 per cent, 10 per cent and 0 per cent), and observations by Ruggles Gates on the Mackenzie River (85 per cent, 15 per cent, 0 per cent and 0 per cent). The blood of sixty-one various other Indians and mixed breeds in the Peace River area, from which the Beaver were taken, showed a similar distribution to the Beaver. There is evidently an unusually high distribution of the *A* group in the Peace River area.

Influence of Recreation on Sedentary Workers

An interesting account is given in the January-February issue of the Polish journal, *Przeglad Fizjologii Ruchu* (Review of the Physiology of Movement), by Dr. W. Missiuro of an investigation on the effect of active recreation upon the output of female sedentary workers. These were between twenty-two and twenty-nine years of age, engaged (seated) in teams of eleven in making shoes. A daily ten minutes interval for physical exercise was introduced, and produced favourable results upon the health and the output of the workers. Dr. Missiuro made a comprehensive physiological study of the effect of this active recreation upon the individual's intake of oxygen and output of carbon dioxide, rise in energy consumption, pulse frequency, 'hæmoglobin value', urea, chloride and sugar content of blood and urine, etc. Among the results observed were a definite diminution of diuresis during work. No case of increase in acidity or albumen in urine was recorded. Perhaps the improvement was most marked in its psychological effects.

Studies of the Grasshopper's Egg

The formation of the membranes of the acridian (grasshopper) egg has been re-investigated by Eleanor H. Slifer (*Quart. J. Micro. Sci.*, 79. Pt. 3, March 1937, p. 493). She finds that in four species of different genera, the eggs possess a delicate vitelline membrane, as described by earlier, but overlooked by recent, investigators. In eggs of *Melanoplus differentialis*, the yellow cuticle is deposited by the serosa at 25° C. during the sixth and seventh days after laying. As soon as this layer is completed, the serosa begins to deposit a second layer, which is white, very tough, and though fibrous in appearance is chitinous in composition. So tough is this membrane that it would prove an obstacle to the emergence of the young grasshopper, but three days before hatching it begins to be dissolved by an enzyme, so that finally the merest trace of it remains. It has been supposed that this enzyme is secreted from the embryo's mouth, but Miss Slifer shows that this is not the case. She applied ligatures at various levels to a series of eggs due to hatch seven or eight days later, so as to isolate the digestive fluid in different regions, if present. The enzyme was finally located in the region of the pleuropodia (appendages of the first abdominal segment), and its formation by these structures was confirmed by removing them. After this operation, the white cuticle remained undissolved, and the embryos in the eggs, though working vigorously to free themselves, were unable to do so. The pleuropodia of *M. differentialis* are trilobed stalked bodies about ⅛ mm. in diameter, and are made up of a single layer of very large cells. Similar structures occur in other insects, and their function has long been a puzzle; possibly, it is the same as in the grasshopper.

Snakes of Maryland

The Natural History Society of Maryland is credited by the publication of a well-printed and illustrated pamphlet on the snakes of Maryland (pp. 103+10 plates) by Dr. Howard A. Kelly, A. W. Davis and H. C. Robertson (Baltimore: Natural History Society of Maryland). The Maryland snake fauna comprises 26 non-venomous and 2 venomous snakes, the copperhead and timber rattlesnake. The identification of the species is simplified by keys to the salient characters of adult and young individuals, by short descriptions of form, coloration and habits, and by excellent plates in colour and photographs. A general introduction and a chapter on the treatment of snake bites completes the work. One cannot but admire the presence of mind of the individual who, being breathed upon by the dreaded blowsnake (a harmless puff-adder), immediately "took a pint of whisky to quiet his heart, and couldn't work again for two years".

Mole Crickets and their Allies

The attention of students of insect morphology is directed to an elaborate paper by F. Carpentier on the structure of the thorax in mole crickets and their allies (*Mém. Mus. Roy. d'Hist. Nat. Belgique*, Fasc. 4; 1936). For a long time past, true mole crickets have been grouped with the series Gryllotalpides, while certain other forms or false 'mole crickets' constituted the Tridactylides. The author examines the detailed structure of the thorax, wings and legs and, on the basis of the morphological criteria thus afforded, assesses the mutual affinities of *Gryllotalpa*, *Tridactylus* and *Cylindroryctes*.

Care of Ornamental Trees

THE contribution which certain trees and shrubs can make to garden beauty is so great that the gardener naturally desires to prolong their good growth as much as possible. Mr. A. D. C. Le Sueur lectured to the Royal Horticultural Society in January of this year on "The Care of Ornamental Trees", and the text of his lecture appears in the Society's *Journal* of April (62, Pt. 4, 141–152). Many factors of disease, of damage by birds, and of the interaction of urban conditions, are discussed. The beech disease, caused by the insect *Cryptococcus fagi*, is deemed to be only a secondary infestation which masks some previous weakness of nutrition, or prior attack by a virulent fungus. Slimy fluxes from wounds of various trees sometimes prevent their healing, but a thick application of hot tar will provide effective treatment. The action of lightning, and damage by electrical transmission lines, may cause wounds upon desirable trees. It is interesting to find the statement that groups of trees may be killed as a result of electric discharge when the earth acts as a positive potential during thunderstorms. Poisoning of trees by coal gas escaping from defective mains, or by sewage leaking from pipes or cesspools, are two factors which may damage trees growing in an urban environment. The paper deals with the practical treatment of these, and other maladies which might diminish arboreal splendour.

Distribution of Destructive Earthquakes

IN the recent issue of the *Matériaux pour l'Étude des Calamités* (No. 37, 3; 1936), Ugo Vanni deals in great detail with the distribution of destructive earthquakes. His work is based on Milne's well-known catalogue and on its extension from 1900 to 1921. From the year 1850 onwards, he notices that Milne's catalogue becomes stable in the annual number of earthquakes, while, in the preceding half-century, the number gradually increases, the average annual numbers for the two half-centuries being 11·6 and 30·7. During the years 1850–99, Milne records 955 earthquakes of his intensity I, 366 of intensity II and 217 of intensity III. In considering the relative frequency of earthquakes in different countries, Vanni takes no account of their area. Including only shocks of the two higher degrees, he gives the following order: Philippines with 78 earthquakes, Asia Minor with 42, Italy 29 and Greece 26, while Chile occupies the eleventh place with 15, and New Zealand the thirty-fourth with 5. Or, again, dividing Milne's degree III into two grades and taking only those of the higher (corresponding to public catastrophes), he finds for the years 1850–1921 the following order: Asia Minor, China, Japan, Italy, with Chile in the eighth place and Greece in the eleventh. In the same issue of the *Materiaux* (p. 64), C. Bois continues his valuable catalogue of destructive earthquakes for the first half of 1936, during which the number fell so low as 12, including five in China and Japan, three in the Balkan peninsula and two in South America.

Correlation of Ozone with Atmospheric Phenomena

AT a meeting of the Royal Meteorological Society held on April 21, A. R. Meetham read a paper dealing with the upper atmosphere. The author described a statistical investigation that he had made with the view of finding an explanation of the observed connexion between the total amount of ozone in the atmosphere and various other geophysical phenomena, including the distribution of barometric pressure at sea-level—which last has for some time past been known to be correlated in some way with the total amount of ozone. The author obtained correlation coefficients between the daily values of the ozone, after these last had been corrected for their known annual variation (maximum in April), and a number of variables in the upper air such as the height of the tropopause and pressure and temperature at various points in the troposphere and the stratosphere. He found that the ozone was more closely connected with entropy and potential temperature in the stratosphere than with any other function of pressure and temperature, or with any other geophysical phenomenon yet investigated. The last part of his paper is occupied with a very speculative attempt to arrive at an explanation of the statistical results, and in it the author is obliged to assume that there is an appreciable amount of vertical circulation of the air in the stratosphere, notwithstanding the very stable distribution of temperature in that region, an assumption that will not readily be acceptable to meteorologists in general.

Photosensitized Reactions involving Deuterium

DURING the past two years, Prof. H. S. Taylor and his collaborators have studied the mercury photosensitized reactions between methane and deuterium, tetradeuteromethane (CD_4) and hydrogen, and methane and CD_4. Of the processes which occur, some yield deuteromethanes of varying deuterium content whilst others give condensation products of the hydrocarbon (*J. Chem. Phys.*, **5**, 212; 1937). The composition of the deuteromethanes in the reaction products is estimated quantitatively by comparing the relative intensity of absorption of a particular mixture at various characteristic wave-lengths in the infra-red with the values for 'standard' compounds of definite deuterium content (*ibid.*, **5**, 1; 1937). From a study of the influence of temperature and light intensity on the reaction, it has been shown that the reaction processes must be interpreted by a chain mechanism. The rates of exchange in the reactions CH_4+D_2 and CD_4+H_2 are practically identical and much more rapid than in the reaction CH_4+CD_4. The products of the condensation reactions are saturated hydrocarbons at all temperatures, except 490° C., where small traces of unsaturated hydrocarbons were identifiable. It was also found that methane condensed to a greater extent in the presence of deuterium than in the presence of hydrogen. Below 200° C., the recombination of methyl radicals and atomic deuterium, both produced in primary processes, probably predominates; at 200° C. there is mostly exchange between methyl radicals and deuterium molecules yielding CH_3D and D; whilst around 300° C. the exchange is effected most probably by $CH_4+D \rightarrow CH_3+HD$. The condensation process is thought to take place by recombination of alkyl radicals. On the basis of these processes, the experimental data have been satisfactorily interpreted.

The Museums of India*

THE report of the Museums Association on the museums and art galleries of India completes a series of reports, which not only comprises a full directory of the museums of the British Empire, but also contains critical commentaries on every phase of their activities. In the course of six or seven years, nearly two thousand museums in all parts of the Empire have been visited. The funds for this survey were provided by the generosity of the Carnegie Corporation of New York, excepting the grant for the British survey of 1926–27, for the expenses of which the Carnegie United Kingdom Trust was responsible.

The survey of the museums of India began in October 1935. It was carried out by Mr. S. F. Markham, M.P., Empire secretary of the Museums Association, and Mr. H. Hargreaves, formerly director-general of archæology in India. Personal visits were made to the greater number of the museums of India, and for purposes of comparison Ceylon, Malaya and the Dutch East Indies were visited. The funds, as already mentioned, were provided by the Carnegie Corporation of New York, to fill the gap in the Empire survey, but on the distinct understanding that assistance could not be provided for the Indian museums, such as had been made available for the museums of the Empire.

In a brief historical survey the report points out that the institution of museums in India began so long ago as 1796, when the Asiatic Society of Bengal decided that the many curiosities it had accumulated should be suitably housed in Calcutta. Donations were invited; but the plan proved premature, and it was not until 1814 that the Society was able to establish a proper museum. The scope of the museum was defined as "the illustration of Oriental manners and history and to elucidate the peculiarities of art and nature in the East". After persistent pressure, official financial assistance was received from the Court of Directors of the Honourable East India Company in 1839, a grant being made for the salary of a curator, and the Government of India was authorized to make grants for special purposes. Four years previously the Government itself, being anxious to develop the country's mineral resources, had decided to found a Museum of Economic Geology in Calcutta. This was opened in 1840. The Central Museum of Madras was opened in 1851 as the result of a decision of the East India Company, "impressed with the advantage of storing up in some one place the knowledge and the material which had been acquired by the investigators working in different parts of the Peninsula, and with the object of fostering scientific enquiries and pursuits". This was due to the activity of the Madras Literary Society, a branch of the Royal Asiatic Society, but the proposal was mooted so long before as 1819. By 1857 there were twelve museums in India. Further growth was checked by the Mutiny of 1857, and thereafter was slow until the jubilee of Queen Victoria in 1887. This was responsible for the foundation of a number of museums; and a further stimulus was provided, especially in the foundation of archæological museums, during the viceroyalty of Lord Curzon of Keddlestone, 1899–1907, whose personal interest and munificent benefactions did much to encourage study of Indian art and culture. The most recent development, commendable though not without its drawbacks, is the institution of museums on the sites of archæological excavation, in which the local finds are housed, while in some instances excavated buildings are preserved so far as possible intact.

It is, however, significant that notwithstanding activity since 1914, and especially in the last decade, a number of museums formerly in existence have closed, the most recent being Quetta, which has not been reopened since the earthquake of 1935. The Phayre Museum in Rangoon has been closed for thirty-three years, though the collections are reported to be still in existence.

There are now a hundred and five museums in India. These have a quadruple origin: first, the scientific museums at the great centres of government established by the Governments and their European servants; secondly, the museums established by the Indian States, which have followed this example; thirdly, the local museums established by the Archæological Survey; and fourthly, the museums created by the teaching institutions and learned societies for their own requirements. The great majority of the museums are under Government, municipal or provincial control. It is noted, however, that there are fifteen towns with populations of more than 100,000 which have no public museums. Nowhere, except in China, it is pointed out, are there so many large towns without a public museum. Burma, with a population of more than fourteen millions, has no Provincial Government museum which is now open. Yet 35,000 visitors annually pass through the small Palace Museum at Mandalay.

Neither in British India nor in the Indian States, the report points out, have museums been distributed in a rational manner—some of the smaller towns, such as Dehra Dun, have museums of which any great city could be proud, while populous centres, such as Ahmedabad or Amritsar, have no museum at all. There is not a single province or Indian State that does not compare poorly with the leading countries of Europe, the British Commonwealth or the United States. In fact, with the exception of the most backward countries of the world, there is not an area where museums count for so little, are so meagrely supported, or are so few and far between.

Finance repeats the same story in another idiom. The financial provision for the museums is absurdly inadequate. The total amount spent on the one hundred and five museums is no more than £58,000 per annum, and out of this the largest five museums have an income larger than the remaining hundred put together. The total amount, in fact, is less than is spent on a single great museum in the capital cities of Europe or America.

It is not difficult to diagnose the causes that lie at the root of most of the defects in the provision of museums in India. A general apathy and neglect, combined with and in part the cause of an inadequate provision of funds, is responsible for failures in maintenance, an insufficiently high standard in staffing, both as to numbers and qualification, and a lack of energy in administration, which has failed to keep abreast of museum development in other countries, while allowing exhibits to deteriorate and perish through neglect of proper care and attention. Unless immediate steps are taken, the report says, proof of India's cultural greatness in past time, of her technical and artistic skill in perishable materials, will vanish for ever from India itself and will only be found in the vast repositories of Europe and elsewhere.

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* The Museums of India By S. F. Markham and H. Hargreaves. Pp. v+229+25 plates. (London: The Museums Association, 1936) 5s. net.

Notwithstanding the illiteracy of the population, generally estimated at ninety per cent, the inadequacy of the museum cannot be excused on the ground of the lack of interest of its public. It is stated that during a recent festival in Madras, no less than 130,000 individuals passed through the Museum in one day, while the Mysore Government Museum, Bangalore, has 260,000 visitors annually.

As is indicated by the directory of Indian museums, which forms Part 2 of the report, the character of the Indian collections on the whole is sufficiently varied. The predominant place is taken by exhibits illustrating the archæology, history and art of India whether in specialized institutions or as part of a larger institution. The variety and extent of the fauna of India are well shown in the famous collections of the Indian Museum, in the Prince of Wales Museum, Bombay, and the museums at Madras, Nagpur and Darjeeling. The Geological Survey has four galleries in the Indian Museum, which are fully representative of the geology of India. One deficiency to which attention is directed is the inadequacy of the ethnological collections illustrating the culture of the varied peoples of India, although the collections demonstrating the culture of the aboriginal tribes at Lucknow, Calcutta, Nagpur, Madras and Trivandrum are noted. The importance of agriculture and forestry in India is responsible for the efficiency of the Forest Research Institute at Dehra Dun, with its world-famed collections devoted to botany, sylviculture, entomology, timber and other forest products, while systematic botany is covered by the Herbarium of the Royal Botanic Gardens, Sibpur, where there are more than 2,000,000 specimens There are also agricultural museums at Coimbatore and Lyallpur. The Indianization of the staffs is now virtually complete.

Of the recommendations appended to the report, the most important is that the Government should appoint immediately an Inspector General of Museums with European experience, and an assistant to be trained overseas. Further, that the constitution of the Indian Museum should be reorganized to permit the appointment of a director with full powers and freed from other duties. In view of the criticisms of the standard of staffing and of the lack of general appreciation in museum administration of advance in technique and development of museums as centres of cultural organization, special emphasis should be laid on the recommendation that the Standing Committee on Museums and Museum Conferences should be revived, and funds provided to meet the cost of Committee, travelling allowances and printing; while the provinces and municipalities are advised to provide more funds for maintenance and also adequate and competent staffs.

The Service of Unified Knowledge

MR. H. G. WELLS'S recent discourse* on the disastrous inco-ordination and waste of modern knowledge and thought concluded with a warning that "without a World Encyclopædia to hold men's minds together in something like a common interpretation of reality, there is no hope whatever of anything but an accidental and transitory alleviation to any of our world's troubles".

To Mr. Wells's appeal to the learned world to set its house in order comes an answer from Prof. A. B. Dobrowolski, director of the Meteorological Service of Poland, president of the Warsaw Geophysical Society and professor of pedagogic sciences in the Free University of Warsaw. Prof. Dobrowolski, while recognizing the potential value of Mr. Wells's project, suggests that it does not go deep enough. If men's minds are to be held together in something like a common interpretation of reality, it is essential that they should have sufficient general culture for an insight into and appraisal of the rich and complicated life of the civilized world of to-day.

This means that there must be a revival of the ideal of a liberal education and efficacious means for realizing it at a level higher than that of the secondary school. A boy or girl leaves school with a certain capacity for self-education. This capacity ought to be cherished and utilized as a means towards higher general education; but encouragement and support are needed. Society ignores the need. The universities are concerned to form, not cultivated men and women, but specialists. Such general culture as is acquired after school-days are over is derived from no systematic cultivation of the arts of observing and thinking, with study to understand and appraise the observations and thoughts of others; but from a purely haphazard succession of experiences, chance readings, conversations, attendances at exhibitions, public meetings, concerts. So, in the vast majority of cases, the intellectual worker's conception of the civilized world, his philosophy of life, if such it may be called, which will determine his reactions to circumstances throughout his life, is the haphazard product of a series of accidents, a thing of shreds and patches.

Prof. Dobrowolski suggests that the remedy lies in creating, in every university, a new 'faculty of general knowledge', the function of which would be to arouse, especially among the young, a lively sense of the value of higher general culture and to stimulate and guide efforts to attain to it through self-education. The mere existence of such an institution would be, already, a most effective piece of propaganda. Among its activities would be, in addition to classes, discussions, exercises, seminars and individual counsel and advice; also publication of specially prepared handbooks for aspirants to self-culture, since the popular manuals now on the market do not meet the case.

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* Delivered at the Royal Institution on November 20 and published as a Supplement to NATURE of November 28, 1936, under the title "The Idea of a World Encyclopaedia".

Prof. Dobrowolski has won for his ideas the support of a group of some fifteen of his colleagues, and a working model of the suggested university faculty has been brought into being under the significant name "Universitas Rediviva". For eight months, thirty students of varying ages and professions have taken part in this experiment. The work is organized in two stages: first, evening classes and exercises extending over four semesters (two years) and occupying eight hours a week; secondly, tutorial counsel given, orally or by correspondence, by various specialists, and group discussions.

The subject-matters of the course range over the widest fields: the art of thinking, general history of ideas, science and technology, art, literature, psychological sciences, economics and sociology, education, the use of leisure, ideologies and criteria of values. In practice, they are divided into six groups: (1) physics, chemistry and astronomy, with mathematics; (2) natural and geographical sciences; (3) psychological sciences; (4) social sciences; (5) pedagogic sciences, and, in relation thereto, the technique of intellectual work, conceptions of the world, philosophies, etc.; (6) art and literature.

Embracing, though it does, the whole of civilization, the programme is intended to be taken in its entirety by every student, and, in order to ensure unity of treatment the professors keep ever before themselves their common aim: the acquisition by the student of the capacity to judge, to appraise, to estimate.

Association of Teachers in Technical Institutions

THE twenty-eighth annual conference of the Association of Teachers in Technical Institutions was held in Coventry during Whitsuntide. On May 17, the president for 1937–38, Mr. W. E. Park, principal of the Technical School, Luton, was installed by Mr. W. T. Maccall, of Sunderland Technical College, who had filled the presidential office during 1936–37. A civic welcome to the Association was accorded by the Deputy Mayor of Coventry, the chairman of the Education Committee and the chairman of the Technical Schools Sub-Committee of Coventry.

"In no town more than Coventry," said Mr. Park in his presidential address, "can we see so well exemplified the changes which are so rapidly taking place. Its industries, built up on the tradition of skilled craftsmanship, are being adapted to the means of the defence of our realm, and as the adaptation proceeds the serious shortage of skilled workers and trained technicians is being realized". It is the business of technical educationists to solve such problems as these, Mr Park continued. But it must be remembered that, whatever the needs of the immediate present, the fundamental business of technical education is to serve the industrial and commercial civilization which is ours. To that end, the system must be carefully and scientifically planned. For this reason, he emphasized the value of a report on "Co-operation in Technical Education" recently prepared by a conference of representatives of the associations of local education authorities and the London County Council and issued by the Board of Education. Mr. Park directed special attention to the passages of that report which recommended consultation between authorities in regard to the provision and planning of new buildings, and the need for co-operation in connexion with the distribution and delimitation of different stages or types of instruction. Association between authorities to deal with problems of industrial regions as a whole facilitates negotiations with industrial and commercial organizations for the region, and will enable possibilities in connexion with the utilization of teachers, particularly with those possessing high qualifications of a specialized character, to be examined much more carefully than has hitherto been the case.

Mr. Park insisted that technical education will fail its ultimate purpose if it neglects training for citizenship. Merely to train technicians either for the purposes of re-armament or for the bare needs of industry and commerce would lead to the creation of a nation of robots. Hence the Association's activity in conjunction with its sister associations in producing a "Report on Education for Citizenship" which was discussed and accepted during the Conference. Whether 'citizenship' be taught directly or indirectly in technical colleges, the question of "bringing politics into the college" must be faced. It is important in this connexion to remember three things: First, that in the initial stages the social sciences are mainly descriptive and non-controversial; second, that the average teacher is conscientious and knows that he can and must distinguish between facts and his own opinions; and third, that if a scientific approach to social and political problems is not taught in the class room, young people will be left completely unprotected against propaganda in later life

Among the resolutions passed by the Conference was one which urged the release of technical teachers, after seven years' teaching service, for further periods of industrial service without loss of salary or superannuation rights. Another resolution urged the advisability of increasing facilities for the attendance of young persons at part-time day technical classes in preference to evening classes. This arrangement the Conference held to be in the best interests of students, physically and mentally, and ultimately to be most beneficial to the nation and to industry. In a resolution dealing with the Factory Act, the Conference expressed the view that no overtime should be worked by young persons less than eighteen years of age.

Science News a Century Ago

General Registration of Diseases

IN connexion with the Act for registering births, deaths and marriages in England, the issues of the *Lancet* and *London Medical Gazette* of May 27, 1837, contained the following letter signed by Henry Halford, Astley Cooper and J. Hingston: "We, the undersigned, President of the Royal College of Physicians, President of the Royal College of Surgeons and Master of the Worshipful Society of Apothecaries, having authority from the several bodies whom we represent, do resolve to fulfil the intentions of the legislature in procuring a better registration of the causes of death, being convinced that such an improved report cannot fail to lead to a more accurate statistical account of the prevalence of particular diseases from time to time.

"We pledge ourselves, therefore, to give in every instance which may fall under our care an authentic name of the fatal disease. And we entreat all authorized practitioners throughout the country to follow our example and adopt the same practice, and so assist in establishing a better registration in future throughout England."

Ventilation of Mines

ON May 30, 1837, Mr. Horne contributed to the Institution of Civil Engineers a paper dealing with a method which had been successfully adopted for the ventilation of mines by means of air forced under pressure through pipes. The pipes were 5 inches in diameter and extended a mile, and the ventilation produced, it was said, was complete. A discussion took place on the friction of air and gases passing through pipes of different lengths and diameters. It was stated that the loss on forcing gas through 1,000 feet of pipe amounted to 75 per cent; that is, if 100 cubic feet of gas were delivered through an aperture under a given pressure, only 25 cubic feet under the same pressure would be delivered through a pipe 1,000 feet long. At the same meeting, the Institution was presented with a model of one of the ribs of the centring employed in the construction of Waterloo Bridge.

Darwin on Coral Formations

AT a meeting of the Geological Society, held on May 31, 1837, Rev. W. Whewell, president, being in the chair, Darwin read a paper "On certain areas of elevation and of subsidence in the Pacific and Indian Oceans as deduced from the study of coral formations". After noticing the structure of lagoon islands, encircling reefs and barrier reefs, Darwin went on to give his views on their formation. "The theory which Mr. Darwin then offered," said the *Athenæum*, "so as to include every kind of structure is simply that as the land with the attached reefs subsides very gradually from the action of subterranean causes, the coral-building polypi soon again raise their solid masses to the level of the water, but not so with the land. Every inch lost is irreclaimably gone; as the whole gradually sinks, the water gains foot by foot on the shore, till the last and highest peak is finally submerged. The author then proceeded to offer some considerations on the probability of general subsidences in the Pacific, where many causes tend to its production, and the difficulty of explaining the existence of a vast number of reefs on one level, unless we suppose one mountain top after another becomes submerged, the zoophytes always bringing up their stony masses to the surface of the water. Subsidence being granted, it was shown that a fringing reef would be converted by the upward growth of the coral, into one of the encircling order; and thus by the disappearance of the central land into a lagoon island."

The Restoration of Condamine's Pyramid at Quito

WHEN in 1735 the Paris Academy of Sciences sent an expedition to South America to measure a degree of meridian near the equator, work was begun in a valley of the Cordilleras running about two hundred miles south of Quito. On June 3, 1837, the *Athenæum* contained a note stating that the pyramid erected in 1736 by the celebrated mathematician Condamine and his associates Bouguer and Godin, to commemorate their labours in that part of the world, having been soon after thrown down by the order of the Court of Madrid, was being restored by direction of the President Rocafuerte. The foundation stone was relaid in November 1836, on which occasion an address was given by our countryman General Miller, the Minister Plenipotentiary from Peru. In the course of his remarks, General Miller said: "I cannot pass this opportunity without recalling to mind the names of Juan Jorge and Ulloa—companions of the illustrious Frenchmen—Spaniards who prove that men most distinguished for their love of the sciences are precisely those who most endeavour to promote the welfare of humanity. The report which these two learned men made to the King of Spain, lately published under the title of 'Noticias Secretas' is a production which ought to immortalize them. It is an exact account of the abject and cruel servitude under which the unhappy aboriginal race then groaned, and, I am sorry to say still groan . . . it is to be hoped that the present enlightened President will better the conditions of these unfortunates, and that while he fosters the arts and sciences, he will as efficaciously employ his zeal in abolishing a system of tyranny a thousand times worse than slavery itself." General Miller, who was born in 1795 and died in 1864, served in the Peninsula and North America, was long associated with Chile and Peru, and from 1843 was British consul-general in the Pacific.

Chemistry and the Art of Painting in Enamel

THE June 1837 number of the *Philosophical Magazine* contained an interesting article entitled "Some Account of the Art of Painting in Enamel", by Alfred Essex, the son of William Essex (1784?–1869), enamel-painter to Queen Victoria. In the course of his article, Essex wrote: "To obtain the richness of the master-colourists it is obviously necessary that the painter in enamel should be in possession of colours capable of emulating those of painters in oil. In this, however, the artists of former times were sadly deficient. But, fortunately for this durable and beautiful art the discoveries of modern chemistry have afforded the materials to supply this long-sought desideratum. From three of the metals which till lately were known but to chemists, and which were regarded as curiosities only, namely platinum, uranium and chromium, are already produced four of the richest and most useful of the colours on the palette of the painter in enamel. And doubtless we may look to this source for the means of further improvements."

University Events

Cambridge.—Dr. J. A. Todd, of Trinity College, has been appointed University lecturer in mathematics, Dr. D. Stockdale, of King's College, and Dr. F. B. Kipping, of Trinity College, University lecturers in chemistry and Dr. P. Tate, of Christ's College, University lecturer in parasitology.

It is proposed that Prof. O. T. Jones and Prof. C. E. Tilley be appointed to represent the University at the International Geological Congress to be held in Moscow on July 21–29.

The electors to the Isaac Newton studentships give notice that an election to a studentship will be held early in the Michaelmas Term 1937. These studentships are for the furtherance of advanced study and research in astronomy (especially gravitational astronomy, but also including the other branches of astronomy and astronomical physics) and physical optics. The studentship will be tenable for three years from October 1937. The emolument of the student is £250 a year. Candidates are invited to send in their applications to the Registrary between October 8 and October 14.

The Michael Perkins Prize of £25 is awarded biennially for the best essay, on a subject to be chosen by the candidate, involving original investigation or interpretation of the natural history of animals. Candidates should send their essays to the Professor of Zoology by September 30.

London.—Mr. John Kirk has been appointed, as from October 1, to the S. A. Courtauld chair of anatomy tenable at the Middlesex Hospital Medical School. Since 1930, he has been senior demonstrator of anatomy at University College.

The title of professor of morbid anatomy in the University has been conferred on Dr. W. D. Newcomb, in respect of the post held by him at St. Mary's Hospital Medical School.

The following doctorates have been conferred: D.Sc. in mathematics on B. R. Seth (University College); D.Sc. in zoology on C. H. N. Jackson (University College); D.Sc. (Engineering) on H. J. Nichols (Northampton Polytechnic Institute).

The Petrie Medal for distinguished work in archæology has been awarded for 1937 to Prof. J. D. Beazley, professor of classical archæology in the University of Oxford.

The Dunn Exhibitions in Anatomy and Physiology for 1937 have been awarded to J. W. Paulley (of Middlesex Hospital Medical School) and Philip Harvey (of Guy's Hospital Medical School) respectively.

Oxford.—Dr. A. G. Gibson (Christ Church) has been appointed Nuffield reader in morbid anatomy while holding the office of honorary pathologist at the Radcliffe Infirmary.

Prof. H. J. Paton (Queen's College) of the University of Glasgow, has been appointed White's professor of moral philosophy as from October 1.

M. L. Jacks (Wadham College), headmaster of Mill Hill School, has been appointed to succeed Mr. George Smith as director of the Department of Education as from January 1, 1938.

Societies and Academies

Paris

Academy of Sciences, April 19 (*C.R.*, 204, 1145–1224).

Charles Achard and Maurice Piettre: The plasma of the smooth muscular fibres studied by means of the acetone method at low temperatures.

André Mercier: The equation $\nabla \rightarrow C = \alpha C$.

Paul Delens: The figures of Lemoine and of Brocard in the tetrahedron.

Louis Pasqualini: The conditions of convexity of a variety V_{p-1} of $p - 1$ dimensions plunged in Euclidian space R_p of p dimensions.

Théodore Anghelutza: A property which characterizes conformal transformation.

Paul Lévy: Integral series representing exponentials of polynomials.

Carlos Biggeri: A theorem on the singularities of analytical functions.

Léon Beschkine: A particular solution relating to rings (plane problems).

Rémy Bourgeat, Denis Cahuzac and Jacques Deullin: The phenomena presented by the calibration of velocity meters in calm water.

Pierre Chevenard and Xavier Wache: The intercrystalline corrosion of chrome nickel steels, cold hardened after tempering.

Léon Auger: The frequencies of the sounds given by a cylindrical pipe with beating reed.

Mme. Irène Mihul and Constantin Mihul: The ionization of the upper part of the atmosphere. The varying heights and discontinuities in the reflecting layer are explained as being due to the variation of the electronic density gradient of the ionosphere with height with the position of the sun.

Frantz Perrier: The ionization of air by electrified dielectrics. G. Reboul explains the inversions of current produced by a dielectric discharging in an ionization chamber as the effect of the ionization of the air surrounding the dielectric, but W. Eichenberger considers that the air does not take part in this phenomenon. The author's experiments agree with Reboul's conclusions.

O. Dony-Hénault and A. de Jaer: Electrolysis with a mercury cathode. Study of the effect of stirring the mercury cathode in the preparation of sodium and potassium amalgams by the electrolysis of solutions of sodium and potassium chlorides. A new form of anode was devised (tantalum wrapped up with platinum gauze). This was found preferable to graphite for the high current densities employed.

Albert Grumbach and Félix Taboury: A new phenomenon observed in batteries with one polished electrode. The rôle of the Beilby layer.

Hannes Alfvén: The origin of the cosmic radiation. It is known that the earth and the sun are surrounded with magnetic fields, and if this is the case with the stars the rotation could set up very high electromotive forces. Charged particles accelerated by such voltages could possess the same energy as the cosmic rays. Some of the consequences of this theory are discussed (see also Nature, 138, 761 (1936); 139, 245 (1937)).

Vitomir H. Pavlović: Tesla currents applied to stroboscopy.

Ernst Olsson: The induced predissociation of the tellurium molecule submitted to intense magnetic fields. Study of the changes produced in the absorption spectrum of tellurium vapour by the Bellevue magnet, field 45,000 gauss.

Pierre Barchewitz : The (OH) and (CH$=$) bands of phenol and its derivatives between 6000 A. and 9500 A.

Jean Lecomte : The infra-red absorption spectra of some mono- and disubstituted derivatives of benzene. The symmetry of benzene.

Pierre Jolibois and Robert Bossuet : The quantitative analysis of metallic solutions by means of the spectrograph. The spark spectrum is obtained with direct current (5000 volt circuit), and an apparatus is figured securing a constantly renewed surface of cooled solution.

Jean Roulleau : The influence of the luminous intensity on the sensibility of photo-electric meters.

René Audubert : The activation energy of the photogenic reactions accompanying the thermolysis of hydrazoates. Measurements of the ultra-violet radiation emitted during the thermal decomposition of NaN_3, AgN_3 and $Pb(N_3)_2$.

Jules Guéron : The wall effect in the evolution of aqueous solutions of ferric chloride.

François Olmer : The study by photographic recording of the reduction of oxides of iron in the presence of their natural impurities.

Osias Binder : The green basic copper carbonates.

Roger Pajeau : The bromination of some aromatic compounds in the presence of beryllium and ethyl ether.

André Meyer and Paul Heimann : A new method of synthesis of derivatives of 2,4-dihydroxyquinoline (4-hydroxycarbostyril) starting from malonic esters and aromatic amines.

Antonio de Medeiros Gouvêa and Georges-Zbyszewski : New observations on the Quaternary of the coast of southern Portugal between Cap Sagres and the mouth of the River Odesseixe.

Constantin T. Popesco : The prolongation of the duration of life in the aubergine grafted on the sweet almond.

Pierre Chouard and René Castau : The tuberization of stems and hypocotyls by longitudinal diffusion of hetero-auxine.

Basile Luyet : The mechanism of cell death by high pressures. The intensity and duration of the lethal pressures for yeast. The yeast cells do not all die at a given pressure : the lethal pressure commences at about 4,000 atmospheres, under which some cells die in some minutes ; at 7,000 atmospheres all are killed in some seconds.

Jean Louis Perrot : The impregnation chamber of *Helix pomatia* and the presence of spermatozoids at this level.

Léon Képinov : The synergy of adrenaline and of the pituitary hormone. The role of the pituitary hormone in the mechanism of the glycogenolytic action of adrenaline.

R. Jonnard : The magnetic susceptibility of normal and pathological blood serum.

Marcel Lévy Bruhl, Georges Ungar and Mlle. Alberte Levillain : The production by means of bacteria, starting with urea, of a substance identifiable physiologically with histamine.

Moscow

Academy of Sciences, (*C.R.*, 14, No. 3, 1937).

M. Kravčuk : Some approximations in the generalized problem of moments.

J. Geronimus : The problem of coefficients for limited functions.

B. A. Wenkov : The automorphic group of an indefinite quadratic form.

P. A. Čerenkov : (1) Visible luminosity of pure fluids under the influence of hard β-rays. The luminosity is caused mainly by the electrons with β greater than 0·8. (2) Angular distribution of the intensity of the luminosity caused in pure fluids by γ-rays.

I. Frank and Ig. Tamm : Coherent visible radiation due to fast electrons passing through matter. A theory is put forward and supported by calculations that an electron moving in a medium radiates light even if it is moving uniformly, provided that its velocity is greater than the velocity of light in the same medium.

F. M. Šemiakin : Colour reactions of rare earths with alkaloids (3). New colour reactions with morphine and brucine are proposed. The brucine reaction may be used for colorimetric determination of cerium.

A. A. Grünberg and D. I. Riabčikov: Application of oxidometric titration for the determination of the constitution of complex compounds.

K. K. Matveiev : Occurrence of nickel in the biotite shales of the Ural emerald mines and of other emerald deposits.

A. Lebedev : Lead-bearing tourmaline from the Maly Khingan.

P. A. Kosminskij and N. P. Eršova : A new eighth linkage group in *Bombyx mori* L.

P. A. Kosminskij and N. A. Mordovkina : Inheritance of yellow colour in cocoons of *Bombyx mori* L.

Z. F. Fedorova : An investigation of inversions in the third chromosome of *Drosophila melanogaster*, and the production of new inversions which completely suppress crossing over along its whole length.

S. O. Grebinskij : Accumulation of citric acid in makhorka (*Nicotiana rustica* L.).

E. D. Bouslova and V. N. Lubimenko : Influence of luminous induction on the development of *Perilla ocymoides* (1).

V. N. Lubimenko and E. D. Bouslova : Contribution to the theory of photo-periodicity (2).

Vienna

Academy of Sciences, February 25.

E. Abel and J. Proisl : Mechanism of the lead chamber reaction. The reaction between nitric and sulphuric acids under various conditions.

Karl Vanek : Radius of curvature of plane curves.

K. W. F. Kohlrausch, A. Pongratz and R. Seka : Studies of the Raman effect (65). Various organic substances.

K. W. F. Kohlrausch and A. Pongratz : Studies of the Raman effect (66). Nitrogenous substances.

Karl Krammer : Reflection of α-rays of radium C' by heavy nuclei.

Otto Pesta : Ponds in the East Alps.

Rudolf Zimara : Observations on mammals from New Guinea.

Otto Koller : Report of a second zoological expedition to Asia Minor in 1936.

March 4.

M. Pestemer and E. Mayer-Pitsch : Influence of substituents on the ultra-violet absorption of two conjugated benzene chromophores.

O. Fruhwirth : Study of the association of water by measurements of dielectric polarization.

M. Pestemer and O. Fruhwirth : Ultra-violet absorption and orientation polarization of the binary systems acetone-benzene and nitromethane-carbon tetrachloride.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Lecturer in Mechanical Engineering in Armstrong College, Newcastle-upon-Tyne, 2—The Registrar (May 31).

Demonstrator in Mathematics in the City and Guilds College—The Secretary, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W 7 (May 31).

Museum Assistant for the Woolwich Borough Museum—The Town Clerk, Town Hall, Woolwich (June 4).

Assistant in Biology and Pharmacy in Dundee Technical College—The Clerk and Treasurer, Bell Street, Dundee (June 5).

Editor of *Science Abstracts* (Electrical Engineering Section)—The Secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2 (June 7).

Curator in the Horniman Museum, Forest Hill, S E.23—The Education Officer (G.P /M), County Hall, S.E 1 (June 10).

Assistant Lecturer in Physics in the University of Manchester—The Registrar (June 12).

Assistant Lecturer in Geography in the University of Bristol—The Registrar (June 14).

Forest Officer in the Forest Service of Burma—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (June 18)

Research Engineer for the Institution of Automobile Engineers, Great West Road, Brentford, Middlesex—The Secretary

Chemists for the War Department Chemist—The Under-Secretary of State (C.5), The War Office, S.W.1 (quote Appts./30).

Assistant Secretary of the Council for the Preservation of Rural England—The Secretary, C.P.R.E., 4 Hobart Place, S.W.1.

Assistant Civil Engineers in the Air Ministry—The Secretary (W.9), Room 712, Air Ministry, Adastral House, Kingsway, London, W C.2.

Instructor Lieutenant (mathematics, chemistry, physics or engineering) in the Royal Navy—The Director, Education Department, Admiralty, S.W.1.

Assistant Divisional Engineer in the Sudan Irrigation Department—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1.

Assistant Teacher of Electrical Engineering and Assistant Teacher of Mathematics in the Acton Technical College, High Street, W.3—The Principal (June 4).

Demonstrator in Mathematics in the University of Cambridge—Dr. H. M. Taylor, Clare College, Cambridge (June 5)

Lecturer in Mechanical Engineering in the Chesterfield Technical College—The Clerk to the Governors (June 7).

Assistant Lecturer in Chemistry and Botany or Zoology or Physics in the Studley Horticultural and Agricultural College for Women, Warwickshire—The Secretary (June 7).

Demonstrator in Geology in the University of Cambridge—Dr. F. C. Phillips, Department of Mineralogy and Petrology, Downing Street, Cambridge (June 8).

Lecturer in Chemistry and Lecturer in Mechanical Engineering in the Northampton Polytechnic, St. John Street, London, E.C 1—The Secretary (June 14)

Head of the Department of Electrical Engineering and Physics in the Royal Technical College, Salford—The Director of Education, Education Office, Salford, 3.

Lecturer in Engineering in the Shrewsbury Technical College—The Clerk to the Governors, County Buildings, Shrewsbury.

Part-time Evening Instructors in Engineering, Physics and Mathematics in the Northampton Polytechnic, St. John Street, London, E C.1—The Secretary.

Official Publications Received

Great Britain and Ireland

Seale-Hayne Agricultural College: Department of Plant Pathology. Pamphlet No. 47. Thirteenth Annual Report for the Year ending September 30th, 1936. Pp. 85. (Newton Abbot: Seale-Hayne Agricultural College.) [284

Ministry of Health Report on an Investigation into Maternal Mortality (Cmd. 5422) Pp 353. 5*s* 6*d*. net. Report on Maternal Mortality in Wales (Cmd. 5423.) Pp 156. 2*s*. 6*d*. net (London: H.M. Stationery Office.) [294

Memoirs of the Cotton Research Station, Trinidad. Series A, Genetics, No. 14. Cytological Studies in Cotton, 4: Chromosome Conjugation in Interspecific Hybrids. By A. Skovsted. Pp. 97–184+3 plates. (London: Empire Cotton Growing Corporation) 2s. 6d. [294

Technical Publications of the International Tin Research and Development Council. Series A, No 52 The Tinning of Steel Strip by Electrodeposition. By D J. Macnaughtan, W. H. Tait, S. Baier and J. C. Prytherch. Pp ii+36+8 plates. Series B, No 3: The Use of Tin in Refrigerating Equipment. By E. J Daniels and D. J. Macnaughtan Pp. ii+8 (London: International Tin Research and Development Council) Free. [294

Annual Reports on the Progress of Chemistry for 1936. Vol. 33. Pp. 512. (London. Chemical Society.) 10*s*. 6*d*. [304

Institution of Professional Civil Servants. Annual Report of Council for the Year 1936. Pp. xiv+54. (London. Institution of Professional Civil Servants.) [304

Other Countries

Ministry of Agriculture and Fisheries. Fifth Progress Report of the Foot-and-Mouth Disease Research Committee. Pp. 386+26 plates. (London H.M. Stationery Office.) 7*s*. net. [75

Survey of India. Geodetic Report, 1936. Pp. iv+97+19 plates. (Dehra Dun: Survey of India.) 3 rupees; 5*s*. 3*d*. [35

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1936. Pp. 27. (Entebbe: Government Printer.) 3*s*. [35

Université de Liège: Institut de Physique. Univers isomorphes et constantes physiques. Par Prof. L. Counson. Pp. 40. (Liège: Éditions E.D K.) [35

Tanganyika Territory: Department of Lands and Mines, Geological Division Bulletin No. 9: A Stratigraphical Classification and Table of Tanganyika Territory By F. B. Wade. Pp. 60. (Dar es Salaam: Government Printer) 4*s*. [35

Annual Report of the Indian Institute for Medical Research, 1935–36. Pp. iv+84. (Calcutta: Indian Institute for Medical Research.) [35

Transactions of the National Institute of Sciences of India. Vol. 1, No. 10: The Characteristic Properties of Colloidal Solutions of Acidic Substances which distinguish them from Acids in True Solution. By Dr. J. N. Mukhurjee, R. P. Mittra and S. Mukherjee. Pp. 227–292 (Calcutta: National Institute of Sciences of India.) [35

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol 22, Memoir No. 6: A Permo-Carboniferous Fauna from South-West Persia (Iran). By Dr. J. A Douglas. Pp. v+59+5 plates. (Calcutta: Geological Survey of India.) 4.4 rupees; 7*s*. [35

Union of South Africa: Department of Commerce and Industries, Fisheries and Marine Biological Survey Division. Report No. 13, for the Year ended December 1935. By Dr. Cecil von Bonde. Pp. 56+3 plates. (Pretoria. Government Printer) [45

Department of Science and Agriculture, Jamaica Bulletin No. 6: Insecticides to Control Insect Pests in Jamaica By W. H. Edwards. Pp. iv+50+4 plates. Bulletin No 7 Dairy Farming in Jamaica. By J. W. Howe. Pp. 32. Bulletin No. 8: A Survey of the Yields of Sugar Cane in Jamaica, 1934–1935. Report by H. H. Croucher. Pp. ii+47. (Jamaica Government Printing Office.) [45

University of Denver: Department of Anthropology The Archaeological Survey of the High Western Plains. Ninth Report: Northeastern New Mexico, Seasons 1929, 1934 and 1935. By E. B Renaud Pp. 68. (Denver, Colo.: University of Denver) [75

U S. Department of Agriculture. Farmers' Bulletin No. 1768. Trapping and Transplanting Live Beavers. By Leo K. Couch. Pp. ii+18. (Washington, D.C.: Government Printing Office) 5 cents. [75

U.S. Department of the Interior: Office of Education Bulletin, 1936, No 13: The Deaf and the Hard-of-Hearing in the Occupational World Report of a Survey directed by the U.S. Office of Education. By Elise H. Martens, with the collaboration of Kenneth Braly, Percival Hall, Jr, Helmer Myklebust, Sam D. Palmer, Alice F. Rowell, Isabelle Walker. Pp. x+95 (Washington, D.C.: Government Printing Office) 15 cents. [75

Department of the Interior. Palæontological Bulletin No 2: The Larger Foraminifera of the Lower Miocene of Victoria. By Irene Crespin Pp. 15 (3 plates). (Canberra: Commonwealth Government Printer) [105

Memoirs of the Geological Survey of India. Vol. 69, Part 1: The Mineral Deposits of Eastern Singhbhum and Surrounding Areas. By Dr. J. A. Dunn. Pp. ix+279+xxiii+23 plates. (Calcutta: Geological Survey of India.) 9.8 rupees; 16*s*. [105

Industrial Research Bureau. Bulletin No. 8: Development of the Heavy Chemical Industries in India. By N N. Sen Gupta. Pp vi+45+9 plates. (Delhi: Manager of Publications.)

Bulletin of the American Museum of Natural History. Vol. 73, Art. 2: Abnormal Dentition in Sharks, Selachii. By E W. Gudger. Pp 249–280. Vol. 73, Art 3: Results of the Oxford University Sarawak (Borneo) Expedition—Bornean Stingless Bees of the Genus Trigona. By Herbert F. Schwarz Pp. 281–329. (New York: American Museum of Natural History.) [115

Field Museum of Natural History. Report Series, Vol. 11, No. 1: Annual Report of the Director to the Board of Trustees for the Year 1936. (Publication 382.) Pp 147+14 plates (Chicago. Field Museum of Natural History.) 1 dollar [115

Catalogues, etc.

The Chainomatic Balance. Pp. 4 Microid Balances, Weights and Accessories Pp. 12 Microid Stainless Steel Analytical Weights. Pp. 6. (London: Griffin and Tatlock, Ltd)

Die Askania-Warte. Nr. 1, October 1936. Pp. 20. Nr. 2, Dezember 1936. Pp. 24. Nr 4, März-April 1937. Pp 24. (Berlin-Friedenau Askania-Werke A.-G)

Apparatus for the Measurement of Dielectric Constants. (Dipol 36.) Pp. 8. (Delft: P. J. Kipp and Zonen; London: W. Edwards and Co)

Cambridge Dynamometers and A.C Test Sets. (Folder No. 57) Pp. 6. (London. Cambridge Instrument Co, Ltd.)

The Kodak Clinical Camera Outfit. Pp. 12. (London: Kodak, Ltd)

Botanica Generalis. (No. 92.) Pp. 66 (Den Haag: W Junk.)

Billige Bücher aus allen Gebieten der Unterhaltung und des Wissens. (Antiquariats-Anzeiger No. 168) Pp. 70. (Leipzig: Gustav Fock, G.m b.H.)

Eastman Organic Chemicals. List No. 28. Pp. 124. (Rochester, N.Y.: Eastman Kodak Co)

Apparatus for Testing Petroleum, Tar, Asphalt and their Products. (List No. 96A.) Pp 64. (London A. Gallenkamp and Co., Ltd.)

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No. 3527 SATURDAY, JUNE 5, 1937 Vol. 139

Freedom of the Mind

OUR civilization is clearly separated from all that have gone before by its reliance upon science. Science makes certain demands on social environment, and among the chief of these is surely freedom of the mind. Without such freedom, our scientific system could not exist or progress : without it, representative institutions cannot be maintained. Milton saw these things very clearly, and it was in the early days of the Royal Society that he wrote :

> ". . . True Liberty
> . . . always with right Reason dwells
> Twinn'd, and from her hath no dividual being.
> Reason in Man obscured or not obeyed
> Immediately inordinate desires
> And upstart passions catch the Government
> From Reason, and to servitude reduce
> Men, till then free."
> "Paradise Lost", Book XII, 83-90.

We are witnesses of the simultaneous destruction in several parts of the world of the twins—liberty and reason—and the consequent deterioration of science. We see reason not only obscured and disobeyed but even ousted by unreal creatures of the imagination—'racial consciousness', 'national self-sufficiency', 'the leadership principle'—or one or other of the chimæras of the totalitarian States. Some peoples have been caught thereby from reason, so that the desires and passions of their Governments have already reduced men to servitude, and are on their way to reduce science to nothingness. We have seen a great country, until of late rightly proud of its universities and its scientific achievements, abandoning its belief in reason, destroying the careers of a fifth of its scholars and, by rendering the position of all insecure, humiliating the profession of learning itself and lowering the whole standard of its civilization.

For, let it be remembered, civilization must depend upon a small minority. Our present civilization is upheld by the critical and creative efforts of a few, whose judgment and knowledge ultimately determine the values of the rest. Only in an atmosphere of freedom can such men make their contribution to their own communities and to the world. The need for the Society for the Protection of Science and Learning to save for the freer parts of the world the learning rejected by these slave States, is the measure of the destruction of freedom.

It is an experience, gathered from history, that the great periods of intellectual activity follow the coincidence of the discovery of important new facts with the wide extension of a sense of personal liberty. Of this relation a fortunate illustration is provided by the seventeenth century, which saw both the foundation of English ideas of liberty and the establishment in England of the scientific disciplines. On these two foundations have been built most of the good things that make up our national life. The other democracies—and it is among democracies only that science seems now to flourish—have had a comparable experience.

The rise in the social valuation of freedom of the mind has, therefore, been of incalculable importance for science. Unfortunately, this great movement has had its own vicissitudes and has brought with it its own dangers. In the eighteenth century, science was still confined to a very small class, within which free opinions passed as common intellectual currency. With the emergence of the liberating influences of the French Revolution, such opinions came to be greatly feared. Active measures were taken to stifle them when expressed freely, though if buried in expensively printed works the Governments of their day could afford to treat them with contempt. When the 'atheist' William Godwin brought out his "Enquiry concerning Political Justice and its Influence on Morals and Happiness" in 1793, it escaped prosecution only because the authorities supposed that little harm could be done by a three-guinea publication! Soon, however, the technical and industrial triumphs of science won it new prestige, so that during the later Victorian age, freedom of the mind came to be less feared. Gradually there came another change. With compulsory State education, the proportion of literates increased enormously. Moreover, new channels were found for the passage of ideas. Cheap printing, a new technique of daily journalism, and then the cinema and the wireless, have increased again the danger of ideas to those who fear them. Inordinate desires and upstart passions have now again caught Governments from reason, and man has again been reduced to servitude. The very products of science have been used to suppress the spirit of science.

Of all forms of checks on reason, that on the universities is the most dangerous and destructive, for it strikes many of those best equipped to determine social values. The totalitarian States have not failed to perceive this. National Socialism is the form of totalitarianism that has been most destructive of science, and National Socialism is, as its exponents never tire of explaining, an attempt to exalt instinct at the expense of reason. Last year, at the celebration of the so-called 'jubilee' of the University of Heidelberg, which was timed to coincide with June 30, the day of the great political massacre of 1934 in Germany, the Minister of Education, Herr Rust, delivered a speech in which he exalted the so-called 'racial instinct' over the disinterested pursuit of scientific truth. The day of the supremacy of the intellect, he assured us, is over. Under National Socialism, through its agent, Herr Rust, who has no sympathy with the great tradition of free thought, the universities have been regimented and those who do not share national socialist views have been eliminated. Science has thereby been degraded and German men of science have been made subservient to the engineers of a ruthless political machine.

In Germany, science has always been essentially a product of university officials, and the amateur has played a minor part in its intellectual life. But now, not only are its university officials spied upon and kept under a strict rule, but even private workers dare no longer express their opinions. The printing press is as much under control as are universities. What may and what may not be published is determined by men who have repeatedly and publicly expressed their opposition to freedom of the mind. The result has been a general deterioration in the quality of scientific publications in every department from mathematics to anthropology.

Apart from this, what can be said of the scientific literature that has been discouraged or suppressed? What of all that great output of the German intellect that we might have expected during the last four years? Some of it has appeared in foreign countries as the work of men whose continued activity has been rendered possible by foreign hospitality, and what Germany has lost other countries have gained, but much of the potential output of German men of science has been altogether lost. Nor must we forget the great episode of the 'Burning of the Books' which swept as an epidemic over the university towns of Germany. That event will be long held in memory as a sign of what may happen to men by whom reason is disobeyed and the desire for liberty is lost. It is three centuries since Milton wrote words that are as vivid now as then:

> "Books are not dead things but do contain a potency of life in them to be as active as that soul was whose progeny they are. Who kills a man, kills a reasonable creature; but he who destroys a book kills reason itself, kills the image of God. We should be wary therefore what persecution we raise against the living labours of public men, how we spill that seasoned life of man, preserved and stored up in books; since a kind of homicide may be thus committed, sometimes a martyrdom; and if it extend to the whole impression, a massacre, whereof the execution ends not in the slaying of an elemental life but strikes at the breath of Reason itself; slays an Immortality rather than a Life."

Milton saw that freedom of thought is possible only under free social conditions. Many British men of science appear to be indifferent to the application of this essential principle of progress. They hold aloof from the great social questions of the day and seem to disregard the activities of forces destructive to the very world of science. We would not wish men of science to become politicians, but surely they should indicate with no uncertain voice their determination to resist those dark forces of unreason implicit in the regimes that would destroy scientific ideals.

Mathematical Biology

Biologie mathématique
Par Prof. V. A. Kostitzin. (Collection Armand Colin: Section de biologie, No. 200.) Pp. 223. (Paris: Armand Colin, 1937.) 13 francs.

THIS is an admirable little book. It does not pretend to teach a biologist mathematics: it does not deal with the ready-made mathematics (so to speak) of the snail-shell, the fir-cone or the honeycomb: it opens our eyes to a variety of biological problems which lie remote from elementary or conventional mathematics, but may nevertheless be brought under mathematical treatment with great advantage. To learn, *ad hoc*, this or that chapter of mathematics, does a biologist little good; all he wants—and what a deal it is—is to lap up something of the spirit of mathematics, to learn how the mathematician economizes thought by his symbols, simplifies argument by his equations, starts from unequivocal postulates, uses an ancient and traditional logic, and has his own unmistakable ways of saying what he knows and what he wants to know. These are the advantages, or some of them, which bring one science after another under the spell and dominion of mathematics.

The first-found alliance between mathematics and biology came by way of 'statistics', when Quetelet, prompted by Malthus, studied the growth of a population, and dealt with the stature and proportions not of men but of mankind. From Quetelet's right hand Raymond Pearl, after rediscovering Verhulst's 'logistic law', raised up the new science of demography; from his other hand Karl Pearson, valiantly helped by Weldon to begin with, took the new art and science of biometrics. The study of the growth of a population, or of the mean growth of an individual, is in neither case an easy thing. What population, higher than a cluster of yeast-cells, can be deemed simple and homogeneous? By what graph or formula can we hope to represent a creature's growth, which begins in its mother's womb, is fed by its mother's milk, bends under the sexual hormones, has its spell of untrammelled vigour, and lingers on under the burden and the disabilities of age? We must start afresh, with easier and simpler things. Imagine a population not even approximately homogeneous, but definitely heterogeneous, where half is at war with the other half, and one half is the other's inevitable and helpless prey; or again, imagine a population consisting of host and parasite. In either case, the 'growth of the population'—of the mixed or heterogeneous population—is a theme for the mathematician. Here and round about, in a class by themselves, to be dealt with after a fashion of their own, lie many curious problems; and Dr. A. J. Lotka on one side of the Atlantic, and Prof. Vito Volterra on the other, were the first to see their mathematical bearing and to devise the differential equations to which they lead. This, then, is the main but not the only theme of Dr. Kostitzin's little book, which is the first to deal in a general way with this class of problems. To the mathematician the book looks like a useful collection of examples of differential equations; to the naturalist it is obviously a well-chosen set of problems in evolutionary biology. When we realize that it is both of these rolled into one, we begin to see what an eye-opening book it is.

When we study a 'mixed population', it must be no vast and complicated 'fauna'; we may be well content if we can deal with some local association of two or three species whose lives are plainly interlinked together. Even so, their complex and changing interrelations might seem beyond the scope of mathematics, and the fact that they are not so is nothing short of a great discovery. We begin by learning to symbolize the conditions of existence by coefficients of vitality and mortality; we must be prepared for critical changes when one constituent of a population has greatly dwindled or preponderantly increased; we cannot fail to recognize a tendency towards equilibrium—but we end by discovering that equilibrium is never to be attained! An everlasting ebb and flow, a mean level and a tide, is our nearest approach to equilibrium. A typical illustration, the very one which led to what we call Volterra's law, is that of two associated fishes, one feeding on the other—call them shark and cod. While the shark are few the cod multiply; when cod are plentiful the sharks wax fat and multiply in turn; the predaceous horde plays havoc with the shoals of cod, and at length the poor sharks go short of food and their numbers dwindle. We find analogous cases everywhere. The whalers equip fleet after fleet while whales are plentiful; sooner or later the whales are reduced to vanishing point, the trade ceases to pay, and the few whales left have time to breathe and breed again; and so on, and so on, in a long, slow cycle of trade. But so simple a differential equation is soon complicated, the worse for the whale. The older whale-fishery was so eked out by seals, narwhals, walrus, bottlenose and beluga, that it went on long after the whales had grown too scarce to pay the cost of a voyage. The modern whale-fishery, again, is or was based on the great blue whale ; but increasing scarcity confers no respite or immunity on this poor monster, for less valuable species live alongside, and serve to keep the industry in being and prolong the epoch of destruction.

The lack of permanent equilibrium, the inevitable flux and reflux, may be seen everywhere : in the battles of the bulls and bears, the alternation of slump and boom, the vicissitudes of party politics and the hopeless dream of a world where there shall be no more war. From Volterra's first equation, Dr. Kostitzin (following M. E. Fischer-Piette) takes us to a sea-shore abounding in mussels, but starfish came in from every side (just as they do on oyster-beds), and the mussels soon grew few ; in the mixed population were also dog-whelks (*P. lapillus*), which feed on mussels and on barnacles, by choice the latter. In a good mussel-year mussel-spat covers everything, the rocks, the barnacles and the old mussel-shells ; the whelks turn, perforce, to a diet of mussels, and flourish exceedingly. The mussels diminish, and leave the rocks bare for a new invasion of barnacles ; and in a year or two, as these grow up, the whelks forsake the now scanty mussels, and come back to barnacles as their proper food. All these facts and phases can be easily symbolized If p_1, p_2, p_3 be the population of barnacles, mussels, whelks, then (for example) to begin with, p_1^1 (the initial population of barnacles) $= \varepsilon_1 p_1$ (where ε is a coefficient of vitality) $- h_{13} p_1 p_3$ (where h_{13} is a coefficient of interrelation, and symbolizes the effect of p_3 on p_1) $- h_{12} p_1 p_2 - h_{11} p_1^2$ (this last being the fight among the barnacles themselves for food and foothold). For each phase, for each scene of the drama so to speak, we have a new set of such equations as these ; and these several groups of differential equations combine, pass from equilibrium to inequilibrium, and show the ups and downs of one species after another. After this simple fashion, without talking over our heads, Dr. Kostitzin shows us how his differential equations are built up. It is not his fault if their solution, even their qualitative solution, turns out to be a harder matter.

The wolf, the goat and the cabbage : the great carnivorous lizards, the little herbivorous mammals and the normal vegetation of Komodo : the little mite-populations which survive when both are few, but of which one goes under when the other multiplies : the various associations of infusoria, *Paramœcium, Bursaria, Didinium* : these are a few of the cases to which Dr. Kostitzin fits his protean differentials. From vague and transitory associations we pass on to more stable relations of symbiosis and of parasitism. One of these—we never dreamed of old of its being open to mathematical analysis—is that of *Adamsia* and *Eupagurus*, the sea-anemone and the hermit-crab. The larvæ of these are free and independent, and each lives in its own country ; but we must not suppose that mere chance, apart from any pre-adaptation or predisposition, brings them together. The partnership brings its recognizable advantages, all the greater the earlier it is formed ; and while other hermits and anemones may associate temporarily and fortuitously, in this particular case they so draw together as to be at last inseparable.

The growth of a population prepares us for that of an individual organism, which is indeed a population in itself, a cluster of organs or a multitude of cells. These, *mutatis mutandis*, are alike to a first approximation ; but, to take only one of many differences, reproduction, which should be a function of all the individuals of a population, is by no means common to all the cells of a multicellular individual. The author points out, in passing, that the growth of man, from youth to age, is singularly complete and unusually instructive ; for we follow it even into extreme old age, all through the phase of senility which wild Nature cuts away, but in man alone is permitted and assisted to endure.

A short chapter follows, on the forms of living things—a somewhat trivial chapter, below the level of the rest of the book ; and the book closes with a chapter on evolution, a short one but long enough to let the author's originality appear. He points out the cardinal distinction between local and general evolution. In the world at large things really tend towards equilibrium, dropping down into their most probable state : entropy goes on increasing, and all the wheels are slowly, slowly, running down. But this does not hold for all the local, isolated cases ; the less probable gets its chance now and then. We must on no account suppose, as some did in early Darwinian days, that evolution is going on here, there and everywhere, that organisms are everywhere and evermore growing better, finer and more beautiful ; in the vast duration of geologic time and the vast range of the living, a notable step in organic evolution is always a rare and most unlikely thing. This being so, life is no negation of the law of entropy ; it only illustrates and confirms it. What, then, lies at the root of evolution ? To begin with, there is the principle of selection, the struggle for existence, through any or all of those things that in our various equations add ever so little to the coefficients of mortality. Every grade of advantage and disadvantage, every stage of disqualification up to extinction itself, may be symbolized and analysed mathematically; of selection as a factor in evolution there can be no doubt at all. Next comes the occurrence of mutations. As Jachin and Boaz, so are mutation and selection the two pillars of the house:— Given these two, the origin of species is so far explained. But when all is said and done, then ignorance lays hold of us again. Our author assumes, apparently, that the origin of species is an unlimited process and that species (or 'phenotypes') vary all but continuously and without end: but the fact is we begin by marvelling at the wealth of species in the world, and end by realizing that, in contrast to an infinite variety, they are astonishingly few. Mutation has its narrow limits, so far as ever we see: and the science of genetics does not explain the mechanism of evolution. Again, when mutations do occur, what leads to them? What chromosomes look like we know well; But what are they, and what do they really do? Biology will have come at last into its kingdom when we shall have found a simple answer to these and a few other simple questions.

D'ARCY W. THOMPSON.

Britain's Scenic Beauty

The Scenic Heritage of England and Wales
By O. J. R. Howarth. Pp. xxv+190+48 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1937.) 8*s*. 6*d*. net.

THE Councils for the Preservation of Rural England and of Rural Wales have rightly judged that their efforts may be strengthened by interesting senior pupils of our schools in that beauty which is such a feature of Great Britain in spite of the disfigurements that have been multiplied so disastrously since industrialism classed our cities under Dr. Jacks's general name of 'Smokover', and 'bungalitis' spread along so much of our coast. To the appreciation of scenic beauty our minds, variously stored with early memories and the results of study of many kinds, may bring diverse contributions, but these associations are beyond standardization and it is difficult to communicate them far and wide, so Dr. Howarth has in the main focused this book upon sheer physical characteristics, while appropriately bringing in man-made features in many connexions. Dr. Vaughan Cornish, with the artist's eye, sees that our venerable trees that have been allowed to grow in their own way, instead of being lopped as are so many on the Continent, are a splendid part of our heritage and essentially a British feature, and he has striven in an introduction to suggest the changes of the scene around the year.

Dr. Howarth bases his study upon the geology of our country, which is to such a remarkable, almost a unique, extent an epitome, in miniature, of the story of the rocks of the world; but his chapter on historical aspects exhibits a wise perspective, illustrated as it is by "Long Meg and her Daughters", for the prehistoric; Fountains Abbey and Salisbury for the ecclesiastical; and Charles Darwin's garden at Downe for the scientific phase of our social evolution. There is a very soberly written tribute to London that may be more effective than the more enthusiastic account of our incomparable capital that some of us would have composed. It is good to see that the author has learned from Lethaby. The Weald, the Chalk, the East, the Hampshire Basin, the Secondary Limestones, the Midlands, the Western Marches, the South West, Wales, the Pennines, the North-east and the Lake District are treated successively, and there are forty-eight full-page illustrations from well-chosen photographs. One hopes that the book may spread both among the general public, and, in particular, the motoring and the hiking sections of the community, as well as in the schools, and that second and third editions may soon be called for. If that is the case, the promoters of the book will be well advised if they increase still further the number of good illustrations. It is probable that we can do most in the desired direction by educating the eye, and one looks forward to such a development of this book, without increase of price, as will make pictures its mainstay, though our appreciation of the thoughtful character of the text is likely to grow.

The low and dissected plateau of newer rocks was the basis of our English nationalism and of the Puritan tradition, now become essentially conservative. Its quiet scenery, its picturesque villages, too often still needing better sanitation, its trees still shading the parish churches that are such a feature of England, all help to give it a character of its own that John Constable expressed as few others could. The wilder areas of older rocks, the south-west, Wales and the north, all with stronger infusions of the Celtic heritage that is nowhere entirely wanting, were of old the basis of warlike vigour and regionalism, of the Cavalier tradition and the associations of John Peel. But it has been their strange fate to be transformed, in patches here and there, into the industrial slums that sprawl over the West Riding, South Lancashire, the Black Country, and what were once gems of beauty like the Rhondda Valley in South Wales. So it comes about that nests of ancient survivals and hives of nineteenth century industry, not a few now half derelict, are interspersed. And now industry is spreading into the old England of the newer rocks. Have we learned our lesson ? Dr. Howarth is hopeful about Corby.

Since 1895, many beauty spots and some four thousand monuments of our past have been placed under the protection of trusts concerned solely with our heritage of beauty and our historic record. This is a worthy record of piety, but it suggests some uncomfortable questions. What will our successors preserve as the records of the Britain of industrial and commercial imperialism ? Shall we put a fence around some condemned slum area in Manchester or London and call it a historic monument ? Might we not dedicate the slagheaps and discarded railway station of Landore ? Are we not perhaps on the way towards sublimating Crewe Junction into the realms of history ? Can we not consider a recent suggestion to move the great majority of the statues of booted and frock-coated or robed worthies that encumber rather than adorn our streets and squares into out-of-the-way corners of parks ? H. J. F.

The Preservation of Food

Canning Practice and Control
By Osman Jones and T. W. Jones. Pp. xii +254 + 65 plates. (London: Chapman and Hall, Ltd., 1937.) 25s. net.

THE great changes in the conditions of life brought about by the industrial developments of the last century have necessitated an increased consumption of preserved foods. Of the various processes used in commercial practice, that of sterilizing in hermetically sealed tinplate containers—more commonly referred to as 'canning' —has rightly assumed pride of place, and foods properly preserved in this manner are not only in a form convenient to the housewife but are also at least as nutritious as similar products cooked in the home. The steady growth of the canning industry in size and efficiency has been aided throughout by researches which have covered a wide field, ranging from investigations connected with the growth of suitable raw products through the many problems associated with the technical processes of industry to studies of a more academic nature in bacteriology and metallurgy. It is a little difficult for the general food chemist to keep track of this widespread literature, and for that reason we must welcome any attempt to consolidate the existing knowledge of the science and art of food canning.

The title of the present book is perhaps a little misleading, as there is a noticeable lack of balance between the treatment of the sections on canning practice and laboratory control, and it seems a pity that the authors have limited their discussion of the practical side to about a fifth of the book. On the other hand, the chapters dealing with scientific control as applied to the duties of the works chemist or bacteriologist are more comprehensive than would appear to be necessary.

After a preliminary chapter dealing with the statistics of production and consumption of canned foods, the authors go on to describe the construction and equipment of a cannery and then give a brief outline of canning processes in general. The latter chapter can scarcely fail to be disappointing to the practical canner on account of the many very obvious errors it contains. To take but one example, it is incorrect to say that the majority of canners make their own cans, as almost every firm engaged in the canning of fruits and vegetables obtains its supplies from one of the companies which specialize in making the standard open-top can. Nor are the cans made by these companies supplied in the flattened form, this method of packing being intended only for export purposes.

Adequate space is given to methods of chemical analysis, but greater stress might have been laid on the difficulty of estimating copper in the presence of tin and iron. The bacteriological side of laboratory control occupies about a quarter of the book, and much of the descriptive matter concerning the elementary aspects of the subject could have been omitted with advantage.

The book contains much material of interest and value to the food chemist, the cultural notes on the principal food spoilage organisms being particularly worthy of mention. The text is well supplied with references, and there are many excellent illustrations, the numerous photomicrographs of bacteria being remarkably good.

F. H.

Einführung in die klassische Elektrodynamik

Von Dr. Johannes Fischer. Pp. viii + 199. (Berlin: Julius Springer, 1936.) 13.80 gold marks.

THIS small volume on the classical electric theory contains a general, but not very novel, survey of the portions of the mathematical-physical theory which are still relevant in the broader technical applications of the subject. Starting with electrostatics, the author carries his readers carefully through all the important physical ideas underlying the static field theories of Maxwell and Faraday, including the theory of dielectrics. Following this, he introduces in a small chapter the field and energy relations of the magnetostatic field, basing himself on the analogy with the electrostatic field. The first section of the book closes with a brief survey of the kinematical problems of current flow in conducting media.

In the second section, the usual laws of electrodynamics are discussed in some detail, together with their application in current theory and its bearing on the problems of electro-technics. The treatment is based on the ideas underlying Maxwell's equations, which are given in explicit form and used in the last chapters to develop the main ideas of the theory of the propagation of electromagnetic disturbances.

The author lays some stress on an endeavour to circumvent the difficulties in the assumptions underlying presentations of this subject via the æther theories, but one cannot but feel that he has been successful only to the extent to which he has avoided discussion of these difficulties. He gives, for example, the Kelvin-Larmor discussion of the polarization constituent of the total electric displacement, but says nothing whatever about the other constituent—the 'æthereal' one. His use also of the magnetic circuit to overcome some of the difficulties of the magnetic formulation really introduces more difficulties than it overcomes. He still fails to realize that the difficulties in the old-fashioned formulation of the magnetic relations all result from the use of the fundamentally faulty electric-magnetic analogy. It is also noticed that, like all Continental writers, the author still adheres to the form of the Maxwell stress deduced originally by Helmholtz by an argument which Larmor showed more than forty years ago to be physically unsound.

These are, however, perhaps small blemishes on a very brave and generally successful attempt to present in about 170 pages a reasoned account of a subject which most of us feel demands nearly four times this space. G. H. L.

The Annual Register:

a Review of Public Events at Home and Abroad for the Year 1936. Edited by Dr. M. Epstein. Pp. xii + 304 + 190. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 30*s.* net.

THERE can be few events in the political or social history of Great Britain or the Empire that escape record in the pages of this widespanned annual. A dispassionate review of the year ranges over a field wide enough to include reduction in telephone charges and non-intervention in Spain. The Dominions and India follow, and then comes a long section treating of foreign history, preceded by several pages on the League of Nations. A few States have had a year so happily uneventful as to escape inclusion in the survey, but this is exceptional.

Part 2 of the book has the usual arrangement of a chronicle of events; a retrospect of literature, art, science, finance and law. Science of the year is reviewed in epitome: much is mentioned in an extremely condensed form. Two among other general trends are noted: the growing disquiet among men of science at the frustration and prostitution of science for anti-social ends, and also the clear realization that advance in scientific thought can only come through intellectual freedom. Among the public documents published in full is the new Soviet constitution. An admirable index much facilitates reference.

The Tropical Garden

Its Design, Horticulture and Plant Materials. By Loraine E. Kuck and Richard C. Tongg. Pp. xi + 378 + 16 plates. (New York: The Macmillan Company, 1936.) 12*s.* 6*d.* net.

THE authors of this volume are writing primarily for gardeners in the Haiwaiian Islands, though, as the climate in this part of the Pacific is fairly typical of the moderate tropics everywhere, the information they give will be of use to a much wider public. They treat their subject from two angles, design and choice of suitable plants. In twenty-three chapters these two aspects are fully explored. The book is written in a popular and lively style, but is, nevertheless, scientifically accurate—as is to be expected from the list of helpers given in the preface.

The numerous photographs add to the value of the text, and the volume is well produced. A greater use might, however, have been made of italics for Latin names. The volume is a welcome addition to the rather meagre list of works on gardening in the tropics.

Technical Electricity

By H. T. Davidge and Robert W. Hutchinson. Fifth edition. Pp. x + 520. (London: University Tutorial Press, Ltd., 1936.) 12*s.* 6*d.*

WE can commend the fifth edition of this book highly. It is easy to understand, has been thoroughly brought up to date and will appeal to students, teachers and engineers. The answers are given to the problems set and many of them are completely worked out. Electrical engineers can refresh their memory about the fundamental facts of atomic disintegration, thermionic valves and photo-electric cells. They will even find something instructive said about tariffs and the British Grid. We think, however, that the authors' résumé about the laws governing the sizes of fuses and the temperature rise in cylindrical conductors could have been improved. They have not laid sufficient stress on the important part played by thermal convection currents in this connexion. A better rule than the one given is that, within certain limits, the fusing current varies as the 1·25th power of the radius of the wire. A proof is given by Russell (*Proc. Phys. Soc.*, 22, 450).

The Bermuda Oceanographical Station

By Prof. E. W. MacBride, F.R.S., Chairman of the Advisory Committee of the Development Commission on Fishery Science

THE British Government has decided to grant a sum of money in order to establish and carry on for a period of five years an oceanographical station in the Bermuda Islands. The management of the station has been vested in a Committee, of which I have the honour to be chairman, nominated by the Royal Society, and hence it seemed appropriate that I should endeavour to give to readers of NATURE an account of the reasons which led to the decision to found the station and the objects which it is hoped to attain by its activity.

At a time when taxation is so heavy in the United Kingdom, some members of the general public may think it a piece of quixotic extravagance to subsidize what might be regarded as a Colonial institution. The answer to this objection is that the station is not being established for the benefit of the Bermuda Islands but to help British fisheries.

At one time it was thought that by the artificial hatching of the eggs of our edible fish, and by then releasing the fry in the coastal waters, the fisherman's catch could be increased. Not so very long ago, haddock fry were thrown into the sea off the east coast of Scotland and herring fry were released in Loch Fyne, just as to-day lobster fry are poured into the sea near Barra Head in the Isle of Man. It was that brilliant zoologist and oceanographer Prof. Johan Hjört who first clearly showed the futility of this procedure. He pointed out that if one counted up the total number of fry hatched at one of the fishery stations and expressed this total in terms of the number of females necessary to produce them, the whole work of the station was equivalent to adding at enormous expense a few dozen female fish to the teeming millions already in the sea. The main service which fishery research can render to the fisherman is to tell him where to find his fish and what the magnitude of the catch in the coming season is likely to be.

In certain cases, however, the fishery expert can perform the additional service of proving that in some areas of the narrow seas, such as the Flemish Bight, too heavy a toll is being levied on the young fish and that the remedy for this is to make it illegal to sell fish below a certain size, and to insist on the nets used having a certain width of mesh so that the smaller fish can escape through them.

Prof. Johan Hjòrt was perhaps the first to predict successfully the future yield of edible fish and to find spawning grounds off the coast of Norway hitherto unknown. All honour should be given to him for leading the way; but as he would be the first to admit, the conditions of the North Atlantic near the coast of Norway are simple compared to those obtaining in the North Sea, in the English Channel and in the Western Atlantic where it bathes our shores. Nevertheless, by hard continuous labour and the piling up of innumerable data, which constitute the only road to success in zoological science, the fishery experts of the Scottish Fishery Board and those of our own Ministry of Fisheries, under the guidance of the chief scientific adviser, Dr. E. S. Russell, have succeeded in predicting the yield of the haddock fishery in Scotland and of the herring fishery off the East Anglian coast, in each case about six months ahead. In other areas, baffling and hitherto unsolved problems confront them. One small example of these problems may be given.

For many years, Mr. E. Ford, now vice-director of the Plymouth Marine Biological Station, has been investigating the herring fishery in the south-west area of the English Channel. He has found that during the past five or six years there has been a steady decline in the yield of this fishery and that this decline has been due to the fact that the fishermen have been drawing on the same stock of fish, which every year has been growing older and fewer in numbers. Far too few herring fry are entering the Channel to replace the losses in the older fish. The cause which Mr. Ford has found for this deficiency is the falling off in the stream of highly saline Atlantic water entering the Channel. This water is rich in phosphates and supports a large number of micro-organisms on which the fry feed. Mr. Ford has strong suspicions that the fry which should have entered the Channel are to be found farther afield; and that the fishery which the men of Devon and Cornwall exploited is now to be sought for off the south coast of Ireland.

This brings us to the central problem of British fishery research, namely, the cause of the periodic variation in the pulse of warm Atlantic water—popularly known as the Gulf Stream, though the actual Gulf Stream cannot be distinguished east of Newfoundland—which washes our shores. If we could solve that problem, we should be able to give our fishermen a guidance out of all proportion greater than that which has been so far afforded to them. The so-called Gulf Stream, as is well known, travels in a north-east direction from the coast of Florida and pours through the Faeroe Channel, north of the Shetlands, into the North Sea. Strange to say, the stream, when strong, does not bring with it an abundant fishery but the reverse. Our most valuable food-fish loathe it like poison. Poor catches of herring, haddock, plaice and sole go along with a strong Gulf Stream. This stream brings with it enormous numbers of jelly-fish of all kinds and of gelatinous algæ which are avoided by our fish. The cold current which streams down the coast of Norway—unlike the Channel water—is very rich in phosphates and gives support to an enormous multitude of minute Crustacea on which herring, haddock and plaice feed.

As most people are aware, a similar current, known as the Labrador Current, flows down the eastern shores of North America as far as Cape Hatteras, where it dives under the Gulf Stream. Its temperature is very low (in the neighbourhood of 40° F.) and yet it is teeming with life. On one occasion Prof. W. Garstang when crossing the Atlantic eastwards tested the relative abundance of life in the Gulf Stream and Labrador Currents respectively by attaching a piece of bolting cloth to the bath tap of the steamer through which sea-water freshly pumped up was continuously passing. The bolting silk was afterwards rinsed in a bottle of formalin. After a few minutes passage of Labrador water, the contents of the bottle resembled a thick opaque emulsion, whereas after several hours passage of Gulf Stream water only a few grains were found in the bottle. The Labrador Current varies in width and when it invades the territory of the Gulf Stream it causes the death of the fish which live in the warmer water. On one notable occasion the 'file-fish' (*Lopholatilus*), which is allied to our sea-bass and is prized as a food-fish in America, was found floating dead in millions at the surface of the water. The passage from Gulf Stream to Labrador Current is a dramatic experience—which has happened to me on several occasions. Leaving the north of Ireland in the early autumn, one encounters the familiar type of mild stormy weather accompanied by drizzling rain, so unhappily associated with Irish summers. The bath water was exceedingly mild, as indeed is the sea-water encountered in bathing off the Irish coast in September. In a few hours the whole aspect of the sky changed. The weather might become dazzlingly clear or grey and foggy. The temperature fell and the bath-water became icy.

We have used for the warm water the term "so-called Gulf Stream" advisedly. The term 'Gulf Stream' in the narrower sense means the

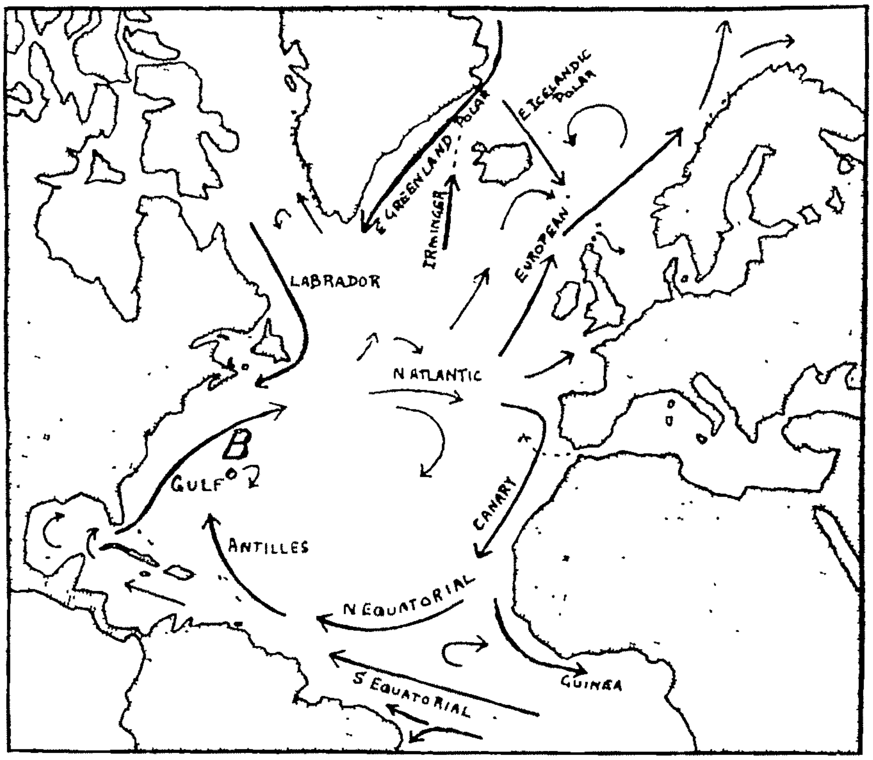

Fig. 1.
THE PRINCIPAL ATLANTIC CURRENTS. *B* = BERMUDA

water issuing from the Gulf of Mexico. But as a glance at the map (Fig. 1) will show, this current is joined by another termed the Antillean—which is fed by two currents, the North Equatorial and the South Equatorial, running west from the coast of Africa, and the water flowing through the Straits of Florida forms only one fifth of the total volume of the warm current. When this water reaches the coast of Africa, part of it turns south as the Canary Current which eventually joins the North Equatorial Current, so that it will be seen that in this way a huge vortex is constituted in the centre of which lies the calm water of the Sargasso Sea.

It is the merit of Prof. Garstang, who is a member of the Advisory Committee of the Development Commission on fishery matters, and of Dr. Robert Gurney who is a relative of the former Governor of Bermuda, to have brought before the notice of the Development Commission the suitability of the Bermuda Islands as a base for oceanographical research. The term 'islands' as applied to Bermuda is misleading. The gaps between the separate islands are so shallow that they are actually spanned by railway bridges, and the islands themselves are formed of nothing but wind-blown fragments of coral and other calcareous organisms cemented together by the deposit left by evaporating rain. It is clear that we have here the remains of a typical atoll without any trace of the peak which presumably once occupied the centre of the lagoon. Fifty miles north or south of Bermuda the enormous depth of 2,500 fathoms is reached, and Prof. Garstang has compared Bermuda to a lightship permanently moored in the centre of the ocean.

Turning again to the map, it will be seen that Bermuda (*B*) lies about 100 miles east of the Gulf Stream. Opposite it, west of the Stream on the coast of Massachusetts, is situated the Woods Hole Oceanographical Station, not to be confounded with the Woods Hole Biological Station, which is a totally distinct institution. The scheme of research planned by the Bermuda Committee is one to be carried out in the closest and most friendly co-operation with the Woods Hole Oceanographical Institute. The American corporation has a suitable research steamer, and the Bermuda Committee has appointed a sub-committee to draft plans for buying or building a suitable motor-boat. It is arranged that the two boats at suitable intervals shall penetrate about 100 miles into their respective sides of the Gulf Stream and take observations on the temperature and salinity at various depths. From these observations it can be shown that by an easy mathematical calculation the volume and velocity of the Gulf Stream can be computed and therefore the variation in volume over a series of years can be ascertained. In five years' time it is confidently anticipated that the correlation between these variations and the fluctuations in British fisheries will begin to emerge from obscurity, and the justification for continuing the research will become obvious.

As most people are aware, a Bermuda biological station has been in existence for about forty years. This is controlled by a Board of Governors of which until quite recently Prof. E. G. Conklin, of Princeton, the very distinguished American embryologist, was chairman. This corporation has in recent years endeavoured to widen its appeal by including in its number Dr. E. J. Allen, former director of the Marine Biological Association's laboratories at Plymouth, and the late Prof. J. H. Ashworth, of Edinburgh, and by appointing an Englishman, Dr. J. F. G. Wheeler, late of the *Discovery* Expedition, as director.

The investigations carried out at this station have been concerned solely with the fauna and flora of the warm water of the lagoon, as no boat was available which could safely be trusted in the turbulent oceanic water outside. The Bermuda Committee has entered into negotiations with the governors of the Bermuda station, and have been met in the most friendly spirit by that corporation. The Bermuda Committee has arranged to pay £250 a year for the rent of a portion of the Bermuda Biological Laboratory, including, of course, its equipment in tanks and water-supply. In addition, the Committee has agreed to pay half Dr. Wheeler's salary, as he, by his experience with the *Discovery* and by his local knowledge, is obviously the most suitable man to become director of the new Oceanographical Institute. The work of the Bermuda station is very intermittent and it is computed that he will be able to allot at least half his time to the Oceanographical Institute, and that indeed this work will extend the opportunities of ordinary biological workers at Bermuda, who may thus gain some acquaintance with the oceanic fauna.

The decision of the Government to support the Bermuda scheme was arrived at only on December 24 of last year and was immediately communicated by cable to the Bermuda corporation. The money is to be furnished in the first instance from the funds of the Ministry of Fisheries and thereafter by the Development Commission. As the whole scheme originated with the Commission, it may seem strange that the Commission did not at once assume the management of it. But the Commission was advised that its function was to criticize schemes put before it, not to initiate them, and the Royal Society was asked to nominate a committee to manage the new Institute. Of this Committee, Dr. Stanley Kemp, formerly leader of the *Discovery* Expedition, now one of its governors, and the new director of the Marine Biological Station at Plymouth, is secretary. The Committee met about two months ago and considered the grant of money necessary to carry out its plans; it applied for this grant to the Development Commission, which unanimously approved it. It then became possible to co-opt to the Committee two distinguished civil servants, namely, Mr. H. G. Maurice, assistant secretary of the Ministry of Agriculture and Fisheries, and Dr. E. S. Russell, chief scientific adviser on fishery matters. Needless to say, the assistance of these two members will be an invaluable addition to the powers of the Committee.

The staff to be appointed consists of Dr. Wheeler as director, a hydrologist, who will proceed to Woods Hole to be trained in the mathematical methods employed by that institute, and a director's assistant, who will be a naturalist.

It is perhaps vain to endeavour to lift the veil which shrouds the future, but it is to be remembered that the research work at Plymouth is really mainly oceanographical in character and with prophetic vision Dr. Kemp looks forward to the time when the Plymouth research will extend into mid-Atlantic and there meet in cordial co-operation with an eastward extension of the work of the Bermuda station.

Conduction of Electricity in Solids*

By Prof. N. F. Mott, F.R.S.

THE modern theory of the conduction of electricity in solids has already been applied to a large number of special problems; all that can be attempted here is a broad sketch of the fundamental ideas of the theory, together with an account of one or two of the most recent developments.

In the classical Drude theory, the conductivity of a metal depends on three quantities; namely, N, the number of free electrons per unit volume of the metal; v, their mean velocity, and l, their mean free path. Elementary considerations then give for the conductivity, σ,

$$\sigma = \tfrac{1}{2}Ne^2l/mv \qquad (1)$$

With certain slight modifications (in the quantum mechanical treatment v is actually the *maximum* electronic velocity) this formula may be transferred to the quantum mechanical treatment; the new theories are, however, important when we come to estimate N, l and v.

In monovalent metals we should expect that each atom would contribute just one to the total number of free electrons, so that N will be equal to the number of atoms per unit volume. For the alkali metals there is direct experimental evidence that this is the case. R. W. Wood[1] has shown that thin films of these metals deposited on glass are transparent to ultra-violet radiation below a certain wave-length, the transition from the opaque to the transparent region being rather sharp. Now as Zener[2] was the first to point out, one can apply to the reflection of light from a metal, provided that the absorption is neglected, the same formula as that used in the theory of the reflection of wireless waves from the upper atmosphere, namely,

$$n^2 = 1 - Ne^2/\pi m\nu^2 \qquad (2)$$

where n is the refractive index and ν the frequency of the radiation. n is real only for short wave-lengths; for long wave-lengths the right-hand side of (2) is negative and n imaginary, so that total reflection of the radiation takes place. From the observed long wave-length limit of the transparent region, therefore, N can be determined; it turns out to be quite near to the number of atoms per unit volume for each of the alkali metals. Formula (2) cannot be applied to other metals owing to the existence of characteristic absorption bands, such as the band at 3100 A. in silver.

As regards the mean velocity v of the metallic electrons, classical statistics, treating the electrons as a perfect gas, demand that their mean kinetic energy shall be $3kT/2$, corresponding to a velocity of $1{\cdot}2 \times 10^7$ cm./sec. at room temperature. The application of Fermi-Dirac statistics, first made to this problem by Sommerfeld[3], leads to the conclusion that the mean velocity has a very much greater value. The general ideas of the Fermi-Dirac statistics are most clearly seen by considering an idealized 'one-dimensional' metal, consisting of electrons free to move up and down a line of length L. We neglect first the interaction of the electrons, both with one another and with the atoms of the lattice. Now the velocity v of an electron is connected with its de Broglie wave-length λ by the well-known formula

$$\lambda = h/mv.$$

For an electron confined within a metal of length L, the de Broglie wave associated with the electron must have the form of a standing wave. The wave-length must therefore have one of the values

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* Substance of a course of lectures delivered at the Royal Institution on January 19, 26 and February 2

$$\lambda = 2L/n, \qquad (3)$$

where n is an integer, and the energy of an electron will be

$$E = \tfrac{1}{2}mv^2 = n^2h^2/8mL^2, \qquad (4)$$

For values of L of the order of a centimetre, these values of the energy will be so close together as to be practically indistinguishable, so that to all intents and purposes the energy can take a continuous series of values. Nevertheless, our quantization of the energy is of importance for the following reason. According to the Pauli exclusion principle, not more than *two* electrons can be in any one quantized state. At the absolute zero of temperature, all the electrons will be in states of as low energy as possible; thus according to formula (3) two electrons only will have the lowest energy, corresponding to a wave-length $2L$. If the total number of electrons is N, the electrons will have all wave-lengths from $2L$ down to a minimum $4L/N$. With one electron per atom, this is equal to four times the interatomic distance a. The velocities thus have all values from practically zero up to a maximum $h/4ma$; with $a = 2 \times 10^{-8}$ cm. this corresponds to $v = 9 \times 10^8$ cm./sec., or an energy of 2·3 electron volts. Similar results are obtained when the motion of the electrons in three dimensions is taken into consideration, the maximum energy being

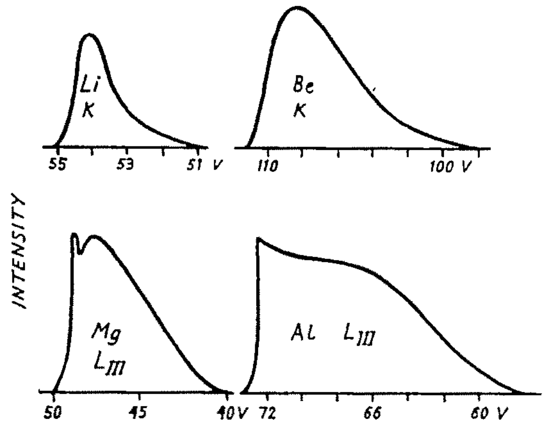

Fig. 1.

K AND L_{III}-EMISSION BANDS FOR LIGHT METALS; THE WAVE-LENGTHS ARE SHOWN IN ELECTRON VOLTS, ACCORDING TO THE EQUATION $eV = hc/\lambda$.

$$E_{\text{max.}} = \frac{h^2}{8m}\left(\frac{3N}{\pi\Omega}\right)^{2/3} \qquad (5)$$

where Ω is the volume of the metal.

At finite temperatures a few of the electrons will be excited into higher states (these electrons give a small contribution to the specific heat, linear in the temperature), but since kT is small compared with $E_{\text{max.}}$ up to the melting point, the change in the energy distribution of the electron is insignificant.

Experimental evidence that the conduction electrons have a series of energies lying in a range of several electron volts is provided by observations of the soft X-ray emission bands, of which those of O'Bryan and Skinner[4] (Fig. 1) are typical. The X-ray quantum is emitted through one of the conduction electrons making a transition to the K- or L-level; since the energies of the conduction electrons are distributed in a wide range, an emission band instead of an emission line is observed. The sharp cut-off at the high frequency limit will be noticed.

THE MEAN FREE PATH

Using values of N and v obtained in these ways, one can, by using formula (1), deduce the mean free path from the *observed* electrical conductivity; the following are some values for silver:

Temperature (degrees Kelvin)	273	76	4 2
Conductivity (ohm-cm. × 10^4) observed	6 8	36	(960)[5]
l (cm. × 10^{-4})	1·14	6	(168)

The very long mean free paths, far greater than the interatomic distance, will be noticed. These values, quite inexplicable according to the classical theory, are easily understood for a crystalline metal in terms of wave mechanics, as follows:

The model which we have used to derive the energies of the conduction electrons is highly artificial, neglecting as it does the interaction of the electrons with each other and with the ions. To remedy this, in all recent work each electron is treated as moving in the field of all the positive ions together with the *average* field of the electrons. The approximation is exactly that used by Hartree[6] in his calculation of the self-consistent fields in atoms. Thus, in a crystalline metal, if we use this model, we must think of the electrons as moving in a periodic field having the period of the lattice. In order to calculate the distance that an electron will move without being scattered we must apply the methods of wave mechanics, and picture a plane de Broglie wave moving through the metal with wave-length rather greater than the interatomic distance. We then obtain a result entirely at variance with classical ideas. Each metal ion scatters a wavelet, but since the metal is crystalline these wavelets build up a new plane wave front. There is therefore no resultant scattering of the wave. Hence, in a perfectly crystalline metal in which the ions are at rest in their positions of equilibrium, there is no scattering of the electrons and hence no resistance whatever.

Resistance in a pure metal arises from the fact that at any finite temperature the ions are not at rest in their positions of equilibrium, but are vibrating about them. The period of the atomic vibrations ($\sim 10^{-13}$ sec.) is very large compared with that of the de Broglie waves (10^{-16} sec.); the wave scattered by any displaced atom will therefore be slightly out of phase with that scattered by any other. A certain amount of incoherent scattering will take place. This incoherent scattering, and hence the resistance, will increase as the temperature is raised. Detailed calculations give good agreement with experiment both at high and low temperatures; though of course the model has proved totally unable to give an explanation of supraconductivity.

Although the periodic field of the crystal lattice does not lead to a finite mean free path, it has other effects; for example, the effective mass of an electron in a metal is found to be not exactly equal to that of a free electron. The further developments of the model, such as the explanation of the existence of insulators and semi-conductors by Wilson[7], cannot be discussed here.

Some attempts have recently been made to demonstrate these long mean free paths experimentally by measuring the resistivities of very thin wires[8], or of thin films deposited on glass[9]; obviously the mean free path cannot be greater than the thickness of the wire or film along which the current is flowing. We therefore expect the resistivity to increase for very small thicknesses. Such effects are in fact observed.

RESISTANCE OF ALLOYS

As first pointed out by Nordheim[10], the large increase in the resistance of metals due to foreign atoms in solid solution finds a ready explanation in terms of the theory. A dissolved atom taking the place of one of the atoms of the lattice will not in general scatter an electron wave of the same amplitude as the solvent atoms. If the amplitudes of the waves are denoted by A and B, the increase in the resistance will clearly be proportional to $(A - B)^2$. Since the scattering power of an atom depends on the field within it, we should expect the resistance to increase with the horizontal distance between the two elements in the periodic table. This was first pointed out as an empirical rule by Norbury[11]. More recently, Linde[12] has shown that the increase in the resistivity of copper or silver or gold due to one atomic per cent of any metal to the right of them in the periodic table is proportional to $(z - 1)^2$, where z is the number of electrons outside a closed shell (2 for zinc, 3 for gallium, 4 for germanium, 5 for arsenic). Such a simple rule is obviously susceptible of explanation in terms of this theory[13].

The explanation of the resistance given here does *not* depend on the strained state of the metal round the impurity atom. In general, the surrounding atoms will certainly be displaced from their mean positions, and this will give rise to an increase in the resistance, but the effect of this is probably small compared with the effect considered above.

The theory of the conduction of electricity in alloys is certainly capable of further development. One phenomenon to which it may possibly be applied is that of age hardening. This is generally believed to be due to the precipitation of very small crystals of solute metal from a supersaturated solid solution[4]. The resistance of an alloy during age hardening usually shows an initial increase, followed by a marked fall. The initial increase has been ascribed to strain, but this does not seem to be the only possible explanation. Since the wave-length of the electron waves is rather larger than the diameter of the solute atoms, one would expect the initial stages of the precipitation, in which small crystals of 20–30 atoms are formed, to increase the resistance. It is only when the crystals become large compared with the wave-length that any decrease in the resistance is to be expected.

If this explanation be correct, the phenomenon has a certain analogy with the passage of light through moist air. The water vapour molecules, being smaller than the wave-length of light, do not scatter it much. If, however, they condense into small drops of size comparable with the wave-length, a more or less opaque fog is formed. If they condense still further into rain drops, the atmosphere becomes again transparent.

CONDUCTION IN INSULATORS

Some light on the very complicated phenomena of photoconductivity has been shed by the recent theoretical researches of Landau[15], Frenkel[16] and others[17]. Their ideas will be illustrated most clearly by considering the alkali halide crystals, which have been investigated in great detail from the experimental side by Pohl and his school. The alkali halide crystals are built up of positive metal ions and negative halogen ions. The electrons in both these ions have the rare gas configuration, and do not make any contribution to the conductivity. If, however, an electron is added to one of the metal ions, one would expect that it would be able to jump quite easily from one metal ion to the next, and theoretical calculations[18] confirm this; such electrons ought to have a mobility of the same order of magnitude as the electrons in a metal.

If, however, a halide crystal is illuminated with ultra-violet light, a new absorption band is formed in the visible (the F-band), the rock salt thereby acquiring a yellow and silvine (potassium chloride) a blue colour. The F-band is generally recognized to be due to electrons attached to metal ions, and can be produced in other ways; for example, by heating in alkali vapour, so that positive ions and electrons diffuse into the crystal. The coloured crystal is, however, an insulator at low temperatures, and shows photoconductivity only when illuminated with wave-lengths in the F-band. It is therefore often stated that these electrons are located at internal surfaces or cracks, which might be expected to play some role in rendering the electron immobile[19]. The work of Landau shows, however, that this hypothesis is unnecessary; this will now be explained.

The large dielectric constant of polar crystals is partly due to an actual displacement of the positive and negative ions from their mean positions by an external field. The time taken to polarize the medium is of the order 10^{-13} sec., and since the electron jumps from atom to atom in a time comparable with 10^{-16} sec., it will not in general have time to polarize the medium as it goes. If, however, the electron remains in the neighbourhood of one metal ion for a sufficiently long time, it will polarize the surrounding medium, the positive ions moving into new positions of equilibrium nearer to, and negative ions farther from, the electron. The electrostatic field round the electron falls from $-e/r^2$ to $-e/\kappa r^2$, where κ is the dielectric constant. Therefore, in the field of the polarized medium, the potential energy of the electron is

$$V(r) = -\left(1-\frac{1}{\kappa}\right)\frac{e^2}{r}$$

In the 'potential hole' thus created, the electron will have a series of bound stationary states, similar to those for an electron in the field of a hydrogen atom, for which $V(r)$ is $-e^2/r$. The absorption band (F-band) corresponds to the removal of the electron from this potential hole and is thus analogous to the ionization of a hydrogen atom; the electron is then free to move through the crystal, and the potential hole disappears.

These trapped electrons have, according to Frenkel[16], a certain very small mobility, since the electron can jump from ion to ion and the surrounding ions move into displaced positions at the same time. Since by a well-known theorem of electrostatics a charged particle in a dielectric medium is repelled by any boundary of or hole in the medium, the most stable positions for trapped electrons will be as far as possible from any internal crack!

The theory of trapped electrons outlined here is quite general and can be applied to any polar solid; in future developments of the theories of the conduction of electricity in semi-conductors and insulators, it may prove of considerable importance.

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Obituary Notices

Prof. A. R. Ling

ARTHUR ROBERT LING, whose death took place on May 14, owed his career as a research chemist to the inspiration of Prof. H. E. Armstrong, under whom he studied at the Finsbury Technical College in 1883 and thereabouts. He was encouraged to work on halogen derivatives of the nitrophenols, and he afterwards extended his investigations to similar derivatives of quinones, and in this began his long association with Julian Baker. The latter was continued when, as chemist to the London Beetroot Sugar Association, he carried out his routine work in the daytime, and in the evenings and at week-ends prosecuted with Baker his extensive investigations on the constitution of starch.

It is in the fields of starch and sugar chemistry and as an authority on brewing that Prof. Ling was best known. Ling's work during the decades preceding and succeeding the beginning of the century is recognized as being of sound character, and the interpretation of many of his results in the light of present-day knowledge and concepts adds materially to the known chemistry of starch and the mechanism of its degradation by diastase. It had, among other things, the important effect of preventing a hasty acceptance of erroneous views which were widely held at the beginning of the century.

After leaving the Beetroot Sugar Association, Ling practised as a consulting chemist, his special fields being the brewing and sugar industries. From 1895, that is, the time of its commencement, until 1920, he was editor of the *Journal of the Institute of Brewing*, and for many years technical editor of the *Brewers' Journal*, work for which he was most admirably suited and which he performed in a most competent manner. During the War period his work on the subject most dear to him, starch, was apparently almost at a standstill.

In 1920 Ling was appointed professor of brewing at the University of Birmingham, where he brought about the institution of an honours degree in biochemistry of fermentation. Now with better facilities than had hitherto been at his disposal, he was able to resume his work on starch. It was one of the great griefs of his declining years that this later work was incomplete. Nevertheless, more recent knowledge of the enzymes which were present in some of the preparations used by him at that time, now known to be composite, reveals that many of the results he obtained in conjunction with Nanji can be explained, although not in the way put forward at the time. In 1931 Ling retired from the chair at Birmingham, and generously bequeathed to the University the whole of his library of scientific books and journals.

To those who were privileged to know him well' Ling was a kind-hearted man, to whose encouragement many younger men owe a great deal. His enthusiasm for research was inspiring and his knowledge of the literature in his field amazing. In his domestic life he was dogged by ill fortune, serious illness and death being frequent visitors, culminating in the loss of his wife in 1935. Notwithstanding the latter and his own persistent ill health in the last two years, he maintained an active interest in scientific and technical work right up to the week of his death.

R. H. HOPKINS.

WE regret to announce the following deaths:

Prof. Alfred Adler, founder of the Society for Individual Psychology, originally called the Society for Free Analysis, at Vienna, on May 28, aged sixty-seven years.

Prof. Ladislas Natanson, formerly professor of physics in the Jagellonian University of Cracow, on February 26, aged seventy-three years.

Prof. A. G. Perkin, F.R.S., emeritus professor of colour chemistry and dyeing in the University of Leeds, on May 30, aged seventy-five years.

News and Views

Soviet Expedition to the North Pole

THE comprehensive Soviet scheme for the exploration and utilization of arctic territories has been carried another step forward by the institution of a polar research station within twelve miles of the North Pole. An aeroplane carrying Prof. O. Schmidt and several others left the meteorological station on Rudolf Island, Franz Josef Land, in lat. 81° 47′ N. on May 21 and flew over the Pole before landing on a convenient floe. A few days later three other aeroplanes arrived with materials for the hut, instruments, stores and fuel. The way between the station and Rudolf Island has been marked every thirty miles by bombs of dye-stuff. The hut, which is of metal, wood and rubber, is to be maintained for a year. It will be in wireless communication with Moscow, which will receive daily weather bulletins. The chief object of the enterprise is meteorological research, since only casual data have hitherto been obtained north of lat. 80° N. Such data will have a practical bearing on the proposed air route between the Soviet Union and the United States. The station is, of course, afloat and is reported to be drifting at the rate of about half a mile an hour. The direction is not stated: it may be rotary or more likely towards north-east Greenland. However, so long as the station remains in a high latitude, its purpose will be fulfilled, for its location actually at the Pole has more dramatic than practical value. A moving station will certainly facilitate hydrographical work. There is little likelihood of the floes disintegrating unless they drift into a much lower latitude or approach the area of ice pressure off northern Greenland.

The Thames Barrage Proposal

A DEBATE in the House of Lords on May 26 revived the publicity given about two years ago to a somewhat grandiose scheme for impounding the tidal area of the Thames above Woolwich by means of a dam, or barrage, across the river at that point. The scheme received a notable degree of attention at the time as it presented a number of attractive features, and was put forward with considerable plausibility of argument by its promoters, who have since been busily engaged in propaganda work through the agency of an organization, called the Thames Barrage Association. That a number of the promoters' contentions are true, or rather that they have a basis of fact, cannot be gainsaid by a fair-minded critic. There are undoubted defects to which, in some degree, the scheme might afford a remedy, principally, perhaps, in regard to mitigating the pollution, by tidal reflux of sewage effluent, of the river above the suggested dam. The promoters claim that the evil would be entirely eliminated; but this could scarcely be the case in view of the direct discharge, into the area proposed to be impounded, of sewage-laden tributaries. In all probability, there would be intensification of pollution immediately below the dam for lack of current movement.

THERE are, however, other serious counter arguments which cannot be disregarded or minimized. London, in addition to being a metropolis, is a great port, one of the largest in the world, and the requirements of shipping must therefore claim an important degree of consideration. As was pointed out by Lord

Ritchie, chairman of the Port of London Authority, in opposing the appointment of a Government commission of inquiry, which was the object of the debate, the substitution of half a dozen lock entrances at the barrage for an unimpeded fairway would mean obstruction to navigation and congestion of river traffic. On last year's figures, some 43,000 ships and 463,000 craft of various kinds would have to be locked through annually: the operation, he said, would be physically impossible. Moreover, the traffic is continually increasing. Other cogent reasons against entertaining the proposal were marshalled by the Earl of Erne, speaking for the Government, who explained the antipathetic views of the Ministries of Transport and Health and of the Board of Trade. In the issue of NATURE of December 7, 1935, we said that "an enterprise of this magnitude cannot be embarked upon without a considerable degree of risk to important interests, however propitious the general circumstances may appear to be" and, in view of the announcement that the estimated outlay is 4½ millions sterling, the need for a cautious attitude is greatly increased. Indeed, the objections already put forward are of so weighty a character that the trouble and expense of a public inquiry were considered unjustified by the Government and, under protest, the motion was withdrawn.

A Suggested Botanic Garden in South Florida

THE attempts to raise tropical plants under the extremely artificial conditions imposed by a temperate climate limits greatly the scope and usefulness of botanic gardens in the latitude of North America and Europe. The suggestion, therefore, which has been put forward, to found a tropical botanic garden in the United States, is warmly welcomed; for this will, in a way, bring the tropics within the reach of American botanists and plant breeders ("An Argument for a Botanical Garden in South Florida, to be called the Fairchild Botanical Garden", by Marjory S. Douglas. Kells Press, Coral Gables, Florida). The only possible site appears to be that suggested, which is in a frost-free area in the extreme south of Florida. This is close to Chapman Field, where the United States Department of Agriculture has its Plant Introduction Garden, with which the name of David Fairchild is so closely associated. Here are grown tropical plant introductions for the needs of the Department of Agriculture. It serves a very useful purpose in this respect, but it differs from a botanic garden in that it does not offer a permanent home to tropical trees and plants. It is strictly utilitarian and is not laid out with that æsthetic taste which one associates with botanic gardens and which has so large an educational effect on the visiting public.

THOUGH the United States are fortunate in having a site for a tropical garden within their boundaries, and therefore of easy access to those who wish to visit it, the establishment of such a garden will be a costly undertaking. The soil of this region is extremely shallow, and much of it exists in crevices in the soft limestone which is often exposed on the surface. The principal agricultural industry in this area is fruit growing, and extensive orchards of mango, avocado and citrus have been established. Formerly, planting holes for the trees were blasted out of the soft rock, but it was found that the roots were strictly confined to the filled-in excavation thus formed. In recent years, soils have been made by 'scarifying' the surface with very heavy engine-drawn cultivators. The exposed soil with the limestone rubble is then collected into low, wide ridges along the top of which the trees are planted. It is found that a more extensive root system is thus formed, and the trees suffer much less from violent wind storms which occasionally visit this coast. Such calcareous soils are usually associated with the dry tropics, and it is possible that many species from such regions may thrive here, but in the humid tropics, which are so rich in their floras, the soils are generally acid and contain very little lime and, though many species of palms with their peculiar root system may be able to adapt themselves to local soil conditions, it is a different matter for many evergreen, broad-leaved species. To obtain the desired luxuriant tropical growth it may, therefore, be necessary to transport suitable soils in large quantities in which to grow such trees and plants, and this—if it proves to be necessary on an extensive scale—requires generous contributions towards the funds for founding these tropical botanic gardens.

Central Asiatic Gold Mines of the Bronze Age

THE sources from which prehistoric peoples obtained their minerals and other raw materials of industry afford valuable clues to their intercourse and cultural and economic contacts. A new source of gold in Central Asia is reported in the announcement of a discovery of prehistoric workings at Kazakhstan by a Russian expedition sent out by the Soviet Government (Soviet Union Year Book Press Service). The mines had been worked by a large number of workmen who used some implements of bronze, but for the most part of stone and the bones of animals. There were no traces of iron. Near the shafts were primitive ore-crushing plants, consisting of stone slabs and hammers. Two skeletons of these bronze age miners were found, who had met their death by a fall of the roof. On one of the skeletons was a necklace of glass and clay beads and in one hand was a bronze chisel and in the other a stone hammer. They were not Mongolian, as was indicated by their skulls. The mines were 0·75 m. wide and 20–25 m. deep. They were connected by underground passages 100–150 m. long. These passages had natural ventilation, and for illumination it is probable that fat in shallow bowls was employed. Some of these bowls have been found. Stone cross pieces were used as props. Polished slabs and triangles of stone have been found which appear to have been used on the steppes of Kazakhstan as sign-posts to guide caravans on their way to the mines. The slabs were orientated and polished on the eastern side. The Soviet Government is sending out another expedition this year to explore the mines further, and to work the ore which was left unextracted by the ancient miners.

Atmospheric Pollution

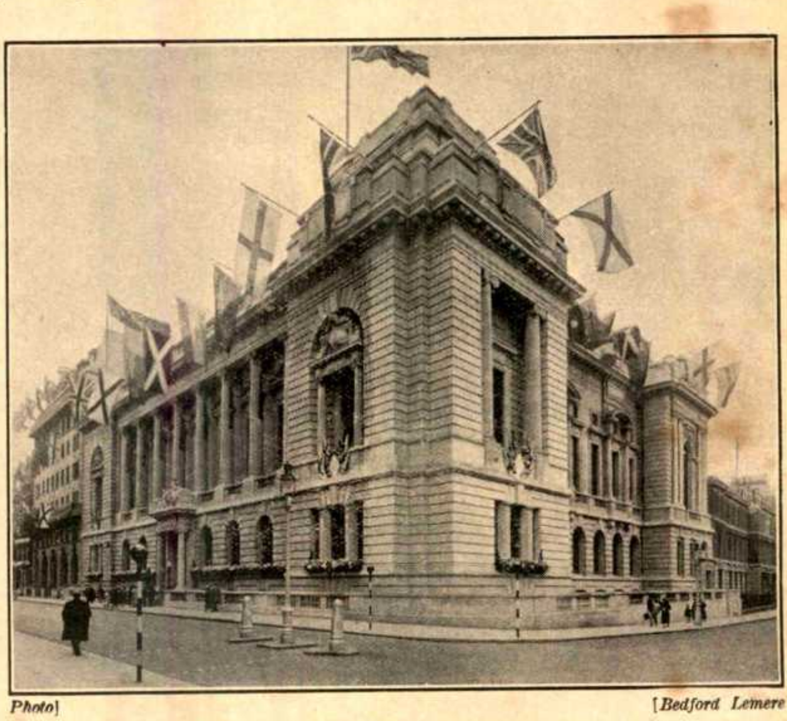
THIRTY-EIGHT representatives of local authorities and other organizations co-operating with the Department of Scientific and Industrial Research met on May 31 at the offices of the Department in the usual half-yearly conference. Dr. G. M. B. Dobson, chairman of the Atmospheric Pollution Research Committee, presented, as usual, a report on the progress of the investigations carried out under the Committee. Systematic observations in connexion with the intensive survey of the pollution in and around the City of Leicester were begun on April 1. During the preceding four months, the survey staff were installing different standard measuring apparatus at twelve sites. The decision of the authorities at Leicester to equip and maintain a station for regular meteorological observations was greatly welcomed. The Conference also recorded its appreciation of the valuable assistance given by the public analysts of Glasgow, Hull and Sheffield, in an investigation of the possibility of combining a dust filter with apparatus for the determination volumetrically of sulphur dioxide in the atmosphere. A report was submitted through the Medical Officer of Health for Leeds on the analysis of dust samples collected in Leeds, Halifax and Huddersfield. The Conference endorsed a proposal made by the Research Committee that a meeting should be convened of public analysts and others who are directly responsible for making observations on behalf of co-operating bodies, to discuss technical problems and to interchange ideas on the measurement of atmospheric pollution. Mr. Brownhill Smith retired from the chairmanship of the Conference, having served for the maximum period of three consecutive years. Alderman David Adams, a representative of Newcastle-upon-Tyne, was elected chairman for the ensuing year.

Study of Bird-Migration

The British Trust for Ornithology has accepted responsibility for the future conduct of the principal scheme in Great Britain for the study of migration and other aspects of bird-life by the ringing method. This scheme was instituted in 1909 by Mr. H. F. Witherby, editor of *British Birds*, and has been maintained with the co-operation of readers of that journal. More than half a million birds have been marked to date, and the recoveries of a proportion of these have already added greatly to knowledge of the subject. Important facilities for the work have at the same time been granted by the Trustees of the British Museum (Natural History), who are providing accommodation for the headquarters of the scheme in the Bird Room at South Kensington and permitting the Museum's address to be used. Rings will in future be inscribed "British Museum Nat. Hist. London", instead of "Witherby High Holborn London", with an individual identification number in addition as before. The scheme will now be directed by a special Bird-Ringing Committee, constituted as follows: Dr. A. Landsborough Thomson (chairman); Mr. A. W. Boyd; Mr. A. B. Duncan; Mr. P. A. D. Hollom; the Earl of Ilchester; the Earl of Mansfield; Mr. H. F. Witherby; and Miss E. P. Leach (hon. secretary). The headquarters' work will be in the hands of Miss Leach, who has had much experience of it as Mr. Witherby's collaborator in recent years. *British Birds* will continue to be the medium for publishing results.

Institution of Civil Engineers

WHEN the foundation stone of the present building of the Institution of Civil Engineers was laid in 1910 by the late Sir James Charles Inglis, then president of the Institution, the north-west corner could not be completed owing to the existence of a lease covering offices flanking that corner of the site. The demolition of the offices was, for various reasons, deferred until 1936; but the corner, with the consequent internal modifications in the library and reading-room, is now practically completed (Fig. 1), and Princes Street, which is to be known as Rennie Street from July 1, 1937, has also been widened to



Photo] [*Bedford Lemere*

Fig. 1

COMPLETED BUILDING OF THE INSTITUTION OF CIVIL ENGINEERS its full width. The rebuilding of the north-west corner has allowed of an extension to the main library, in addition to extensions to the rooms on the other floors, and advantage is being taken of this extension to house, at the west end of the main library, the original collection of books, etc., presented by Thomas Telford to the Institution in 1820, which formed the nucleus of the existing library, now containing more than 62,000 volumes.

Television Exhibition

PARTLY with the view of demonstrating that television has now emerged from the experimental stage, partly to illustrate the general principles which underlie the modern technique, and partly to foster the widest possible appreciation of television as a home entertainment, a special exhibition has been organized by the Science Museum, South Kensington, in co-operation with the British Broadcasting Corporation and the leading manufacturers. The exhibition will be opened by Lord Selsdon, chairman of the Television Advisory Committee, on June 10. The exhibition incorporates a historic section dealing briefly with early proposals for television, and a number of exhibits describe the developments of the past ten years. There is a working demonstration of the low-definition television which was broadcast by the Baird process a few years ago, there are demonstrations on modern cathode ray receivers supplied by the various manufacturers, and a demonstration of large-screen television by a mechanical-optical process. In order that these demonstrations can be given when there is no B.B.C. transmission available, a local transmitter has been installed which will provide programmes from cinema films. In connexion with the exhibition a handbook has been compiled by Mr. G. R. M. Garratt, assisted by members of the Exhibition Committee. Copies will be on sale at the Science Museum, or may be obtained from the publishers, H.M. Stationery Office, price 6*d.* (by post 7*d.*).

The Royal Society of Arts

FEW societies have done more to stimulate the arts and industries of the British Empire than the Royal Society of Arts, which during the last few days has had on exhibition, for the benefit of overseas visitors, a series of documents and objects illustrating its achievements since its foundation in 1754. Before the modern practice of holding frequent meetings to hear papers and lectures, the Society instituted awards for improvements in science, art and manufacture; and many of the objects exhibited illustrate the work of some of the Society's medalists. Hanging on one side of the room in which the exhibition was arranged was the first geological map of Great Britain prepared by William Smith. The map was published in 1815, Smith being assisted by a grant of £50. On the other side of the room were a model of Abraham Darly's iron bridge of 1788 (happily still standing); a model of Greathead's lifeboat and Bell's lifeline-throwing mortar for ships, for which medals were awarded. On another stand were samples of coco-nut oil, cinnamon, silk, tea, nutmegs, cloves, mace, wool and indigo from the Colonies, all representing products the cultivation of which has been stimulated by the Society. In addition to these and similar objects, were many books, prints and letters recalling the history of the Society and its never-ceasing activity.

Institute of Physics

THE annual report for the year 1936 of the Institute of Physics presented at the annual general meeting held on May 26 shows that the total membership has continued to increase in a very satisfactory way. The membership at the end of the year was 902. An informal discussion on the training of industrial physicists was held on February 11, 1936, at which appointed representatives of nearly every university and college in Great Britain and Ireland, of firms employing physicists and of research associations and Government establishments were present. As a direct result of this discussion, a scheme was inaugurated whereby registered students of the Institute are enabled to gain first-hand experience of industrial research and development work in physics during their vacations. The report records that in its first year this scheme proved most successful. The fifth conference of Australian physicists and astronomers was convened by the Australian Branch of the Institute and was held in Sydney on May 25–28, 1936. A London and Home Counties Branch of the Institute was founded in November. The general improvement in industry is reflected by the report of a great increase in the activities of the appointments register and panel of consulting physicists maintained by the Institute. The following officers have been elected to take office on October 1: *President*, Mr. C. C. Paterson; *Vice-President*, Prof. W. Makower; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Secretary*, Prof. J. A. Crowther; *New Members of the Board*, Prof. J. Chadwick and Mr. D. C. Gall.

Maynard Ganga Ram Prizes

IN 1925, the late Sir Ganga Ram, presented to the Punjab Government a sum of Rs. 25,000 for the endowment of a prize of the value of Rs. 3,000 to be called the Maynard Ganga Ram prize and to be awarded every three years, for a discovery, invention, or a new practical method which will tend to increase agricultural production in the Punjab on a paying basis. The competition is open to all. The first award, due in 1929, was made in 1931 to Dr. C. A. Barber, late Imperial sugar expert, for his fundamental discoveries which resulted in the production of Coimbatore sugar-cane. During the last five years, no further awards have been made owing to lack of suitable entries. The 1932 award has now been made to T. A. Miller Brownlie, lately agricultural engineer to the Government of Punjab, for his invention of a slip strainer suitable for water augmentation supplies derived from bores sunk in open wells. This strainer has the particular merit that it is not affected by alkaline sub-soil water—a defect from which many of the earlier metal strainers suffer. By its use, owners of well-irrigated lands can increase the output of water from their wells. The 1935 prize has been awarded to R. S. L. Jai Chand Luthra, professor of botany, Punjab Agricultural College, Lyallpur, for his new method of treating wheat seed against the fungal disease called loose smut. The wheat seed to be treated is merely soaked in water at ordinary temperature for four hours during the morning of a day in summer. Thereafter the soaked grain is spread in the sunshine until it is thoroughly dried. Experience has shown that this treatment is effective in controlling the disease without damaging the germinating power of the seed. Entries for the next award should reach the Director of Agriculture, Punjab, Lahore, on or before December 31, 1938.

Aquarium Notes

THE *Aquarist and Pond-Keeper* of March–April 1937 (**7**, No. 7) contains a good article (to be continued) on the freshwater sunfishes (family Centrarchidæ) by A. Fraser Brunner. These fishes are natives of North American freshwaters, their nearest relatives being the perches. A key to all the species is given with notes, and a double-page illustration together with a coloured plate comprises most of the species which can be kept in aquaria. Among other interesting contributions is one entitled "The Ways of the Natterjack" by Eric Hardy. The author states that he finds no difficulty in obtaining specimens in early spring and late summer on the brackish slacks of the west Lancashire dunes below Southport, and others may be found at the Solway marshes, in the Prestatyn district of the Conway estuary, North Wales, at Hilbre Island in the Dee Estuary and on the Leasowe marshes of the West Cheshire coast. He has kept this toad successfully in indoor aquaria.

Birth-rate in the United States

THE birth-rate in the United States, based on returns from thirty-four of the forty-eight States and covering only the first nine months of 1936, was the lowest on record, according to a provisional report recently issued by the Metropolitan Life Insurance Company (*Med. Rec.*, Feb. 17). The death-rate was slightly higher than that of any year within the last five, so that the natural excess of the birth-rate over the death-rate fell to a minimum of about 5 per 1,000.

A Heidelberg Correction

WITH reference to the article in our issue of January 16, 1937, "University of Heidelberg and New Conceptions of Science", Dr. E. Wolf, Privatdozent of the University of Heidelberg, writes to us from the Biological Laboratories at Harvard University under date April 20, as follows: "I had already left Heidelberg in Fall of 1931 with the consent of the Minister of Education and that of the Faculty of Science, to accept an invitation from Harvard University. Since then I have been on a leave of absence from Heidelberg and I can assure you that I regard it always an honour to be a member of the Faculty of the University of Heidelberg".

Göttingen and the Massachusetts Institute

IN response to requests for information on the extent of the Institute's participation in the celebration on June 30 of the two hundredth anniversary of the founding of the University of Göttingen, the Massachusetts Institute of Technology has issued the following statement: "Although the Massachusetts Institute of Technology will not send an official delegate from Cambridge to attend the celebration of the two hundredth anniversary of the founding of the University of Göttingen, the rector of the university has been notified that Werner T. Schuarte, a technology alumnus of the class of 1914, who lives in Germany, will represent the Institute as an academic courtesy to a university which during the past two centuries achieved world-wide renown through distinguished scholarship and notable contributions to the advancement of scientific knowledge. This action is not intended to condone changes in or restrictions placed upon German universities in recent years."

Canadian National Research Council Scholarships

WITH the view of encouraging postgraduate training in scientific research, chiefly in the graduate schools of Canadian universities, the National Research Council has awarded forty-seven scholarships for the year 1937–38. These include three fellowships of 700 dollars each, twelve studentships of 600 dollars and twenty-seven bursaries of 500 dollars, all of which will be held in departments of science at the universities. Five other scholarships, tenable in the National Research Laboratories at Ottawa, will enable the holders, all of whom have already done postgraduate research at the universities, to gain experience in the field of industrial research before engaging in commercial work. The awards show that chemistry in its various branches heads the list with twenty-five, physics comes next with twelve, followed by four in biology, two in genetics, and one each in botany, geology, mathematics and mechanical engineering. Applications were received from graduates of eighteen Canadian universities, and awards have been made which will enable the holders to work in the Universities of Dalhousie, Laval, McGill, Montreal, Queen's, Toronto, Western Ontario and Saskatchewan.

Congress of French Physiologists

THE eleventh Congress of French Physiologists will be held on June 7–9 at the Paris Faculty of Medicine under the presidency of Prof. Cardot, of the Lyons Faculty of Science. The principal subjects for discussion will be trophic sensibility, introduced by A. Pi Suner, professor of physiology at Barcelona; comparison of histological and biochemical data in ossification, introduced by Profs. Policard, of the Lyons Faculty of Medicine, and Roche, of the Faculty of Medicine at Marseilles, and exploration of organic functions by the electrical manifestations of their activity, by Prof. Ryart of the University of Brussels. Further information can be obtained from M. R. Gayet, Laboratoire de Physiologie Pathologique, 1 rue Lacretelle, Paris.

British Waterworks Association

THE twenty-sixth annual general meeting of the British Waterworks Association will be held in London on June 22–26 under the presidency of Sir William Prescott. The following papers will be read and discussed: "The Inland Water Survey", by R. G. Hetherington; "Present-day Aspects of the Purification of the London Water Supply", by Lieut.-Colonel C. H. H. Harold; "The Work of the Freshwater Biological Association of the British Empire", by Prof. P. A. Buxton, of the London School of Hygiene and Tropical Medicine; "The Present Aspects of the Rivers Pollution Prevention Problem", by H. F. Atter. Further information can be obtained from the Secretary, British Waterworks Association Office, Grand Buildings, Trafalgar Square, London, W.C.2.

Agricultural Abstracts

UNDER a recent agreement between the Central Agricultural and Scientific Bibliography and the Bureau of Chemical Abstracts (Chemical Society and Society of Chemical Industry) it has been arranged that the staff of abstractors engaged on abstracting work for that Bureau will be invited to act as abstractors in the interests of the C.A.S.B., to the extent that while engaged on their ordinary work they will also prepare a comprehensive list of those articles and papers published in the same journals, which should in their opinion be specially useful to subscribers to Section 1 (Agriculture and Allied Industries) of the C.A.S.B. The scheme has been in operation since January 1, 1937, and it is proposed to issue shortly the first bibliography in this series to all subscribers to the C.A.S.B. Further information can be obtained from W. P. Dreaper, Hon. Secretary, C.A.S.B., Science Museum Library, South Kensington, London, S.W.7.

Announcements

THE Albert Medal for 1937 of the Royal Society of Arts has been awarded to Lord Nuffield, "for services to Industry, Transport and Medical Science". The Medal was instituted in 1862 as a memorial of H.R.H. the Prince Consort, for eighteen years president of the Society, and is awarded annually for "distinguished merit in promoting Arts, Manufactures, or Commerce".

DR. MARCUS FRANCIS has been appointed director of research to the British Pottery Manufacturers' Federation. The Federation, in conjunction with the Department of Scientific and Industrial Research, is to establish a new research station in the extension of the North Staffordshire Technical College, Stoke-on-Trent. Dr. Francis is at present on the technical staff of the Munitions Technical Planning Establishment.

THE annual general meeting of the Research Defence Society will be held at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, on June 15 at 3 p.m., when the eleventh Stephen Paget Memorial Lecture will be delivered by Prof. G. Grey Turner. The subject of Prof. Turner's lecture will be "What Research Owes to the Paget Tradition".

THE Emil Chr. Hansen Gold Medal and a prize of 3,000 Danish crowns has been awarded to Prof. Aurelio Quintanilha, professor of botany in the University of Coimbra, for his valuable investigations on sex in the Hymenomycetes.

THE forty-eighth annual conference of the Museums Association will be held at Newcastle-upon-Tyne on July 5–9, under the presidency of C. Squire. Further information can be obtained from the Secretary, E. W. Wignall, Chaucer House, Malet Place, London, W.C.1.

THE annual summer meeting of the Association of Technical Institutions will be held at Blackpool on June 25–26 under the presidency of the Right Hon. Lord Kennet. Further information can be obtained from Dr. H. Schofield, Loughborough College, Loughborough, Leicestershire.

THE German Rontgen Society has recently founded a Röntgen Institute at Munich containing a museum and library. Publications should be sent to Ottostrasse 5, München.

THE second World Congress on Mental Hygiene will be held in Paris on July 19–23 under the auspices of the French League for Mental Hygiene. Further information can be obtained from the Secretary of the National Council for Mental Hygiene, 76 Chandos House, Palmer Street, London, S.W.1.

THE third Annual Conference of the National Federation of Personal Health Associations will be held at the British Medical Association's House, Tavistock Square, W.C.1, on June 24 at 2.45 p.m. The chief subjects for discussion will be the Government campaign to promote the physical fitness of the people and the part to be played by local authorities and individuals in co-operating with the National Advisory Council to ensure the success of the campaign.

WITH reference to the paragraph in NATURE of May 29 (p. 915) including the names of new officers of the Linnean Society, the Assistant Secretary informs us that, "owing to an error on our part, the name of Mr. Fred Howarth as a new member of council was omitted from the notice sent". Five new members of Council are elected annually.

ERRATUM. The X-ray photographs of nitrided steel reproduced as Fig. 6 in Sir William Bragg's article "Recent Crystallography" printed in NATURE of May 29 were incorrectly ascribed to Dr. G. Shearer. The photographs are due to Mr. W. A. Wood, of the National Physical Laboratory.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 969.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Dry Crossings of the Nile

ATTENTION has been directed on page 351 of NATURE of February 27, 1937, to a natural bridge "so strong that it bears the elephant from one bank to another", near Nimule, which is situated at the point where the Albert Nile, as it is commonly called to-day, becomes the Bahr el Jebel. It is clear that Dr. Hurst finds difficulty in believing in any such phenomenon, for in his review of May H. Lindsay's translation, the "Life Story of a River", from Emil Ludwig's work, he says: "Nobody else has ever reported this bridge." This is not so.

So far as I can discover, I was the first European to see and describe a natural bridge, or dry crossing, near this point, or to know of its existence; and it seems clear that Emil Ludwig obtained his information from a short illustrated account that I wrote of it. I first saw this dry crossing from the air in 1930 when I supposed it to be a temporary blockage by sudd which had been burnt; and three years later I crossed it on foot. It is or was situated, for I hear that it is slowly breaking up, at a point about seven miles below the Folar rapids.

The following is taken from the account above referred to[1]:—

"The dry crossing is a blockage some 1,200 feet in length and about 370 feet across and occupies the entire width of the Nile at that place. Its surface consists of soft soil with a very high percentage of vegetable matter, supporting an herbaceous land flora, but no papyrus. It is edged on its upstream side with a broken line of tree trunks (for the most part boles of palms) leaning steeply upstream and thus recalling a raked stockade. Apart from being soft and powdery the ground is unyielding, except near the right bank where it responds to the foot as a mattress does on a spring bed; but there is so little danger of going through into the water below that elephants cross over the surface, as some fresh spoor clearly indicated".

"About 570 feet upstream of the usual path over the crossing extending for a length of seventy-five feet an oily-looking pool breaks the dry surface, and from time to time ugly swirls appear upon it, and immediately downstream of the path is a much smaller pool of a similar kind, while in line with this at the downstream end of the blockage there is an exposed channel along which water can be seen swiftly flowing. It would appear that the main course of the Nile under the blockage is by the right bank." The flow of the Nile in this part of its course is powerful.

A similar dry crossing has been described by Sir Samuel Baker who, on page 455 of his "Albert Nyanza Basin of the Nile," 1892, says: ". . . we arrived at the junction of the Bahr el Gazal, and turning sharp to the east, we looked forward to arriving at the extraordinary obstruction that since our passage in 1863 had dammed the White Nile."

"There was considerable danger in the descent of the river upon nearing this peculiar dam, as the stream plunged below it by a subterranean channel with a rush like a cataract. A large diahbiah laden with ivory had been carried beneath the dam on her descent from Gondokoro in the previous year, and had never been seen afterwards"

E. J. WAYLAND.

Geological Survey,
Entebbe, Uganda.
April 7.

[1] Wayland, E. J., "A Dry Crossing of the Nile", *Uganda Journal*, 1, No. 1, 68–69 (1934). Another note of interest in the present connexion is the following Pitman, C. R. S., "A Dry Crossing of the Nile and its possible Influence on the Distribution of Mammalian Species", *Uganda Journal*, 2, No. 1, 86–89.

I HAVE read with interest Dr. Wayland's letter on the subject of a natural bridge over the Nile some eleven miles below Nimule. Unfortunately, I had not seen his note in the *Uganda Journal* when I wrote my review of Dr. Ludwig's book or I should have realized that "A natural bridge has grown at Nimule, such as hardly another river on earth possesses in this form, consisting of rank water plants, so strong that it bears the elephant from one bank to the other, and so powerfully rooted that when floods have destroyed it, it closes up again of itself" was merely an inaccurate way of describing a sudd block, and did not relate to some entirely new phenomenon of vegetative growth.

So far as I know, "sudds" (the word "sudd" is Arabic for a blockage) have not previously been reported on the stretch of river between Nimule and Rejaf, where the rapid stream is unfavourable to their formation, but farther north in the area known as the Sudd Region, where the Bahr el Jebel flows through swamp, they were of common occurrence in the last century. One of the first pieces of work undertaken on the Nile after the reoccupation of the Sudan was the removal of these blocks, and this was successfully accomplished in the early years of the present century. Since then, owing to the regular navigation of the Bahr el Jebel by steamers, blocks have rarely occurred, as it has been possible to remove obstructions before they became consolidated.

A full account of the formation and history of these sudds on the lower Bahr el Jebel was given by Sir Henry Lyons[1] and a shorter account by Phillips and myself[2].

Similar blocks have occurred on the Victoria Nile at its exit from Lake Kioga, on the Pibor, and on the Bahr el Ghazal where in 1880 the steamer of Gessi, one of Gordon's officers, was completely shut in for some weeks, and many of his company died.

The blocks which occurred on the lower Bahr el Jebel were composed mainly of papyrus, reeds and um soof, large masses of which with earth clinging to their roots were sometimes torn loose by the combination of strong winds and a rising river and found their way into the main stream, where they were arrested at a sharp bend or a narrow part of the channel. As these masses were sometimes acres in extent, the channel became blocked by floating vegetation, and so its section was reduced while the velocity of the water below the mass increased. Fresh vegetation as it arrived was sucked under the old and caught in the narrowing section, so that the block increased and became consolidated by the heading up of the water behind it. In this swampy region the water sometimes found another channel, but sometimes the block burst under the pressure of the water.

The block to which Dr. Wayland directs attention was no doubt formed from vegetation uprooted on the swampy reach above Nimule in the same way as has just been described. The conditions, however, are different inasmuch as the river at the block is in a narrow rocky valley and not in swamp, and the velocity of the water is greater than on the lower Bahr el Jebel. Some interesting points mentioned in the article in the *Uganda Journal* are, that natives say that the blockage is not permanent but that there have been several at the same spot each lasting for a few years, and that their formation is in no way related to the height of the river.

In 1924 I was at what appears to be the spot described by Dr. Wayland, and at that time a block must have been just beginning to form, for at a point where the river narrowed suddenly there was an accumulation of floating dead vegetation, mostly um soof, covering the whole width of the river and extending for perhaps thirty yards upstream. It was, however, not at all consolidated nor was it a serious obstruction to the river.

The Bahr el Jebel draws the greater part of its water from Lake Albert, and in the dry season only changes its level slowly; but in the rainy season from April to October it is liable to rises and falls due to torrential tributaries entering it between Lake Albert and Nimule.

I would suggest that, as in the case of the lower Bahr el Jebel, a rise of the river accompanied by strong winds occasionally detaches a mass of vegetation large enough to form a block at the constriction, and that the block increases and consolidates as I have already described. As there is no possibility of the river opening a new channel, the block can only be removed by bursting. This would probably take place when the river rose considerably; perhaps also after a time the barrier is weakened by the rotting of the lower layers of vegetation. Thus both the formation and destruction of the sudd would depend to some extent on rises of the river and not on its actual level, in accordance with native report.

In the past it has been suggested that the site of a dam to convert Lake Albert into a reservoir might be at Nimule. One of the objections raised against this choice of a site was the danger of vegetation accumulating above the dam and blocking the sluices. Weight is added to this objection by the fact that a sudd can form at present near the proposed site.

I am sorry to have doubted Dr. Ludwig on a point which had a sound foundation, but my doubt has had the good result of directing attention to Dr. Wayland's description of a very interesting phenomenon.

As Imperial Airways have a regular service passing near the site of the block, it might perhaps be possible for their pilots to keep notes of its state, so that the conditions which lead to its formation and destruction may be investigated.

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[1] "The Physiography of the River Nile and its Basin". Lyons. (Cairo: Government Press, 1906).

[2] "The Nile Basin" Vol. 1. Hurst and Phillips. (Cairo: Government Press, 1931.)

Radioactivity Produced by Gamma Rays and Neutrons of High Energy

WHEN lithium is bombarded by protons of energy of about 450 kV., gamma rays of about $17 \cdot 5 \times 10^6$ eV. energy are emitted. Recently Bothe and Gentner[1] have observed that these gamma rays can produce radioactivity in many elements. In all the cases reported, the primary process probably consists in the emission of photo-neutrons. In six cases they have observed the formation of new radioactive isotopes. These are gallium (60 min.), bromine (5 min.), silver (24 min.), indium (1 min.), antimony (13 min.) and tantalum (14 min.).

We have repeated some of their experiments with similar results using lithium metal targets bombarded by magnetically separated protons of about 520 kV. and 10–20 μ amp. ion currents as gamma ray source. We have also observed a weak 'photo-radioactivity' in oxygen with a half-period of about 2 min. This is probably due to the formation of the known radioactive isotope ^{15}O (2·1 min.) according to the reaction:

$$^{16}O + h\nu \rightarrow {}^{15}O + {}^{1}n.$$

The threshold energy for removal of a neutron from a stable isotope is presumably well below $17 \cdot 5 \times 10^6$ eV. for most elements. We have therefore attempted to produce the new radioactive isotopes by means of gamma rays and also by neutrons of energy smaller than that of the lithium gamma rays. Radioactivity produced by 'neutron loss' (as opposed to 'neutron capture') was first observed by Heyn[2] in copper bombarded by the neutrons from lithium + deuterons.

We were able to produce five of the new radioactive isotopes reported by Bothe and Gentner, by using the neutrons of lithium + deuterons and boron + deuterons (energy $\leqslant 13 \cdot 5 \times 10^6$ eV.). For a voltage of about 520 kV. and equal ion current (deuterons or protons) the yield in radioactivity was usually much higher in the case of neutrons than in the case of lithium gamma rays. We were unable to detect any radioactivity with the gamma rays from boron + protons (energy $\leqslant 14 \times 10^6$ eV.) and beryllium + protons (energy $\leqslant 6 \cdot 5 \times 10^6$ eV.). Our results concerning radioactive isotopes which cannot be obtained by neutron capture are summarized in the accompanying table.

As antimony has only one known slow neutron period but two isotopes, we specially verified that the 13 min. period cannot be produced by slow neutrons, the upper limit for its intensity being $1/10^5$ of the activity produced by slow neutrons in indium (54 min.). It seems therefore very likely that the 13 min. period is due to ^{120}Sb, and not to ^{122}Sb.

After bombarding with neutrons of lithium + deuterons we sometimes noticed a short-period radioactivity which we finally found to be due to oxygen. This element can be activated very strongly. Its activity decays with a period of 8 seconds, which is apparently identical with that observed in fluorine bombarded by fast neutrons, and long presumed to be due to ^{16}N. We may therefore account for this period by the reaction :

$$^{16}_{8}\text{O} + ^{1}_{0}n \rightarrow ^{16}_{7}\text{N} + ^{1}_{1}\text{H}.$$

We could also produce this radioactivity with the neutrons of boron + deuterons, but not with those of beryllium + deuterons or with slow neutrons. We were unable to detect this period in nitrogen bombarded by slow neutrons (beryllium + deuterons + paraffin).

RADIOACTIVE ISOTOPES OBTAINED BY 'NEUTRON LOSS'.

Source		Gamma rays			Neutrons			Radio-isotope produced	Half-period (min.)
		Li+H	Be+H	B+H	Li+D	Be+D	B+D		
	Energy in 10^6 eV.	17 5	⩽6·5	⩽14	⩽13·5	⩽4·5	⩽13		
Element irradiated	Isotopes								
8 O	16, 17, 18	2		—	—	—	—	^{15}O	2 1
29 Cu	63, 65	100	—	—	1200		300	^{62}Cu	10 5
31 Ga	69, 71	40		—	1200	—	500	^{68}Ga	60
35 Br	79, 81	20	—	—	500	—	600	^{78}Br	5
47 Ag	107, 109	25	—	—	700	—	300	^{106}Ag	24
49 In	113, 115	35	—	—	300	—	100	^{112}In	1
51 Sb	121, 123	10	—	—	2000	—	300	^{120}Sb	13

The figures give the relative initial activity (measured with a tube counter) observed in thick samples bombarded by gamma rays or neutrons. The values are expressed in arbitrary units and are reduced so as to correspond to samples of equal size, to equal ion current (at about 520 kV.), and to infinite time of exposure.

In gallium bombarded with neutrons from lithium + deuterons and boron + deuterons a new radioactivity decaying with a half-period of about 5 min. and having an intensity similar to that of the 60 min. period has been found. As this period seems to be identical with one of the periods produced in copper by neutron capture, it is probably due to ^{66}Cu, formed according to the reaction :

$$^{69}_{31}\text{Ga} + ^{1}_{0}n \rightarrow ^{66}_{29}\text{Cu} + ^{4}_{2}\text{He}.$$

We wish to thank Dr. W. B. Lewis and Mr. W. E. Burcham for putting their apparatus at our disposal, and Prof. E. N. da C. Andrade for lending us a sample of pure gallium.

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May 5.

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[1] Bothe and Gentner, *Naturwiss*., **25**, 90, 126, 191, 284 (1937).

[2] Heyn, NATURE, **138**, 723 (1936). *Physica*, **4**, 160 (1937).

Absorption of γ-Rays Measured by their Photo-effect in Beryllium

IT results from recent determinations of atomic masses, that in the photo-nuclear effect of radium C γ-rays in beryllium, only the hardest groups, namely, 2·2 × 10^6 eV., 2·0 × 10^6 eV. and 1·8 × 10^6 eV., can be efficient. The absorption of these γ-rays measured by the number of neutrons produced in beryllium should therefore be very nearly exponential without any preliminary filtering. However, Gentner[1] has found that the absorption curve obtained by this method exhibits a flat maximum for small thicknesses of absorbing material (lead or aluminium) and then decreases, at first with a coefficient corresponding to 0·9 × 10^6 eV., and afterwards more slowly. Gentner interprets these results by assuming that the observed maximum corresponds to the maximum intensity of the 0·9 × 10^6 eV. rays developed by the Compton effect from the primary rays, and that this quantum energy represents twice the energy necessary for extracting a neutron from the beryllium nucleus.

In view of these discrepancies, I have repeated these experiments using the following arrangement. About 120 gm. of beryllium contained in a thin-walled zinc box, 5 cm. × 5 cm. × 5 cm., was placed at 4 cm. distance from the source of γ-rays (50 mgm. of radium contained in platinum tubes kindly lent by the Maria Curie-Skłodowska Radium Institute, Warsaw). The activity excited in a silver foil placed against the box opposite the source was measured as a function of the thickness of different absorbers interposed between the box and the source. Paraffin wax was placed behind the box in order to increase the efficiency of the neutrons. The front side of the box exposed to the radium was covered by a sheet of cadmium in order to minimize the back-scattering of slow neutrons from the absorbing material. The results

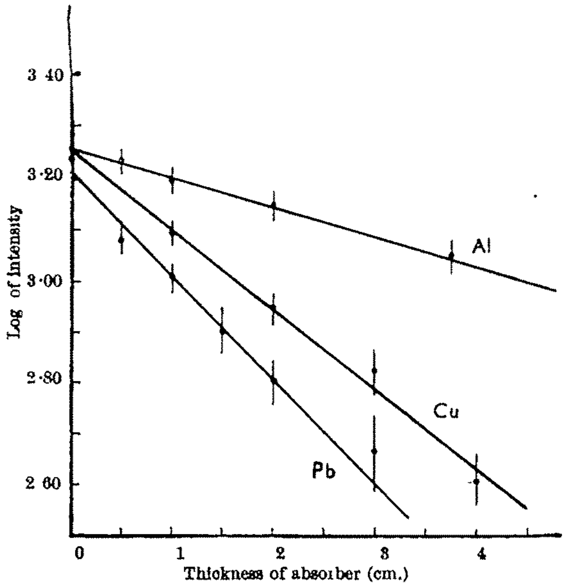

Fig. 1.

for absorption in lead, copper and aluminium are represented in Fig. 1.

The curves are exponential, the half-value thicknesses being 14 mm., 19 mm. and 52 mm. for lead, copper and aluminium respectively. I deduce for the atomic absorption coefficients: $\mu_{at}^{Pb} = 1{\cdot}51 \times 10^{-23}$, $\mu_{at}^{Cu} = 0{\cdot}434 \times 10^{-23}$, $\mu_{at.}^{Al} = 0{\cdot}215 \times 10^{-23}$. The best value found by comparison of theory and recent experimental work[1] for radium Cγ-rays filtered through 10-15 cm. lead is $\mu_{at.}^{Pb} = 1{\cdot}53 \times 10^{-23}$, and the values calculated for these rays for copper and aluminium using the figures given by Gentner[2] are $\mu_{at.}^{Cu} = 0{\cdot}439 \times 10^{-23}$ and $\mu_{at.}^{Al} = 0{\cdot}195 \times 10^{-23}$. The agreement is very satisfactory and shows that the efficient wave-length for neutron production is about equal to the mean wave-length—6·3 x.u., corresponding to $1{\cdot}96 \times 10^6$ eV. quantum energy—of rays filtered through 10-15 cm. lead.

The divergent results obtained by Gentner must probably be attributed to the back-scattering of slow neutrons from small thicknesses of the absorbing material. I performed some experiments in which the box was *not* protected by cadmium, and obtained a curve which without showing a maximum was nearly flat at the beginning. The effect of scattering is small in my arrangement because the sheet of beryllium is 5 cm. thick. With a smaller thickness of beryllium a maximum would certainly be observed.

I have compared also the efficiency of radium C and thorium C″ γ-rays in producing neutrons from beryllium and found, in agreement with Gentner, for equal intensities of γ-rays (filtered by 1 cm. of lead and measured by a Geiger counter) that the first source gives about twice the number of neutrons produced by the second source. This fact may be attributed to a nuclear resonance effect, or alternatively to the smaller efficiency of neutrons of higher kinetic energy, produced by the harder γ-rays of thorium C″[3]. Experiments now in course seem to support the later assumption.

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April 5.

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[1] *C R.*, 199, 1211 (1934).

[2] Gentner, *J. Phys.*, 6, 274 (1935).

[3] Chadwick and Goldhaber, *Proc Roy Soc.*, A, 151, 479 (1935).

Induced Radioactivity of Silver with Neutrons from Slow Deuterons

IN a recent paper[1] we have described experiments, in which artificial radioactivity of silver was produced by neutrons delivered by 25 kV.-deuterons. Some further results on this point are communicated in this note.

The first task was to decide whether a deuteron-deuteron process or the reaction deuteron-beryllium is the origin of our neutrons. For this purpose, the mica foil with the beryllium layer used in our first experiments was replaced by a similar foil without beryllium and the experiment repeated in the same way. The results from a series of a hundred runs do not show an effect comparable with that of the beryllium covered foil (though a very small effect, just about the order of magnitude of the statistical errors, possibly exists; but it would require far more runs to establish with certainty the reality of the effect). At all events, we can be sure that the neutrons which produced the activity measured in our first experiments are due to the process:

$${}^9_4\text{Be} + {}^2_1\text{H} \rightarrow {}^{10}_5\text{B} + {}^1_0n$$

In order to get information concerning the velocity of our neutrons, we tried to state the relation of the intensities of the two known periods of silver as a function of the velocity of the primary deuteron-ray. Since it is known that the shorter period is far more influenced by the slowing down of the neutrons, one can at least easily establish, by varying the energy of the primary radiation within the small range of our voltages (15–35 kV), whether the velocity of the neutrons is of the order of magnitude of that of the primary radiation, or not. If the energy of the effective neutrons is of the order of magnitude of 10^4 eV., we should expect a systematic variation of the intensity relation of the two periods; and conversely, a practically constant intensity relation would mean that the energy of the neutrons is large compared with the energy variation used, namely, about 10^4 eV.

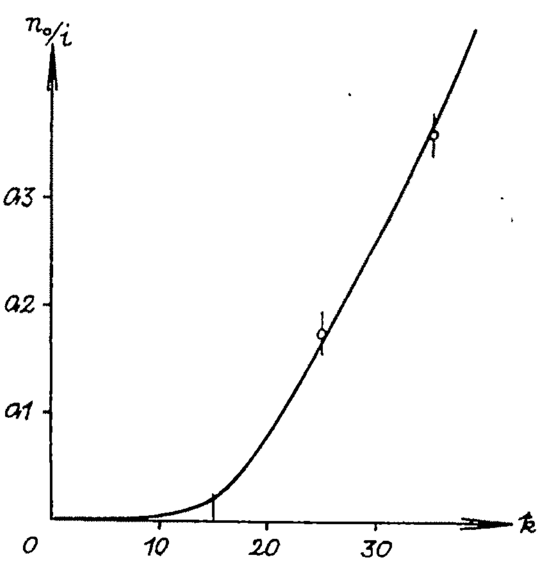

Fig. 1.

Unfortunately, the activity produced by the 15 kV.-beam was too small to permit us to carry out this programme entirely. With this voltage our ion-current was not sufficient to produce in 150 runs an activity exceeding the statistical uncertainties. From 150 measurements with 35 kV. we got very exact decay curves, giving the following results for the half-value periods and the intensity relation (which may be defined by two coefficients C_1 and C_2, where $C_1 + C_2 = 1$): $T_1 = 24 \pm 5$ sec., $T_2 = 110 \pm 12$ sec., $C_2 = 0{\cdot}58 \pm 0{\cdot}06$. Using these values for the half-periods, one gets the best agreement with the experimental decay curves from the 25 kV.-measurements with $C_2 = 0{\cdot}50 \pm 0{\cdot}07$. The second value is indeed smaller than the first, as might be expected for neutrons of about 10^4 eV., but the variation is just within the possible error, so that it is again impossible to decide with certainty the point in question.

Finally, it is of interest to examine the excitation curve for our low-voltage neutrons. In Fig. 1 we have plotted the total number n_0 of silver atoms transmutated in a single run (extrapolated from the decay curves) divided by the positive ray current in microamperes. We have found the yields: $< 0{\cdot}024$; $0{\cdot}176 \pm 0{\cdot}02$; $0{\cdot}360 \pm 0{\cdot}02$ respectively. Expressed in radium equivalents (that is, the values resulting from the comparison of our total induced activity with that of a preparation of radium-beryllium with known content of radium element) the yields are: $< 0\cdot2$; $6\cdot8$; 19 mgm.

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[1] Bertl, Furth, Obořil and Sitte, NATURE, 139, 716 (1937)

Androgenic Activity of Ovarian Extracts

IT is well known that œstrogenic activity may be shown by extracts of testes and by extracts of urine from the males of certain species. Conversely, androgenic activity can readily be demonstrated in the urine of normal women, and Hill and Gardner[1] have shown that, under certain conditions, the atrophic seminal vesicles of castrated mice can be restored by ovarian grafts. Further, since the comb of the domestic hen atrophies after ovariectomy and responds to male hormone but not to œstrone, its increase in size during the laying season presumably indicates production of androgenic substance by the active ovary.

So far, however, androgenic activity does not seem to have been demonstrated in ovarian extracts, possibly because much larger amounts of male hormone than of œstrone or œstradiol, in terms of crystalline substance, are required to evoke a significant biological reaction. By the use of Fussganger's highly sensitive modification[2] of the capon test—direct unction of the comb with the extract—we have now been able to demonstrate androgenic activity in two crude alcohol-acetone-ether extracts of pig ovaries. The first extract was qualitatively tested on the combs of two bantam capons and produced growth (L + H) in five days of 11 mm. and 7 mm., a clear-cut response. The second, quantitatively tested on ten Leghorn capons by the application to each of a total of 0·125 c.c. of the oily extract over five days, produced an average growth of 4 mm., about the same as that given by the similar administration of 2·5 γ androsterone, or 1/40 I.U. The yield of extract was 3·9 gm. per kgm. of fresh tissue, so that the androgenic activity of pig ovaries would seem to be rather less than 1 I.U. per kgm. Suitable control tests with arachis oil solutions of œstrone, œstradiol and œstriol gave negative results, and it is likely therefore that the androgenic activity of the ovarian extracts was due to the presence of substances of the androsterone-testosterone group.

This result is of obvious significance in relation to the origin of the androgenic material in the normal human female. A number of observations suggest that the adrenals are one site of elaboration. Thus Reichstein[3] has isolated an androgenic diketone from the adrenal, while, examined by the unction technique, a crude extract of horse adrenal was slightly androgenic, and a highly concentrated discard fraction of pig adrenals, kindly supplied by Dr. Reichstein, gave good growth. Further, Simpson, de Fremery and Macbeth[4] have shown that very large amounts of androgenic substance may be present in the urine of women with virilism of adrenal origin, and Callow[5] has isolated as much as 110 mgm. per litre of *trans*-dehydroandrosterone from the urine of a female child with an adrenal tumour. Finally, in conjunction with Dr. Callow and Dr. Levy Simpson, it has recently been shown that considerable amounts of androgenic material may be found in the urine of ovariectomized women. Nevertheless, the presence of androgenic activity in ovarian extracts shows that the female gonad must also be considered as a possible source of at least a part of the androgenic material found in the normal human female.

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May 4.

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[1] Hill and Gardner, *Anat. Rec.*, 64, 21 (1936).
[2] Fussganger, *Medizin u. Chem. Z.*, 2, 194 (1934).
[3] Reichstein, *Helv. chim. Acta*, 19, 223 (1936).
[4] Simpson, de Fremery and Macbeth, *Endocrinology*, 20, 363 (1936)
[5] Callow, *Chem. and Ind.*, 55, 1030 (1936)

Inactivation of Vaccinia Virus by Ascorbic Acid and Glutathione

JUNGEBLUT and his co-workers[1] have shown that the virus of poliomyelitis and diphtheria toxin were inactivated by ascorbic acid. One of us[2] has shown that addition of ascorbic acid to cultures of *C. diphtheriæ* leads to production of relatively atoxic filtrates. Further studies on the nature of this interaction established a reasonable presumption that there was an oxido-reduction between the ascorbic acid and toxophore group of diphtheria toxin.

It occurred to us that if this is the type of reaction involved, other viruses might also be inactivated in the same manner. Experiments conducted with vaccinia virus gave positive results. Relatively small amounts of ascorbic acid inactivated many infective doses of the virus. Similar results were obtained also with glutathione, but this substance proved much less active than ascorbic acid in the same concentration.

The procedure employed was briefly as follows: Vaccinia virus was inoculated into a rabbit testicle. After 3–4 days the testicle was removed, ground with sand, suspended in saline and various decimal dilutions made in saline. These suspensions were mixed with equal volumes of freshly prepared solutions of ascorbic acid. The mixtures were incubated for a half-hour at 37° C. and then kept at icebox temperature. Untreated control suspensions were kept under the same conditions. At various intervals, 0·2 c.c. of the different mixtures were injected intracutaneously into rabbits. A summary of four different experiments is tabulated below:

Vitamin Conc.	Incubation Time	Infective doses inactivated
1 · 20,000	3 hours	10*
1 : 2,000	3 ,,	100
1 : 200	3 ,,	1,000
1 . 20,000	6 ,,	10
1 : 2,000	6 ,,	100
1 : 20,000	24 ,,	10
1 : 2,000	24 ,,	1,000*
1 : 200	24 ,,	10,000

* = incomplete neutralization, that is, delayed reaction and milder lesion. Full number = infective doses completely inactivated

It will be noted that the ascorbic acid inactivates the virus and that the degree of inactivation depends on the concentration of the vitamin and the time interval during which it is allowed to act.

Similar tests were made with glutathione. This substance proved much less active than ascorbic acid. A dilution of 1 : 20,000 failed to inactivate virus in 24 hours, while a dilution of 1 : 200 inactivated 10 doses completely and 100 infective doses partially.

It appears, therefore, that ascorbic acid has the same effect on vaccine virus as on the virus of poliomyelitis and on diphtheria toxin. Preliminary experiments indicate a similar effect on coli phage. It may well be, therefore, that the phenomenon is a general one and is related to a common or related group in the chemical composition of viruses and diphtheria toxin, effected by oxido-reducing substances, of which ascorbic acid is the most active.

Further investigations are in progress.

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April 23.

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[1] Jungeblut, C. W., *J. Exp. Med.*, 62, 517 (1935), Jungeblut, C. W., and Zwemmer, R. L., *Proc. Soc. Exp. Med. and Biol.*, 32, 1229 (1935).

[2] Kligler, I. J., NATURE, 138, 291 (1936).

Correlation Phenomena and Hormones in *Selaginella*

IT has been known for a long time that the angle-meristems present at every branching of *Selaginella* shoots, which normally give rise to rhizophores, may be induced to develop as leafy shoots instead of rhizophores[1]. This altered development occurs when pieces of shoot including a branching but with the shoot apices removed are used as cuttings. This is illustrated for *S. Martensii* in Fig. 1 *a*, which depicts a specimen from an experiment in which fourteen pieces of shoot were used. Thirteen of these showed the development of leafy shoots from the angle-meristems while the remaining one showed no further development.

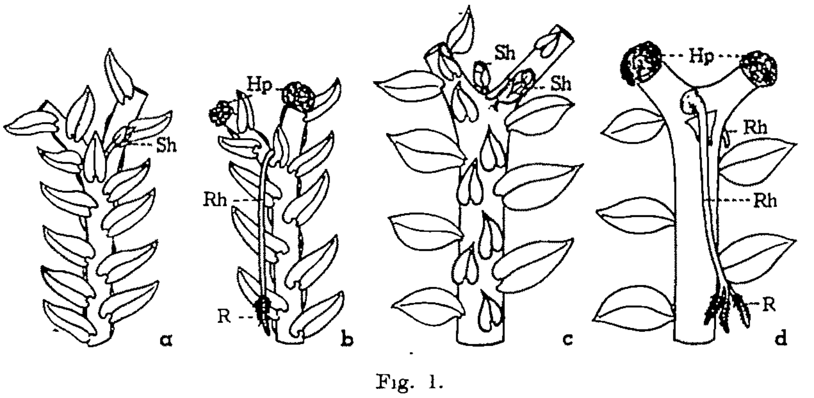

Fig. 1.

Selaginella Martensii. (*a*) UNTREATED LENGTH OF SHOOT; (*b*) LENGTH OF SHOOT WITH HETEROAUXIN PASTE; (*c*) AND (*d*) COMPARABLE LENGTHS OF SHOOT OF *S. Lobbii*. *Sh*, SHOOT; *Rh*, RHIZOPHORE; *R*, ROOT; *Hp*, HETEROAUXIN PASTE. (× 1¼).

The presence of a correlating influence diffusing backwards from the shoot apices has been inferred from the known facts, and it seemed worth while to investigate whether hormones such as heteroauxin (3-indole acetic acid) were concerned. Pieces of shoot were prepared as above, and the cut upper surfaces were then smeared with heteroauxin paste (prepared by the method described by Laibach[2]). Twelve pieces of shoot were used, and all showed the development of a rhizophore from the angle-meristem (see Fig. 1 *b*). Comparable results have been obtained with the more strongly growing *S. Lobbii*, which frequently shows two angle-meristems in an active condition at each branching. In an experiment with eleven pieces of shoot treated with heteroauxin paste, seven specimens showed the development of a single rhizophore, the other meristem remaining dormant; two showed the development of two rhizophores (see Fig. 1 *d*); one the development of a rhizophore followed by the development of a shoot from the other meristem; the remaining specimen showed no further development. Similar shoot pieces without heteroauxin paste showed the development of one or two leafy shoots (see Fig. 1 *c*); no rhizophores were formed.

These preliminary experiments indicate that the presence or absence of heteroauxin is an effective factor in determining whether an angle-meristem shall develop as a rhizophore, leafless and positively geotropic, or as a plagiotropic leafy shoot. They do not prove that the correlating influence normally exercised by the shoot apex is in the nature of a hormone mechanism, but they lend support to this view.

A more extensive series of experiments relating to correlation phenomena in *Selaginella* is in progress.

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April 19.

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[1] Williams, S., "An Analysis of the Vegetative Organs of *Selaginella grandis*", *Trans. Roy. Soc. Edin.*, 57 (1931).

[2] Laibach, F., "Über die Auslosung von Kallus- und Wurzelbildung durch β-Indolylessigsäure", *Ber. Bot. Gesell.*, 53 (1935).

A Device for the Observation of Root Growth in the Soil

STUDIES of root systems have in the past been accomplished by various methods of excavation *in situ* or by the growing of plants in specially constructed boxes which can be dismantled to allow removal of the soil. It is impossible to conduct developmental studies by this means unless a number of subjects are examined at various stages of their growth, and in any event the process is extremely laborious. In work on fruit trees at East Malling, Rogers[1] has designed observation trenches which are in the form of a walled chamber fitted with plate-glass windows. This gives a view of rootlets impinging against the glass.

The necessity for this type of study upon arable crops and grasses has led me to devise a cheap and convenient means suited to field conditions. Land under rotation on a commercially run farm must undergo cultural operations in winter which make it imperative to move the units after the crop is harvested. Cheapness renders it possible to install a sufficient number of points of observation to satisfy statistical needs. A less permanent and expensive method is therefore desirable than in the case of an experimental orchard.

Glass tubes, closed at the lower end, are let into the soil down holes bored to a slightly larger diameter.

A certain amount of packing with dry soil from the various depths is necessary. The glass cylinder may be specially constructed for the purpose, but lamp glasses cemented end to end to a depth of three or four feet have proved very satisfactory. Half-section drain-pipes faced with glass and other types of shaft have also been utilized. Good quality horticultural glass has been found to take the strain in cases where a lamp glass is not employed. The top of the shaft is closed with a metal lid designed to collect rain-water. The glass may be marked into squares to facilitate observation and sketching

The method of viewing the roots is by a mirror mounted at the end of a metal rod with a screw adjustment to allow tilting to a convenient angle. A small electric bulb is fitted above the mirror and this is connected to a pocket torch fixed to the upper extremity of the rod. One instrument, of adjustable length, to which mirrors of convenient sizes can be attached, serves for every type of shaft.

In preliminary observations on *Lolium perenne*, the lamp glass method has provided a clear image at an inclusive cost of not more than half a crown per square foot of area observed. This is a very small fraction of the cost of the permanent chamber.

It is hoped, this year, to conduct a series of observations upon such problems as the effect of continual cutting upon the root systems of grasses and the influence of a concentrated layer of fertilizer upon root growth. The progression of the root system in sugar beet will also be observed.

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Penkridge,
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April 29.

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[1] East Malling Research Station. Annual Report (21st Year) 1933, pp. 86–91.

Distribution of Ultra-High-Frequency Currents in Long Antennæ

IN connexion with some problems concerning the action of ultra-short wireless waves on frame aerials, it was found necessary to know how ultra-high-frequency currents were distributed on long straight aerials. It has usually been assumed that such currents were distributed sinusoidally, and Wilmotte[1] has shown both theoretically and experimentally that this is so in the particular case of a long vertical antenna with a concentrated E.M.F. at the foot of the aerial.

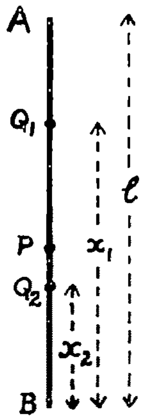

Fig. 1.

If a concentrated high frequency E.M.F. be applied at any point P (Fig. 1), then it can be shown that the currents in the portions of the wire above and below P are distributed sinusoidally with current nodes at half wave-length intervals measured from both A and B. That is, if I_1 be the current at Q_1 and I_2 that at Q_2 then

$$I_1 \propto \sin\frac{2\pi(l - x_1)}{\lambda} \quad \text{and} \quad I_2 \propto \sin\frac{2\pi x_2}{\lambda},$$

where l is the length of the antenna and λ is the length of the wave. Furthermore, the currents in the two parts are dependent one upon the other in such a way that, when AP (say) is an integral number of half wave-lengths, the current in BP is a minimum (theoretically zero) whatever be the length of BP*, and when AP is an odd number of quarter wave-lengths, the current in BP is a maximum. In a similar way, the current in AP is dependent on the ratio of BP to λ.

This current distribution only occurs when the input energy is concentrated at a given point of the antenna, and is therefore applicable to long transmitting aerials if they are coupled by a coil of small dimensions to an ultra-high-frequency oscillator.

With a long isolated receiving antenna in a uniform ultra-high-frequency electromagnetic field, the current distribution seems to be much more complex. Its amplitude variation with distance x along the aerial wire is given by the theoretical expression:

$$I_0 = K \sec\frac{\pi l}{\lambda} \sin\frac{\pi x}{\lambda} \sin\frac{\pi}{\lambda}(l - x),$$

where K is a constant. This reduces to $K \sin^2 \pi x/\lambda$ when $l = n\lambda$. The general expression shows that current nodes occur at intervals of one whole wave-length measured from both ends of the antenna. The nodes measured from one end of the antenna therefore overlap those measured from the other end in such a way that the two central nodes gradually come closer together as the aerial increases in length from one to two wave-lengths, and then gradually separate as the length of the aerial increases from two to three wave-lengths, and so on. The symmetrical disposition of these central current nodes and antinodes and their dependence upon the ratio l/λ will presumably determine the best positions for tapping points for the passage of energy to and from the antenna.

Preliminary experiments have supported the above conclusions, but the practical current distribution graphs for long transmitting and receiving aerials and the measured critical lengths are naturally slightly modified by the fact that the resistance and leakage of the aerial cannot be neglected when compared respectively with the inductive and capacitive reactance components of its impedance.

It is proposed to publish a full account of this work in the immediate future.

L. S. PALMER.
K. G. GILLARD

University College,
Hull.
April 24.

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* With the exception of the special cases when BP is also an integral number of half wave-lengths.

[1] *J. Inst. Elect. Eng.*, **66**, 617 (1928).

Fall in Air Temperature during the Solar Eclipse of December 13-14, 1936

AT a recent meeting of the Royal Astronomical Society[1], a discussion took place on observations of temperature changes made by Dr. John L. Haughton on board the *Strathaird*, during the total solar eclipse of June 19, 1936.

From this discussion, it appears that the amount of fall in air temperature which can actually take place during solar eclipses is very variable. It must depend to a large extent on the time of the eclipse, the meteorological conditions, and the geographical aspect of the point of observation.

During the annular eclipse of December 13–14, 1936, some fairly large falls of air temperature were recorded in New Zealand. Probably the most reliable and complete record is that obtained at the Meteorological Observatory, Wellington. By permission of Dr. E. Kidson, director of Meteorological Services, a tracing of this record is given here (Fig. 1). The record is from the Short and Mason M.O. pattern thermograph, in a Stevenson screen, under standard conditions for recording air temperature, located at an altitude of 415 ft. above sea-level. The thermograph was checked at intervals by comparison with a standard thermometer in the same screen. These check readings are indicated by black dots on the graph. A check reading at 10 hours 30 minutes, New Zealand Mean Time, just before the minimum, shows that the correction to the thermograph at minimum must have been very small. Another check reading at 11 hours, during the rise, indicates a slight lag in the rise of the thermograph. Evidently the minimum temperature occurred within a few minutes after the time of maximum eclipse, of which the magnitude at Wellington was 0·85. During the eclipse the sky was cloudless, and the normal course of the temperature curve would probably have been close to the dotted line shown in the graph. The difference between this line and the lowest point of the temperature curve corresponds to a temperature difference of 4·9° C.; which must be attributed to the eclipse. Records of eclipse temperature changes have been summarized by Clayton[2]; and from the figures given, it appears that the fall in air temperature at Wellington during the eclipse of December 13–14, 1936, was abnormally large, particularly for a partial eclipse.

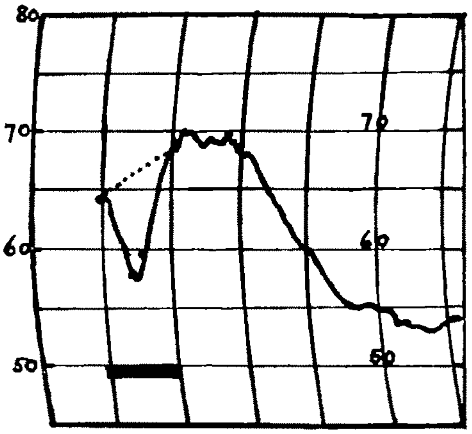

Fig. 1.

THERMOGRAPH RECORD OF AIR TEMPERATURE, KELBURN OBSERVATORY, WELLINGTON, N.Z., DECEMBER 14, 1936. THE PERIOD COVERED BY THE ECLIPSE IS INDICATED BY A BLACK STRIP BELOW THE THERMOGRAPH TRACE. BLACK DOTS INDICATE STANDARD THERMOMETER READINGS.

At Pukekohe, near the central line of the eclipse, observations of a thermometer in a Stevenson screen were made by the eclipse party under the leadership of Mr. C. B. Michie. A fall of 2·5° C. was observed during the eclipse, but this value may have to be increased slightly when the normal temperature change is taken into account[3]. The small fall at Pukekohe as compared with Wellington is due mainly to the effect of clouds at the former place. At New Plymouth, a short distance south of the central eclipse zone, a fall of 4·2° C. was registered by a thermometer in the shade[3].

Apart from the indications of the thermometer, the fall in air temperature was most apparent. The day of the eclipse was a public holiday, and at Wellington the weather was fine and warm. Consequently, a larger number of people than usual were out of doors; and to many, the chilliness of the atmosphere was the most outstanding phenomenon accompanying the eclipse.

R. C. HAYES.
(Acting-Director.)

Dominion Observatory,
Wellington.
April 1.

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[1] *Observatory*, 60, No. 752, 1–2 (Jan. 1937)

[2] *Trans Amer. Geophys. Union*, Seventeenth Annual Meeting, part 1, p 131.

[3] "Preliminary Report on Observations of the Annular Eclipse of the Sun, 1936 December 13·9d. G.M.T." (I. L. Thomsen); *Southern Stars*, 3, No. 2, 20–21 (March 1937).

Meteorites and the Craters on the Moon

DR. SPENCER's article on this subject in NATURE of April 17 will have been read with interest by many astronomers who have held some of the views set forth therein for more than twenty years. I am unable to say who it was that first realized that meteoric impacts on the surface of the moon would be of an explosive nature, and would therefore give rise to circular craters; but, so far as I know, this most important consideration was first brought to the public attention of astronomers by the late Prof. A. W. Bickerton, in the course of discussions at meetings of the British Astronomical Association in 1915[1].

Mr. A. C. Gifford, whose admirable treatment of the subject in more than one publication is referred to by Dr. Spencer, has shown, to my mind conclusively, that the meteoric theory is physically and dynamically sound, and that it affords the only satisfactory explanation of the lunar craters.

Mr. Gifford's work is well known to astronomers, and the whole question has several times been the subject of debate in recent years at meetings of the British Astronomical Association; so it can scarcely be said that the subject has not been duly ventilated. It is, however, a fact that the writers of some recent text-books have shown rather a conservative attitude, almost as though it were desirable to save the time-honoured volcanic theory at all costs, in spite of its many difficulties.

The apparent absence of large explosion craters from the surface of the earth was one of the most serious objections to the meteoric theory; but, now that Dr. Spencer has assured us that this is by no means a fatal difficulty, is it too much to hope that in future this attractive hypothesis will receive the serious attention which it most certainly merits?

W. H. STEAVENSON.

70 Idmiston Road,
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April 18.

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[1] *J. Brit Astron. Assoc.*, 25, 326, 366–67 (1915)

Determination of the Atomic Parameters in Anthraquinone Crystals

THE space group of anthraquinone crystals was found previously[1] to be D_{2h}^{13} *Pmmn*. The estimates of intensities of reflections from a large number of planes published have been utilized for the determination of atomic parameters. The best agreement has been found with the following orientations of the anthraquinone molecules. One molecule is placed with its centre having the parameters $x/a = 0 \cdot 25$, $y/b = 0 \cdot 142$ and $z/c = 0 \cdot 056$. Starting with the molecule placed with its plane parallel to the *ab* face, the correct position is obtained by rotating it by 1° about the z-axis, by 9° about the y-axis and by 30° about the x-axis. The two oxygen atoms are inclined to the carbon skeleton on the two sides but unsymmetrically. The positions and orientations of the other seven molecules in the unit cell are obtained from the equivalent positions corresponding to the space group D_{2h}^{13} *Pmmn*. The carbon skeleton has a plane structure with true hexagons and C—C distance the same as that in anthracene[2]. This is in very striking contrast to benzoquinone, in which the benzene ring is found to be deformed[3]. The complete details of the parameters and the comparison between the calculated and estimated intensities will be published elsewhere.

In conclusion, I wish to express my sincere thanks to Dr. K. Banerjee for his kind interest in the work.

BHAGAWATI CHARAN GUHA.

Midnapore College,
Midnapore, Bengal.

May 1.

[1] Banerjee, K., and Guha, B C, *Ind J Phys.*, 9, 287 (1934)

[2] Banerjee, K, *Ind J Phys.*, 4, 541 (1930). Robertson, J. M, *Proc. Roy Soc*, A, 140, 79 (1933).

[3] Robertson, J. M, *Proc Roy Soc*, A, 150, 106 (1935).

Points from Foregoing Letters

DETAILS concerning a natural bridge, formed by drifting materials, across the Nile below the Folar rapids (to which imperfect reference was made by Emil Ludwig in "Life Story of a River") are given by E. J. Wayland. Dr. H. E. Hurst supplies further information concerning the way in which such bridges come into existence, and suggests that pilots of the Imperial Airways who pass near this particular one during their flights might be asked to collaborate by keeping notes of its change with time.

A table of radioactive isotopes of oxygen, copper, gallium, bromine, silver, indium and antimony, the production of which can only be ascribed to the loss, and not to the capture, of neutrons, is given by W. Y. Chang, M. Goldhaber and R. Sagane. The loss of neutrons was brought about by irradiating with gamma rays of high energy produced by bombardment of lithium, beryllium or boron with protons, or by means of neutrons obtained from the same elements bombarded with deuterons.

J. Rotblat has obtained absorption curves of radium C γ-rays in lead, copper and aluminium, measuring the intensity of the γ-rays by the activity of a silver foil exposed to neutrons from a sample of beryllium irradiated by the rays. The curves are exponential and correspond to the mean quantum energy of $1 \cdot 96 \times 10^6$ eV., showing, in agreement with recent mass data, that only the hardest groups of these γ-rays are capable of extracting neutrons from beryllium nuclei. The divergent results obtained by Gentner are attributed to the back-scattering of slow neutrons.

When beryllium-containing mica is bombarded with slow (25 kV.) deuterons, neutrons are formed which induce radioactivity in silver. These neutrons, according to further experiments by E. Bertl, Prof. R. Furth, F. Oborl and Dr. K. Sitte, arise from the beryllium-deuterium nuclear reaction. The authors describe other experiments intended to determine the energy of the active neutrons, but these have proved, as yet, indecisive. They also give a curve showing the neutrons produced by deuterons of varying energy (0–35 kV.)

The combs of bantam and Leghorn capons can be made to grow, according to Dr. A. S. Parkes, by direct application of an alcohol-acetone-ether extract of pig ovaries, which indicates an androgenic activity of ovarian extracts due apparently to the presence of substances of the androsterone-testosterone group. The author refers to previous experiments which show that the adrenal glands also produce male sex hormones.

Results showing that small amounts of ascorbic acid (vitamin C) can inactivate infective doses of vaccinia virus inoculated into a rabbit testicle are given by I. J. Kligler and H. Bernkopf. Glutathione has a similar effect, but to a lesser degree, and the authors suggest that the action depends upon the oxido-reducing properties of ascorbic acid and glutathione.

Dr. S. Williams describes preliminary experiments on *Selaginella Martensii* and *S. Lobbii* which show that the presence or absence of heteroauxin is an effective factor in determining whether an angle-meristem shall develop as a rhizophore or as a leafy shoot.

A simple method of observing root growth under normal conditions is described by Dr. G. H. Bates. Glass tubes closed at the lower end are let into the soil in holes bored to a slightly larger diameter, and the roots are viewed at intervals by means of an arrangement of a mirror and an electric bulb.

A thermograph showing the falling of air temperature during the solar eclipse on December 14, 1936, at Wellington, New Zealand, is submitted by R. C. Hayes.

The current distribution in a long transmitting aerial, according to Prof. L. S. Palmer and Mr. K. G. Gillard, varies sinusoidally, with current nodes every half wave-length along the two parts of the aerial which are above and below the point of energy input, and the length of one part may be such that the current in the other part is either zero or a maximum. With a long receiving aerial, current nodes occur every *whole* wave-length measured from both ends of the aerial.

Prof. B. C. Guha has determined the atomic parameters of anthraquinone crystals. He finds that the carbon skeleton has a plane structure with C—C distances the same as in anthracene; and that the C—O bonds are inclined unsymmetrically to the carbon plane.

Research Items

Food of the Maya Indians

THREE expeditions to Yucatan have established the fact that male Maya in the Chichen Itza area have a basal heat production averaging from five to eight per cent higher than the commonly accepted standards for white men living in the northern parts of the United States. At the same time, whereas natives of sub-tropical areas usually have a metabolism lower than northern standards, the metabolism of the Maya is relatively high and is combined with a low heart rate and low blood pressure. In view of the possibility of a relation of this condition to diet, a quantitative and qualitative study of the Mayan present-day diet has been undertaken by Dr. Francis G. Benedict, director of the Nutrition Laboratory, and Dr. Morris Steggerda (Carnegie Institution, Washington, D.C. : *Contrib. Amer. Arch.*, 3, 18). It was also anticipated that this investigation might throw light on the diet and food customs of the prehistoric Maya. In the remoter parts of Yucatan, the diet of the modern Maya is still almost entirely independent of white man's civilization. The basic food is maize, with its products, but beans, squash, chile and native meat are also eaten, with, on the sea coast, some sea-food. Seasonings, such as garlic, pepper, leaves, cloves and chile, play an important part. This diet is essentially the same as is recorded in literary sources for the period 1500–1700, and probably goes back to a much earlier date. Precise analysis of protein, fat, and energy content of many items in the daily diet and of daily meals were made. On the average, 73 per cent of the daily energy intake comes from maize. The daily protein intake per individual averaged 74 gm., low rather than high. The daily energy intake averaged 2,565 total calories, low as compared with the American labourer (*c.* 3,500 calories). The energy intake averaged only 66 per cent above the basal needs shown by measured basal heat production. The basal metabolism is not explained, and may be an environmental or racial factor.

The Electric Eel

THE electric discharge of certain fishes has often aroused scientific interest and popular curiosity, and of all electric fishes, the electric eel (*Electrophorus electricus*) is the largest, and develops most power. In their account of the electric discharge of this species (*Zoologica*, 22, 1 ; 1937), C. W. Coates and R. T. Cox summarize the earlier information and pay tribute to the accuracy of Faraday's observations of 1839 and 1844. They themselves have measured the voltages and speeds of propagation of the electric impulse along the body of electric eels, finding that an anterior point on the body is always positive to a posterior point. Peak voltages of the order of 300 and peak wattage of the order of 40 are about the maximum for eels exceeding 50 cm. in length. The velocity of the pulse along the body is between 500 and 1,000 metres a second, and the discharges commonly occur in trains of one minor member followed by three to six major members separated by intervals of about 0·005 sec. The release of the electric discharge is likened to the release of ordinary muscular energy, and the discharge itself must be a cumulative effect of the activity of a large number of cellular elements, which may possibly be fully charged in the inactive state and are connected in series during the discharge.

Citrus Culture in Egypt

BULLETIN No. 44 (1936) of the Egyptian Ministry of Agriculture (Hort. Section) first published in 1924 and written by T. W. Brown, has been revised and brought up to date by Abbas el Sawy. It is a comprehensive treatise on methods of propagation and cultivation of citrus fruits, and should serve as a reliable manual for growers in Egypt with little previous experience of fruit growing. Citrus culture in Egypt has made rapid strides during recent years, the acreage under oranges and mandarines having risen from 6,215 acres in 1923 to 18,229 acres in 1934. In 1925, 7,375,297 kgm. of citrus fruits were imported, while in 1934 this was reduced to 897,808 kgm., and 2,867,469 kgm. of oranges and mandarines were exported. The information provided by the bulletin will undoubtedly prove an invaluable guide in this expanding industry. It is clearly written and contains information on all the cultural operations, including sections on budding and grafting and a critical account of the various rootstocks available. Every phase of the industry is dealt with from the preparation of the ground to the packing of the fruit, particular attention being given to irrigation and manuring. The latter half of the bulletin consists of an excellent catalogue of the numerous varieties of citrus fruits. This is very well illustrated, and the varietal characteristics are given in detail together with notes on the origin and history of the varieties.

Evaporation Records in the Netherlands

IN *Mededeelingen en Verhandelingen*, 39, 1936, Dr. C. Braak discusses evaporation records in the Netherlands and compares the results obtained with those for certain places in Germany and Switzerland. There are some very long records available in Holland, for example, at the Helder, but unfortunately insufficient continuity of method and lack of precise information about the earlier part of this record greatly reduces its value. For the period 1909–35, comparative figures are available for the evaporation from similar pans containing water at de Bilt and the Helder. The averages for the months of least and greatest evaporation are (1) de Bilt, 15 mm. in December and 133 mm. in July ; (2) the Helder, 25 mm. in January and 158 mm. in July. A table is included giving individual monthly totals for de Bilt from May 1897 to December 1935, with a few gaps in 1902 and 1903. Figures for a number of stations with shorter records are compared ; but it is concluded that the differences are caused more by variations of instrumental exposure than by climatic contrasts. Observations made with a floating pan in a pond near the Meteorological Institute, de Bilt, since 1932, are compared with similar observations made by Bindemann in a small lake north-east of Berlin (the Grimnitzee), and others made on the Yssel lake (the former Zuyder Zee) are compared with figures relating to two Swiss lakes. The paper closes with a discussion of the values of the constant in a well-known evaporation formula which makes the evaporation proportional to the saturation deficit, allowance being made for the influence of temperature on the mobility of the water vapour molecules and for the influence of wind speed.

Origin of Cosmic Rays

IN the issue of the *Journal of the Franklin Institute* of April, Dr. M. C. Holmes of the West Virginia University puts forward a theory of a terrestrial origin for cosmic rays. This is based on the Debye water molecule having its positive end heavier than its negative, and in consequence in a gravitational field having its positive end downwards when free to move. Except in polar regions, where it may be frozen, it has its negative end upwards and provides the negative charge known to exist on the earth's surface. Any positive charge produced in the stratosphere by solar radiation will move down towards the earth's negative charge until it reaches the polar air currents of the troposphere, which will carry it towards one of the poles, where positive charges will accumulate. An electric field will be produced between these charges and the negative charge on the non-polar regions, which will supply the 10^9 volts required to account for the production of cosmic rays. Dr. Holmes considers further the application of the same principle to account for the banded appearance of Jupiter, the rings of Saturn and other planetary phenomena.

Reactions of Atomic Deuterium with Paraffin Hydrocarbons

IN addition to an investigation of the photosensitized reaction between methane and deuterium, an investigation of the interaction of atomic deuterium with methane, ethane, propane and butane for temperatures up to 310° C. has been carried out at Princeton University (Taylor *et al.*, *J. Chem. Phys.*, 5, 205; 1937). The nature of the reaction products and the extent of deuteration have been determined by two methods, a fractionation method and a thermal method. For methane, no exchange occurred below 200° C. and at 310° C. the exchange amounted to ten per cent. At temperatures above 27° C. ethane is decomposed by atomic deuterium yielding methane of high deuterium content, but the rate does not become measurable until 100° C., and thereafter increases as the temperature rises. Both propane and butane are relatively slightly decomposed, the products containing a surprisingly large amount of highly deuterated methane. For methane it is impossible to decide between the mechanisms (*a*) $CH_4+D=CH_3D+H$, and (*b*) $CH_4+D=CH_3+HD$ with subsequent reaction of the methyl radical. The C-C bond is readily split by atomic deuterium at room temperatures, presumably by either (*a*) $D+C_2H_6=C_2H_5+HD$ or (*b*) $D+C_2H_6=CH_3+CH_3D$; and of these, (*b*) finds greater favour because of the high deuterium content of the resultant methanes. Above 100° C., deuteration of ethane becomes more pronounced and takes place at the expense of deuteromethanes. The experimental data further show that the deuteration of an alkyl radical occurs much more readily than deuteration of the hydrocarbon. Activation energies have been calculated and from these the bond energies for $CH_3—H$ and $CH_3—CH_3$ have been deduced.

New Mercury Vapour Discharge Lamps

ALL types of metal vapour discharge lamps require a series 'ballast' to prevent the current through the lamp rising to too high a value. In the Engineering Supplement to the *Siemens Magazine* of May, a description is given by J. N. Aldington and G. O. Stephens of the new low-wattage mercury vapour discharge lamps taking 80 watts and 125 watts respectively, which are now on the market. The ballast may be in the form of a choke coil or simply a filament which supplies useful light while limiting the current. The inner bulb of the new lamps is made of quartz. This substance can be operated at temperatures up to 1,000° C. without showing harmful discolorations. The quartz interior is mounted inside a lamp bulb of standard shape with a pearl finish. As is common with all types of high-pressure metal vapour discharge lamps, the new lamps require a few minutes after being switched into circuit before the full light output is attained. Under normal working conditions, the full light output is reached in approximately five minutes. When they are switched out of circuit, they require a period of three minutes before the arc will restrike. After this restriking period, full light output is attained in a shorter time. The radiation from the inner bulb is very rich in ultra-violet rays. For this reason, it is important that the lamps should not be operated if the outer bulb becomes accidentally broken. The inner surface of the outer bulb is coated with 'luminescent' powder; very efficient powders of this nature (both fluorescent and phosphorescent) are now prepared on a commercial scale. These powders are used to supply the red and blue light in which the mercury discharge is deficient.

Motion and Figure of the Moon

DR. H. SPENCER JONES has published a paper "The Mean Motion of the Lunar Perigee and Node and the Figure of the Moon" (*Mon. Not. Roy. Astro. Soc.*, 97, 5, March 1937) in which important conclusions are drawn regarding certain discrepancies in the observed libration results and those obtained by theoretical considerations. Prof. E. W. Brown's computations on the motions of the lunar perigee and node had neglected terms of the fourth and sixth order; these have now been taken into consideration. The motions of the perigee and node contain terms due to solar and planetary actions, the mass of the earth, the figures of the earth and moon, and a relativity correction. Accounting theoretically for all these except the figure of the moon, and comparing with observation, the residuals can be accounted for by the lunar figure. The well-known parameter f has been assigned various values by different investigators, and this has given rise to considerable speculation on certain discrepancies. If A, B, C, be the principal moments of inertia of the moon about its centre, f is defined as the ratio of $(B-A)/(C-A)$, and this can be determined, knowing the mean inclination of the moon's equator to the ecliptic, and also the amplitude of the moon's true libration in longitude. The former is known with considerable accuracy; the latter with less certainty. Dr. Spencer Jones now finds that $f=0·68\pm0·09$, in good agreement with the values deduced from the librations in longitude. The value of the ellipticity of the earth is found to be $1/e=296·08\pm0·95$, which is a little smaller than that obtained by Jeffreys, 296·38, who used the unrevised motions of the lunar perigee and node in his computations.

The Cyclol Theory and the 'Globular' Proteins*

By Dr. D. M. Wrinch

A NUMBER of facts relating to proteins[1] suggest that the polypeptides in native proteins are in a folded state[2,3]. The type of folding must be such as to imply the possibility of the regular and orderly arrangement of hundreds of amino acid residues, which to some extent at least is independent of the particular residues in question.

At present two types of folding have been suggested, the cyclol type[3,4] and the hydrogen bond type[5]. The search for other types of folding is being continued. So far, it has not proved possible to discard either theory on the grounds that the type of link postulated is out of the question. It is, therefore, very desirable to test these theories by checking their implications against known facts Accordingly it is now considered whether the cyclol theory can stand the test of the body of facts relating to the 'globular' proteins, established by Svedberg and his collaborators[6].

THE CYCLOL FABRIC

In previous communications the cyclol postulate has been applied directly to polypeptides, and a number of molecules, cyclol 6, cyclol 18 ... and the general cyclol fabric (Fig. 1) have been suggested for consideration. These are all of one polyhexagonal type, in which the individual hexagons are alternately '2-way' diazine hexagons sharing opposite sides with triazine hexagons and '3-way' triazine hexagons sharing alternate sides with diazine hexagons. In default of information as to the sides and angles of these hexagons, a mean value is at present adopted for the C—C and C—N distances indifferently, and the tetrahedral angle δ as the valency angle for C. The valency angle for N is also taken as δ, since it has this value in hexamethylene tetramine[7], in which, as in the cyclol fabric, each N atom is joined to three C atoms.

In accordance with these assumptions, the individual hexagons in the cyclol fabric are at present taken to be 'crumpled' as in cyclohexane. The mid-points of the sides of a 'crumpled' hexagon are the vertices of a plane hexagon, and the geometrical problems can be simplified by taking these plane hexagons as the fundamental units in a 'median' network which represents the cyclol in a new way, each 'crumpled' hexagon being replaced by a 'median' hexagon.

In previous communications the cyclols have been considered only in the case when all the median hexagons lie in one common plane. With this limitation there has, of course, been no question of building a closed (that is, a space-enclosing) cyclol. To do so, it is necessary to investigate the conditions under which a cyclol fabric can bend about a line. Evidently it is permissible for two abutting median hexagons to lie on different planes, if the angle between the planes is the tetrahedral angle δ. Thus a cyclol fabric need not have a single median plane, but may turn about certain lines provided that the angle between abutting median planes is δ. The problem of the possible existence of space-enclosing cyclols can then be stated precisely as follows. Is it possible for a cyclol network to bend across one line after another so that it joins up and thus surrounds a portion of space ? In other words, can a cyclol network be drawn, not on a plane but on the surface of some polyhedron such that the faces at any edge crossed by the network abut at the tetrahedral angle ?

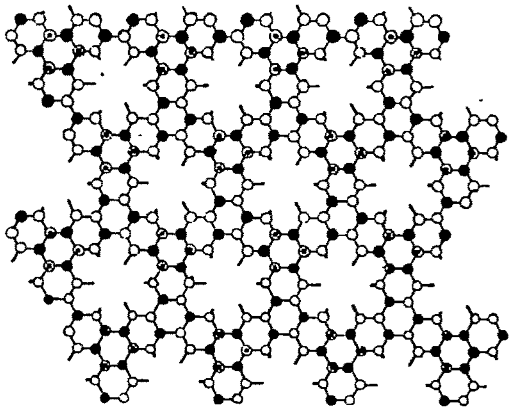

Fig. 1.

THE CYCLOL PATTERN. THE MEDIAN PLANE OF THE LAMINA IS THE PLANE OF THE PAPER. THE LAMINA HAS ITS 'FRONT' SURFACE ABOVE AND ITS 'BACK' SURFACE BELOW THE PAPER.

● = N.

○ = C(OH), PEPTIDE HYDROXYL UPWARDS.

○ = C(OH), PEPTIDE HYDROXYL DOWNWARDS.

○— = CHR, DIRECTION OF SIDE CHAIN INITIALLY OUTWARDS.

○- = CHR, DIRECTION OF SIDE CHAIN INITIALLY UPWARDS.

THE CLOSED CYCLOLS

To solve this problem, all the polyhedra in which some at least of the dihedral angles are equal to the tetrahedral angle will be considered in turn. As a first step it is remarked that among the regular and semi-regular polyhedra[8], only four satisfy the conditions. These are the truncated tetrahedron, the octahedron, the truncated octahedron and the skew triangular prism. On this occasion, as an example of this method of building megamolecules, attention is directed to the truncated tetrahedron, on which it has proved possible to draw closed cyclol networks. These networks form a linear series $C_1, C_2, \ldots C_n, \ldots$ which comprise $72, 288, \ldots 72n^2, \ldots$ amino acid residues. Figs. 2 and 3 show models of C_1 and C_2 in which the cyclol fabric is represented by the median hexagons. These models have 4 hexagonal faces, 4 triangular faces and 6 slits. The actual distribution of the (C—C—N) groups of atoms in the amino acid residues in the molecule can be inferred from the median hexagons, which are to be regarded simply as a shorthand notation.

The possibility of building closed cyclols on the other polyhedra mentioned above and on polyhedra which are not regular or semi-regular is being investigated. If they can be constructed they will also exist in linear series, each comprising numbers of residues represented by a quadratic function of the natural numbers 1, 2, . . . n, . . .

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* This article is based upon lectures given at the Harvard, Yale and George Washington University Medical Schools and at the Medical Centre, Columbia University, in October and November 1936 Communicated to the Editor of NATURE on March 10, 1937

The cyclol hypothesis therefore predicts the existence of one or more series of 'space-enclosing' protein molecules, each series comprising numbers of residues given by a quadratic function of the natural numbers 1, 2, 3, . . . n, . . . and in particular of a series C_1, C_2, . . . C_n, . . . having the shape of truncated tetrahedra and comprising 72, 288, . . . $72n^2$, . . . residues.

These predictions are, it is claimed, confirmed by the results obtained by Svedberg and his collaborators[6].

(1) It is found that certain proteins are 'globular' molecules which, in appropriate circumstances, are monodisperse. The cyclol theory implies the existence of space-enclosing molecules containing certain specific numbers of amino acid residues: their polyhedral character is in accord with and offers an interpretation of the nature of this 'globularity'.

(2) It is found that certain molecules exist in different degrees of association in solutions of different pH, having a maximum molecular weight in a certain pH range and dissociating reversibly into molecules with submultiple molecular weights on one or both sides of this range. This is interpreted to mean that, in certain types of protein, the molecule will form multiple molecules at appropriate pH values by linkages between peptide hydroxyls or by salt linkages between side chains, the process of dissociation on changing the pH being reversible.

(3) It is found that the molecular weights of proteins are not distributed at random, but fall into a sequence of widely separated classes, the molecular weights in one class varying by as much as 15 per cent from a mean value. This is interpreted to mean that the proteins falling into one of these classes have a common structure as regards the arrangement of the constituent amino acids, and it is further suggested that each class connotes one closed cyclol network or an association of a certain number of such units. The variation in molecular weight within a class is then accounted for by the different selections of residues in the various proteins which can yield an average residue weight varying (say) from 100 to 135, which may also entail the presence of different numbers of water molecules in the molecule[9]. A further modification is also introduced if imino acid residues are present.

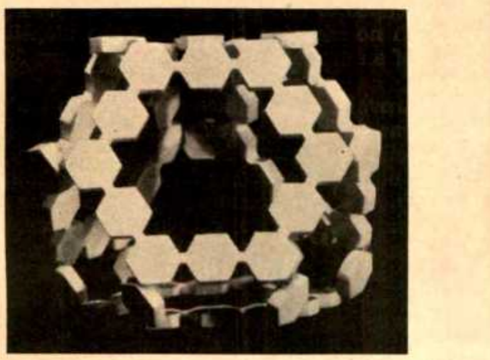

Fig. 2.

These tests are only qualitative. It would be of greater interest to apply more stringent quantitative tests. This will only be possible when data are available which give, for some of the 'globular' proteins, the shape of the molecule, the average value of the weights of the contained amino acid residues, the number of imino acid residues and the numbers of water molecules which form an integral part of the molecular structure.

It is, however, suggested for consideration in the future, that the group of proteins with molecular weights ranging from 33,600 to 40,500[10] are closed cyclol molecules of type C_2. This molecular weight class is of particular importance, since Svedberg has suggested that very many, possibly most, other proteins have molecular weights which are multiples of (say) 36,000.

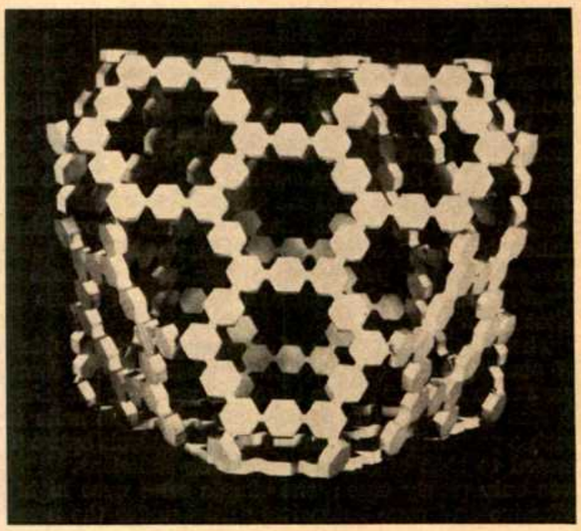

Fig. 3.

Full details of this work will appear shortly.

Postscript added May 28, 1937: My attention has been directed to recent work by Bergmann and his collaborators, which strongly confirms the conclusion reached above. In particular, it may here be put on record that one of the predictions has now been verified: Bergmann and Niemann (*J. Biol. Chem.*, **118**, 301; 1937) deduce from the chemical analysis of egg albumin that this molecule (which belongs to the group of proteins with molecular weights in the neighbourhood of 36,000) consists of exactly 288 residues as predicted by the cyclol hypothesis. Full details of my work are in course of publication in the *Proceedings of the Royal Society*.

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[7] Dickinson and Raymond, *J. Amer. Chem. Soc.*, **45**, 22 (1923). Wyckoff and Corey, *Z. Krist.*, **89**, 426 (1934).

[8] Andreini, *Soc. Ital. d. Scienze*, **14**, 75 (1907).

[9] Jordan Lloyd, *Biochem. J.*, **14**, 147 (1920); **21**, 1352 (1927); **25**, 1580 (1931). *Biol. Rev.*, **8**, 463 (1933).

[10] Svedberg and Eriksson-Quensel, "Tabulæ Biologicæ Periodicæ", **5**, 351 (1935–36).

Chemistry and Agriculture

THE thirty-eighth Bedson Lecture was delivered by Sir John Russell, director of the Rothamsted Experimental Station, on "Applications of Chemistry to Modern Food Production", at Armstrong College, Newcastle-on-Tyne, on May 21.

Sir John approached the problem by a short survey of British agriculture. His conclusions are: we are eating less bread but more meat, vegetables, butter, cheese to-day than in 1913, and although home production of milk, potatoes and vegetables is high, the home production of butter and flour is low, a matter of significance from the point of view of defence. The farmer, he said, must be judged on his own efficiency and not on the ultimate bulk production of agriculture, and statistics show that although there are fewer farmers now than in 1913, the output per person is greater and he feeds a greater number of persons than do the farmers of most other countries.

The classical approach of chemistry to the problem of plant growth was to find a substitute for farmyard manure, and at the time this was first broached it was suggested that a mixture of simple salts in such a proportion that the ultimate analysis approximated to that of manure would be sufficient. This was only partly true; the simple salts were highly effective and were extensively used under the name of artificial fertilizers, but the optimum proportions could be ascertained only by field trial. Interesting consequences followed from the circumstance that these fertilizers contained not only the specified plant nutrient but various amounts of other elements also. Extensive use of chemical fertilizers pushed up production for foodstuffs even where the actual acreage under cultivation has fallen.

Less is known of the more complex problem of the actual elements necessary to plant growth and their action. Science is advancing along two lines of investigation: trial and error methods and systematic statistical investigation. With regard to the function of the necessary elements, a study of plant deficiency diseases has proved useful. Examples of the results are: the addition of borax in certain conditions causes better growth of certain plants; and traces of manganese, copper and other elements appear to be essential to good growth. Some plants will take up particular nutrients more readily than others, so that the correct choice of a fertilizer will lead to preferential growth of these plants.

The soil is now receiving attention from chemists. One method of attack is to carry out field experiments in different types of soil with the same groups of fertilizers and to correlate the results with those of chemical examination. The method is slow and has to be rigorously controlled on a statistical basis.

Finally, Sir John dealt with the organic constituents of manure and described how experiments are carried out from two directions: the investigation of extracts of manure and the use of known organic compounds in growth tests. Examples of compounds exercising a marked effect on growth are indoleacetic acid and naphthalene-acetic acid.

Macculloch's Geological Map of Scotland

WHEN Henry T. de la Beche was trying, in the early eighteen-thirties, to persuade the Government to allow him to undertake an official geological survey of Great Britain, he encountered many objections of a financial nature. Even in 1840, five years after the "Ordnance Geological Survey", as it was at first called, had been officially established, and de la Beche sought permission to spend the winter in London instead of in the field, a letter from the Board of Ordnance stated that the authorities had "adverted to what occurred in respect of the Scotch Geological Survey, and they desire that special care may be taken to prevent the occurrence of a similar fault in the English Survey".

As a result of the perusal of a Parliamentary paper dealing with the expenses of the "Mineralogical Survey of Scotland", submitted to the Commons in 1830, and of the minute books of the Highland and Agricultural Society of Scotland, Mr. V. A. Eyles has been able to show exactly what transpired in Scotland to make the authorities reluctant to give too free a hand to a man so enthusiastic and energetic as de la Beche.

The circumstances connected with the appointment of Dr. John Macculloch as geologist to the Trigonometrical Survey, and the preparation of his geological map of Scotland, which was not published until 1836, the year after his death, are outlined in a paper entitled "John Macculloch, F.R.S. and his Geological Map; an account of the first Geological Survey of Scotland" (V. A. Eyles, *Annals of Science*, **2**, 114–129; 1937). It appears that Macculloch's salary was to be £2 per day during the time he was at work, with an allowance of £1 a day for personal expenses, and 2*s*. for every mile he travelled. There was also an allowance of £90 per season for an assistant, but although no mention is made of the identity or the duties of an assistant, the pay was drawn for several years.

The travelling allowance gave rise to trouble with the Treasury, for in 1828 Macculloch charged for 7,764 miles of travel in 184 days. The auditors pointed out that, allowing for a journey from London to Glasgow, which accounted for 735 miles and four days, and for no work being done on Sundays, Macculloch must have travelled, on an average, 51–52 miles a day, which was, the report continues, "a rapidity of travel, which would hardly allow much time for scientific observation".

It would be unfair to the memory of a great man to refer only to this aspect of his work, for he was hard working and competent, and, as Mr. Eyles points out, in spite of the difficulties arising from a lack of good topographical maps, Macculloch's geological map of Scotland has stood the test of time. It became the basis of all subsequent geological maps of that country, and there are still areas of which little more is known than was recorded more than a century ago by that versatile Guernsey-born Scotsman.

F. J. N.

Science News a Century Ago

The Snake Nut Tree of Guiana

AT a meeting of the Linnean Society held on June 6, 1837, two communications were read from Robert Hermann Schomburgk (1804–65), who in 1831–35 explored British Guiana on behalf of the Royal Geographical Society. The first of these dealt with several new species of Orchideœ found in Guiana, and the second with the snake nut tree. The nut, he said, was the size of a walnut, and when the kernel was opened, and the membrane removed, there was an appearance of a snake lying with its body coiled up, the head, eyes and mouth being very distinct. From this appearance, by some singular analogy, it was employed as a remedy for the bites of snakes, for which it enjoyed a considerable reputation. The colonists were unacquainted with the mode of its growth as they only found it on the banks of brooks and rivulets after floods, but imagined that it grew on a creeper by the side, which explained the reason that it was found on the low islands and in these situations. Having been informed of the whereabouts of the tree, Schomburgk visited it, but it was not sufficiently far advanced for him to recognize the class and order to which it belonged. The tree was of the first magnitude, its branches dividing at a height of 40–50 feet. It contained nothing remarkable except the fruit, which was not known to possess any medicinal properties.

Schomburgk, who was born and educated in Germany, was Government Commissioner for surveying and making boundaries in British Guiana in 1841–43, establishing the 'Schomburgk line'. In 1844 he was knighted.

Vyse's Exploration of the Egyptian Pyramids

IN 1835–37, Colonel (afterwards Major-General) Richard William Howard Vyse (1784–1853) explored the pyramids of Egypt, and some of his discoveries were described in letters read to the Royal Society of Literature on June 8, 1837. The principal results of his exertions were the discovery of three large chambers in the Great Pyramid and the excavation of a remarkable mummy pit in its vicinity. The first of the newly opened chambers was 38 ft. 6 in. from east to west and 17 ft. 1 in. from north to south. This had been named the Wellington Chamber by Colonel Vyse, and he had had that illustrious name inscribed on its northern walls. The second chamber he had named after Nelson, and the third after Lady Arbuthnot, who was present at its discovery. The three chambers were above one another, and it was supposed their object was to lessen the superincumbent weight above the King's Chamber. A great quantity of drawings had been sent home to be engraved, including accurate sections of all the pyramids, and facsimiles of hieroglyphics in the newly discovered chambers.

The Royal Astronomical Society

THE last meeting of the session of the Royal Astronomical Society was held on June 9, 1837, when several papers were read. Baily, the president, who was in the chair, communicated a paper on the non-existence of the star called 42 Virginis, the insertion of which into the British Catalogue of Flamsteed he attributed to an error in computation. Baron Zach had given, in his zodiacal catalogue, a star which he called 42 Virginis, which, however, did not agree with the position given by Flamsteed, but what was very singular, this star also was not then found in the heavens.

Another paper was by Main, principal assistant at the Royal Observatory, on the position of the node, and the inclination of Venus. It appeared that Encke had altered the place of the node from the observations of the transits of 1761 and 1769, and this was found not to correspond with the best modern observations. Main therefore had undertaken the arduous task of determining these positions anew from observations made by Airy at Cambridge.

Premiums offered by the Zoological Society

IN the *Athenæum* of June 10, 1837, it was stated that the Council of the Zoological Society had determined to offer annual medals, or equivalent sums of money, by way of premiums for subjects connected with zoology. The premiums for 1837 were to be awarded for the following: (1) For importing either a pair of musk oxen, or a specimen of the hippopotamus, male or female; or a pair of the *Ornithorhynchus paradoxis*; (2) to the breeder of the greatest number of curassows in the year 1837; (3) to the importer of a male and female Indian pheasant, of a species not already alive in Great Britain; (4) to the breeder of the best specimens of Indian fowls in the year 1837; (5) to the breeder of the most rare or most interesting foreign quadruped in the year 1837; (6) for the best essay on the care and treatment of the species of the genus *Felis* in confinement.

University Events

ABERDEEN.—A capital sum has been given anonymously to the University for the foundation of a part-time lectureship on psychopathology. It is a condition of the gift that the lecturer shall not be an alienist and that the clinical work should be done at the Royal Infirmary. £500 has also been received from Lord Glanely for research in rheumatism.

CAMBRIDGE.—Dr. H. Hamshaw Thomas has been appointed reader in plant morphology; Dr. W. B. Lewis, of Gonville and Caius College, University lecturer in physics; Dr. H. Carmichael, of St. John's College, E. S. Shire, of King's College, University demonstrators in physics; and Dr. W. C. Price (Wales and Johns Hopkins), and Dr. E. A. Moelwyn-Hughes, of Corpus Christi College, University demonstrators in chemistry.

G. L. Clark, of Fitzwilliam House, has been elected to the Sheepshanks Exhibition for 1937.

It is proposed that a second assistant directorship of research in colloid science be established, and that the General Board be authorized to appoint in the first instance to this post Dr. J. H. Schulman.

The following have been approved for the degree of Sc.D.: B. H. C. Matthews, of King's College; R. S. Morrell, of Gonville and Caius College; G. C. Steward, of Gonville and Caius College; and L. R. Cox, of Queens' College.

LONDON.—The University enters upon its second centennium (the completion of its first hundred years was celebrated last July) with a student enrolment of approximately twenty-five thousand. The report recently presented by the acting principal on the work of 1936–37 gives the number of internal students as 12,734, and of these nine tenths were reading for degrees and diplomas, namely, in science (3,727), medicine (3,309), arts (2,957), engineering (1,351) and economics (1,001). Of the external students, some 11,000 in all, 6,779 entered for examinations, and of these nearly three fifths were receiving instruction in institutions in London (1,200) or elsewhere; two thirds of the remainder were prepared by correspondence courses and the rest wholly by private study. An indication of the world-wide extent of the university's contacts is to be found in the fact that the lecturers in the forty-nine courses of special lectures arranged by the Senate were drawn not only from the British Isles but also from Austria, Belgium, China, France, Germany, Holland, Hungary, Italy, South Africa, Sweden and the United States. The report chronicles a significant event in the field of physical culture: for the first time in its history, the University took part in an international athletic match, namely, between teams from the Universities and from boys' schools of Paris and London.

A Carpenter Medal with a money prize of the value of £20 in all will be awarded this year for work of exceptional distinction on statistical, genetic, comparative or experimental psychology including the functions of the cerebro-spinal system, for which a doctor's degree (other than the Ph.D.) has been awarded during the period of three years ending May 31, 1937. Applications should be made not later than June 10 to the Academic Registrar, University of London, from whom further information may be obtained.

Oxford.—At Encænia on June 23, honorary degrees will be conferred upon the following, among others:—D.C.L.: The Right Hon. W. G. A. Ormsby-Gore, Hon. R. H. Brand and Sir Herbert Baker. D.Sc.: Prof. Walter Nernst. D.Litt.: Dr. G. P. Gooch.

Prof. W. L. Bragg will give the Robert Boyle Memorial Lecture in the Museum at 8.45 p.m. on June 11. His subject will be, "The Crystallization Patterns of Alloys".

Societies and Academies

Edinburgh

Royal Society of Edinburgh, May 3.

H. H. Read: Metamorphic correlation in the polymetamorphic rocks of the Valla Field Block, Unst, Shetland Islands. Three metamorphisms under widely different physical conditions have affected the rocks of the western part of Unst. The mineral assemblages produced during each metamorphism in rocks of different compositions—pelitic, calcareous, siliceous, migmatitic, granitic and hornblendic—are correlated both isophysically and isochemically. It is concluded that in polymetamorphism the stability of an assemblage depends upon the bulk-composition of the rock, and that minerals cannot be considered apart from the rocks in which they occur.

J. Small: Quantitative evolution (2). Compositæ *Dp*-ages in relation to time. Using a geological time scale similar to that of Barrell, but with a longer Pliocene like that indicated by Urry (Nature, Feb. 20, p. 334), all the five average tribal *Dp*-ages of Compositæ are found to lie on or near a curve with the formula—$Dp.k+n.d.=t_k.2^n$; for Compositæ $k=0{\cdot}6$; $d=0{\cdot}9$; $t_k=1{\cdot}09375$ million years. From this bat curve, it is calculated that the free doubling period is approximately two million years. (3). *Dp*-ages in Gramineæ. The bat curve for Compositæ is applied to the grasses. The evolutionary sequences of *Dp*-ages in terms of time are found to be in almost complete agreement with the views given by Bews in his "World's Grasses".

W. Graham-Smith and T. S. Westoll: A new long-headed Dipnoan fish from the Upper Devonian of Scaumenac Bay, P.Q., Canada. During the summer of 1934, three specimens of a very distinct new Dipnoan were found at Scaumenac Bay, Quebec. These are described under the name *Fleurantia denticulata*, gen. et sp. nov. The species differs from other Dipnoans in having an extreme elongation of the snout. The dentition consists of a series of large conical teeth and a granulation of smaller teeth. The snout-elongation is shown to be probably correlated with the development of a sectorial dentition and with corresponding feeding-habits.

W. J. Hamilton: The early stages in the development of the ferret: the formation of the mesoblast and notochord. The mesoblastic cells arise from the ectoderm at the site of the future primitive streak. The cells spread anteriorly and laterally as two sheets which meet at the anterior part of the embryonic disk. Henson's Knot does not appear until the primitive streak is well formed and it is separated by a narrow neck from the anterior extremity of the streak. From the anterior part of Henson's Knot the archenteric process with the archenteric canal develops. The cells of the archenteric process become intercalated in the yolk-sac endoderm and form the archenteric plate which terminates anteriorly in the prochordal plate.

W. O. Kermack and A. G. M'Kendrick: Some distributions associated with a randomly arranged set of numbers. In a previous paper, certain frequency distributions associated with the occurrence of sequences or 'runs' of continuously increasing or decreasing numbers in a long series of randomly arranged unequal numbers, have been made use of as the basis of a test of randomness. The general mathematical theory of the distributions of such runs is now discussed for (*a*) an infinite linearly arranged set, (*b*) a finite linearly arranged set, and (*c*) a finite cyclicly arranged set of numbers. The distributions are in general obtained as solutions of difference equations, and expressions are given for the generating functions of these frequency distributions.

K. B. Lal: Immature stages of some Scottish and other Psyllidæ. In the course of previous researches (*Trans. Roy. Entom. Soc.*, 83; 1934) the author realized the difficulty of associating the immature stages of the thirteen species discussed with their particular species. Full descriptions of these stages are therefore given for each species, and the various characters important in distinguishing the species are clearly and carefully illustrated.

D. S. Raitt: The benthic Amphipoda of the north-western North Sea and adjacent waters. Some 3,000 amphipods secured over the Scottish area by Peterson grab and from haddock stomachs were identified and their distributions studied. When division of the North Sea by the 40 and 100 metre depth contours was adopted, the rates of occurrence of the order in the three zones formed was 3 : 2 : 1.

The species, and their abundances, also varied from zone to zone. The genus *Ampelisca* was outstandingly abundant, however, forming 55 per cent of the grab material, with the single species *A. brevicornis* in complete domination, forming 25 per cent of the total grab captures.

Capetown

Royal Society of South Africa, March 17.

F. G. Cawston: Some characteristics of *Bulinus* and *Physopsis*. Considerable variation is observed in several species of *Bulinus*, so that the various shells may resemble one another very closely. *Physopsis africana* Krauss is readily distinguished by its relatively constant columella. It does not adhere so firmly to floating vegetation as allied shells; but, unlike the operculated shells, is a favourite food for ducks.

W. E. Isaac: Studies of South African seaweed vegetation. (1) West coast from Lambert's Bay to Cape Point.

J. C. Smuts: (1) The climate and stone implements of Rooikop. (2) Past climates and pre-Stellenbosch stone implements of Rietvlei (Pretoria), and Benoni.

F. E. Fritsch and F. Rich: (12) Algæ from the Belfast Pan, Transvaal. Belfast Pan is situated in the Transvaal Highveld, 120 miles due east of Pretoria, in a depression on top of a kopje. Samples of the algal vegetation were collected by Dr. E. M. Doidge in 1909, 1913, and 1924. It is remarkably rich in desmids, at least 143 species being present. The wealth of new varieties and forms may perhaps be correlated with the isolation of the Pan. Conjugation was seen in forty species.

M. R. Drennan: The Florisbad skull and brain cast.

B. V. Skvortzov: Contribution to our knowledge of the fossil diatomaceous flora of South Africa. (1) Fossil diatoms from distomaceous limestones from pan near Franzenkop and Prieska, Cape Province.

Cracow

Polish Academy of Science and Letters, March 8.

D. Doborzynski: Measurements of the dielectric constant by means of ponderomotive forces (1), (2) and (3). Discussion of the limitations of the method. Application to quartz crystals.

Th. Banachiewicz: The calculation of determinants.

M. Kamienski: The appearance of the Wolf I comet in 1933–34.

L. Marchlewski and W. Bednarczyk: The absorption of ultra-violet rays by certain organic substances (43). Results for lævulose, glucose and some sugars.

L. Marchlewski and Mlle. R. Grunbaum: Absorption of ultra-violet rays by certain organic substances. (44) Results for substances of importance in physiology. Also the spectra of the three isomeric nitranilines. (45) Phenanthrene derivatives.

L. Marchlewski and W. Bednarczyk: (46) Data for 8-hydroxyquinoline, for unsaturated acyclic alcohols, kiketopiperazine, benzophenone and *p*-toluyl-2-benzoic acid.

L. Marchlewski and J. Dabrowski: Studies on cellulose from flax. Comparative studies of cellulose from flax and from cotton.

B. Skarzynski: Spectrographic studies of the processes of enzyme hydrolysis of saccharose and of maltose.

A. Kocwa: New syntheses of compounds of the pyrazoquinoline type.

L. Chrobak: Analyses of the minerals formed on silver coins of the fifteenth century.

J. Dembowski: Contribution to the problem of instinct.

W. Swienty: The earliest stages of development of the blood vessels in the wing of the fowl.

Geneva

Society of Physics and Natural History, February 18.

K. H. Meyer and J. F. Sievers: The appearance of rubber-like elasticity in selenium. Grey amorphous selenium, heated to between 70°–79° C., acquires an elasticity recalling that of india-rubber, due to the formation of long directed molecular chains.

J. Weigle and H. Saini: The transformation of heavy ammonium chloride. The authors have studied heavy ammonium chloride under X-rays, and have found a sudden change of dimensions of the lattice in the neighbourhood of $-22°{\cdot}5$ C. instead of at $-30°$ C. as with ordinary ammonium chloride.

P. Dive: The geometry of the rotating disk in the Einstein system. The author maintains that the natural geometry of rigid bodies involved in the rotation of the disk is Euclidian.

G. Tiercy: A differential equation met with in a problem of aerodynamics. This concerns the study of the wind. It is found that the equation in question can be used with difficulty.

P. Rossier: (1) The relation between the brightness, colour index and effective wave-length of a star. The brightness is proportional to the colour index. The author generalizes this property in the case of receivers with non-concentrated sensibility. (2) The mean colour index of stars in the neighbourhood of bright stars. This index varies linearly as a function of the guide star. (3) An orthochromatic plate, the sensibility maxima of which have very unequal acuteness. For the Tizian plates, figures for acuteness are found of 41·6 and 940, the ratio of which is the highest known up to the present.

Sydney

Royal Society of New South Wales, April 1.

E. Booth: Some tests of thermal constants of glass bricks. Glass bricks are now regularly used for structural purposes; the type provided to the author (by the Australian Window Glass Pty. Ltd.) were hollow and of external dimensions 16·5 cm. by 16·5 cm. face and 10 cm. depth, the thickness of the glass walls being about 0·8 cm. The faces were patterned both inside and outside (crossed cylindrical lenses) on both fronts so as to prevent direct vision through the blocks, and were constructed in two moulded parts, sealed together by an aluminium solder at 1,400° F. so that the hollow was a partial vacuum, being closed at atmospheric pressure at a temperature of 1,100° F. Tests on thermal transmission (apart from radiation) were made between one face at room temperature and one at 0° C., suitable and satisfactory insulating precautions being adopted; the method is described. The result for a block is 1·8 gm. cal./min./cent./deg. per block, being 0·39 gm. cal./hour/sq. cm./cent./deg. face difference.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, June 7

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Peter Mott: "A Survey of West Greenland".

Tuesday, June 8

WARBURG INSTITUTE, at 5.30.—Miss Violet Alford: "Carnival and Saturnalia".*

Thursday, June 10

CHADWICK PUBLIC LECTURE, at 5—(at the Chelsea Physic Garden, Swan Walk, S.W.3).—H. Gilbert-Carter: "Plants in Health and Disease".*

Friday, June 11

UNIVERSITY OF OXFORD, at 8.45—(in the Museum).—Prof. W. L. Bragg: "The Crystallization Patterns of Alloys" (Robert Boyle Memorial Lecture).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING in the Chesterfield Technical College—The Clerk to the Governors (June 7)

ASSISTANT CIVIL ENGINEERS in the Directorate of Factories, War Department—The Chief Superintendent of Ordnance Factories (Advt No 140), Royal Arsenal, Woolwich, S E 18 (June 8).

LECTURER IN GEOGRAPHY in Birkbeck College, Fetter Lane, E C 4—The Secretary (June 10).

ASSISTANT (grade II) in the External Ballistics Department, Ordnance Committee, Royal Arsenal, Woolwich, S.E 18 (June 11).

ASSISTANT MASTER IN CHEMISTRY (subsidiary biology) in the South-East Essex Technical College, Longbridge Road, Dagenham—The Clerk to the Governors (June 12).

HEAD OF THE DEPARTMENT OF MATHEMATICS AND PHYSICS in the Polytechnic, Regent Street, London, W.1—The Director of Education (June 12).

LECTURER IN METALLURGY and ASSISTANT LECTURER IN ENGINEERING in the Swansea Technical College—The Director of Education, Education Offices, The Guildhall, Swansea (June 12)

HEAD of the Electrical Engineering and Physics Department of Coventry Technical College—The Director of Education, Council House, Coventry (June 12).

LECTURER IN MECHANICAL ENGINEERING in the Merchant Venturers' Technical College, Bristol—The Superintendent (June 14).

FISHERY OFFICER in the Fisheries Department of the Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S W.1—The Secretary (June 14).

ASSISTANT MASTER to teach Mathematics and Science in the Cambridgeshire Technical School—The Education Secretary, Shire Hall, Cambridge (June 14).

MANAGER (CIVIL ENGINEER) to the West Cumberland Industrial Development Company, 30, Roper Street, Whitehaven—The Secretary (June 15).

LECTURER IN ELECTRICAL ENGINEERING in King's College, Strand, London, W.C 2—The Secretary (June 15).

ASSISTANT LECTURER IN APPLIED MATHEMATICS in the University of Liverpool—The Registrar (June 18).

ASSISTANT KEEPER on the Higher Technical Staff of the Mechanical Engineering Division of the Science Museum, South Kensington, S.W 7—The Director (June 21).

LECTURER IN MATHEMATICS in the University of Sheffield—The Registrar (June 22).

LECTURER IN EXPERIMENTAL ZOOLOGY in the University of Liverpool—The Registrar (June 23).

RESEARCH CHEMIST at the Indian Tea Association Experimental Station, Tocklai, Assam—The Secretary, Indian Tea Association, 21 Mincing Lane, London, E C.3 (June 25)

HULME LECTURER IN PHYSIOLOGY in Brasenose College, Oxford—The Principal (June 26)

PROFESSOR OF ECONOMICS in Raffles College, Singapore—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C 1 (June 30).

VETERINARY RESEARCH OFFICER (investigation of contagious bovine pleuro-pneumonia) in Kenya—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S W.1 (June 30).

LECTURER IN MINING in the South Wales and Monmouthshire School of Mines, Treforest—The Director of Education, County Hall, Cardiff (June 30).

PROFESSOR OF BOTANY in the University of Sydney, New South Wales, Australia—The Registrar (September 15)

ASSISTANT ENGINEERS, ENGINEERING ASSISTANTS AND JUNIOR ENGINEERING ASSISTANTS in the Ministry of Transport, Whitehall Gardens, London, S.W.1—The Establishment Officer

ASSISTANT TEACHER OF ELECTRICAL ENGINEERING AND ASSISTANT TEACHER OF MATHEMATICS in the Acton Technical College—The Secretary to the Education Committee, 10 Great George Street, Westminster, S.W.1.

TEACHER OF MECHANICAL ENGINEERING in the Rochdale Municipal Technical School—The Secretary.

ROAD ENGINEER in the Public Works Department, Somaliland—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1.

PROFESSOR OF MINING in the University of Peiyang—The Universities' China Committee, 91 Gower Street, W.C.1.

ENGINEERING INSTRUCTOR in the Kingston Technical School, Jamaica—The Crown Agents for the Colonies, 4, Millbank, London, S.W.1.

Official Publications Received

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 43, Section A, No. 6: Centred Vortex Polygons. By W. B. Morton. Pp. 73–78. 6*d*. Vol. 43, Section A, No. 7: Atmospheric Electrical Conductivity and the Current from Air to Earth. By J. J. Nolan and P. J. Nolan. Pp 79–94 1*s*. Vol. 43, Section B, No. 9. A Petrological Study of the Portrush Sill and its Veins. By Norman Harris. Pp. 95–134+plates 3–5. 1*s*. 6*d*. Vol. 43, Section B, No. 10: The Geology of the Currywongaun—Doughruagh Area, Co. Galway. By L M Ingold. Pp. 135–160+plates 6–9 2*s* Vol. 43, Section B, No. 11: River Liffey Survey—The Chironomid Fauna of the Submerged Mosses By Carmel F. Humphries and Winifred E. Frost. Pp 161–182. 1[illegible]*d*. Vol 43, Section B, No 12 Some Observations on *Lophophy[illegible] cyathophylloides* (Vaughan) By Louis B Smyth. Pp 183–192+plate 10. 1*s* Vol 43, Section B, No. 13: The Faunal Succession in the Carboniferous Limestone near Cork. By J. Selwyn Turner. Pp 193–210. 1*s*. (Dublin Hodges, Figgis and Co; London Williams and Norgate, Ltd.) [45

Ministry of Health Costing Returns, Year ending 31st March 1936. Part 1 Pp. 24. (London H.M. Stationery Office.) 1*s* net [45

The Scientific Journal of the Royal College of Science. Vol 7: containing Papers read during the Session 1936–1937 before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society Pp. 146. (London Edward Arnold and Co) 7*s* 6*d*. [75

Other Countries

Proceedings of the California Academy of Sciences, Fourth Series Vol. 22, No 3 The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 32: The Plant Genus Coldenia in the Galapagos Islands. By John Thomas Howell. Pp. 99–110+plates 26–27. Vol 23, No 7, The Fishes of the Atlantic and Pacific Slopes near Cajamarca, Peru. By Prof Nathan E Pearson. Pp. 87–93+plates 12–13. (San Francisco: California Academy of Sciences) [115

Jahresbericht der Hamburger Sternwarte in Bergedorf fur das Jahr 1936. Erstattet von Dr. R. Schorr. Pp. 22+2 plates. Mitteilungen, Band 7, Nr 42: Das B. Schmidtsche Verfahren bei der Herstellung der Korrektionsplatten für komafreie Spiegel Von R Schorr. Pp. 175–178. Mitteilungen, Band 7, Nr. 43: Beobachtungen des Lichtwechsels der Bedeckungsveranderlichen in verschiedenen Wellenlangenbereichen. Von J. Hellerich. Pp 179–218. Mitteilungen, Band 7, Nr. 44: Über die Beziehung der Amplituden der Licht- und Geschwindigkeitskurven der δ Cephei-Veränderlichen Von J. Hellerich Pp. 219–252. Astronomische Abhandlungen, Band 4, Nr. 9. Untersuchungen der auf der Hamburger Sternwarte in Bergedorf fur das Zonenunternehmen der Astronomischen Gesellschaft benutzten Aufnahme- und Messinstrumente Von Johann v.d. Heide. Pp 213–236+2 plates. (Bergedorf. Hamburger Sternwarte.) [135

Crohamhurst Observatory. Paper No. 6: The Climate of Australia during the Hypothetical Jovian Sunspot Cycles, 1853–1876, together with the Rainfall Observations taken in Australia since 1822, by Years to 1876, with some Comments on the Evidence of Cyclical Reproduction in that Period. By Inigo Jones. Pp 39. Report of the Crohamhurst Observatory for the Year ending 31st December 1936. Pp. 10 (Beerwah, Qd. Crohamhurst Observatory) [135

Kyoto Imperial University: Publications of the Kwasan Observatory. Vol. 1, No. 3 Zodiacal Charts (Type A) for the use of the Observers of Zodiacal Lights, Gegenscheins and Allied Phenomena. Prepared by the Computing Division, Kwasan Observatory. Pp. 2+6 charts. Vol. 1, No 4. Preliminary General Catalogue of Comets. By A S. Yamamoto. Pp. 37. (Kyoto: Kyoto Imperial University.) [145

Union of South Africa: Department of Mines: Geological Survey. The Geology of the Country around Mossel Bay, Cape Province an Explanation of Sheet No 201 (Mossel Bay) By Dr S. H. Haughton, Dr. H. F Frommurze and D. J. L. Visser. Pp. 48+vi. (Pretoria: Government Printer.) 5*s* (including Map). [185

Smithsonian Miscellaneous Collections. Vol 95, No. 24: Time Course of Photosynthesis for a Higher Plant. By E. D McAlister. (Publication 3410) Pp. ii+17+2 plates. (Washington, D.C.: Smithsonian Institution) [185

Proceedings of the United States National Museum. Vol. 84, No. 3010 Observations on the Trematode Genus Brachycoelium Dujardin. By Elon E. Byrd. Pp. 183–200+plates 8–9. Vol. 84, No 3011 New Muscoid Flies (Diptera) in the United States National Museum By David G. Hall. Pp. 201–216. Vol. 84, No. 3013 A New Sub-species of the Nymphalid Butterfly *Polygonia faunus*. By Austin H Clark Pp. 219–222+plate 10. (Washington, D. C.. Government Printing Office.) [185

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Science and Peace

IN the remarkable differences between the world to-day and that of a century ago, the good changes and the evil are in the last resort due mainly to the use or misuse of scientific discovery. Men of science are, of course, not the sole agents in the transformation; their work is applied by others, under the direction of industrialists and Governments, for private gain or for the public good as judged by statesmen and administrators.

Until lately, the average man of science was scarcely more interested in the uses to which his work was put than is the ostrich in the fate of the eggs that she lays. There will always be scientific workers whose interests seem far removed from ordinary human affairs; but the activities of an increasing proportion of men of science are closely linked with social purposes. Many of these can work with good heart in full confidence that the fruits of their labours increase the health and happiness of mankind; but there is a darker side to the picture, since through science the horrors and waste of war have been greatly intensified. The result is that some people think that the only way to save civilization is to suppress further advances in scientific knowledge.

Responsibility for the deplorable growth of destructive forces cannot, however, be accepted by men of science except as citizens. Throughout recorded history there has been war, and the captains and the kings have always sought to increase their military strength by the inventions and the science of their time. The change in our day is not fundamental, but lies only in the much greater effectiveness with which the old purposes are pursued, through the application of modern scientific method and resources. From the military point of view, organized scientific effort meets with the same astonishing success as when applied to peaceful ends; but the result for mankind is to extend enormously the burden of fear and the potential human suffering through war. Indeed, ever since the Great War, this suffering has been not only potential but actual, as recently in Abyssinia and now in Spain.

The Founder of Christianity asked from the Cross forgiveness for those who set Him there, "for they know not what they do". The cross of war laid upon mankind is due, like that other Cross in Jerusalem, to the moral and intellectual frailty of man—to the craft of a few who are deeply evil; to the folly and weakness of others among the great, who are not lacking in goodwill; to the passions and tumult of the multitude. Perhaps the share of science in this modern crucifixion may be compared with the work of the soldiers who then drove in the nails and raised high the crosses.

Were these soldiers worse than other soldiers? Was not the Government and nation that made them soldiers, and assigned their tasks to them, more responsible than they for that evil? In like manner, are those scientific workers who are directly working for military ends to be regarded as worse than other men of science? Surely the chief responsibility lies with the community at large; and in proportion to his single-minded simplicity, the militarized man of science, like the common soldier, is to be honoured for the faithful following of his vocation.

Many minds, however, cannot find rest in simple obedience to authority, in simple national patriotism. The principle of the settlement of disputes by war is increasingly questioned by the mind and conscience of man, and not least among men of science. Many fair-seeming bubbles have been burst, and recognized for the hollow, puffed-out things that they are: the famous Oxford resolution on fighting for king and country was symptomatic of this. Of course, if Britain should become involved in war, the youth of Oxford would fight; but among them and the rest of the soldiers there would be a larger proportion than in any previous war, who from the outset realized the futility, the colossal folly of war. Even in Germany, with all its unchallenged internal propaganda, it is not too easy to resurrect the old 'Heldentum' nonsense, which many German ex-soldiers hoped had been cast into limbo for ever.

Already in the time of the Great War the prostitution of science to warfare was deeply felt by many British men of science, some of whom refused altogether to participate either as soldiers or as scientific workers. The same attitude would again be taken by many, should we be cursed by another war; even in the present time of uneasy peace, the activity in rearmament is renewing in the minds of many men of science the same tension of feeling, the same problems of conscience. Such scruples, sincerely held, claim at least the same measure of public consideration and respect as they received in Britain during the Great War. For such men there is often no choice whether they shall or shall not refuse war-service, scientific or otherwise; like Luther on a famous occasion, "they can no other".

Most men of science will know outstanding examples, among their colleagues, of men who so refused in the Great War, and, by our national wisdom, were spared the penalties that in other countries might have led to their death, by direct act or by obloquy and torment leading to suicide. Many such men have, in the years since then, rendered distinguished service to the community; their work, and that of many lesser men who followed the same course, has enriched the nation, and been rendered with loyal recognition of the toleration extended to them by their fellow-citizens during a time of great national stress.

To the main body of men of science, however, military preparations, and scientific co-operation in them, seem in the existing state of the world a necessary, though regrettable, measure. It is important that there should be mutual respect and understanding between this majority, and their colleagues who are extreme pacifists—the larger group standing by the minority, to protect them against victimization, and the minority co-operating wherever possible with their fellows, and respecting in them their loyalty to their duty as they perceive it.

Should this duty end, however, with the performance of their special technical functions? Does there not rest upon men of science as a body a responsibility for the promotion of peace, and peaceful methods of international adjustment, beyond that which already attaches to them as citizens? Their special outlook, education, training and gifts seem to involve this.

In the first place, scientific workers are better able than most men to reflect with knowledge upon the evolution of man, and to realize what immense conquests have already been made over ignorance, weakness and evil. They can in some measure review the progress of man in social organization, and envisage great improvements still to come, realizing that even to-day unity in government may be maintained, as in Canada, despite enduring differences of race, religion, language and traditions among the people. They know that wider loyalties can develop and become paramount over a hierarchy of narrower loyalties. They have, therefore, ground for good hope, since so much has been achieved by steps largely unconscious or groping, that far more can yet be done by conscious and well-chosen effort.

Secondly, they have long been accustomed to international co-operation, without which the state of science itself would still be relatively primitive. They can, therefore, well judge how fruitful would be the adoption of a similar policy in the social and economic sphere, even if military budgets continued as now; but such co-operation would also remove many of the chief causes of international mistrust, and enable much of these budgets to be diverted to happier uses.

Furthermore, their whole professional activity contrasts strongly both in method and success with the military method of settling international problems. The military method is inherently ill-designed to yield good results. Men of science know that the judgment is warped by bitter passions such as prevail in war, and that difficult problems are best attacked by earnest, dispassionate search after understanding and truth, with prolonged patience and resource; they have therefore a special duty to urge the application of these methods to international problems. To attempt to solve the problems by military force, or the threat of it, is to hazard our whole well-being, with no certainty that the better cause will prevail or the best solution be arrived at: on the contrary, with the certainty that whatever side gains the victory, those who bear the suffering—nowadays the majority of the people—will never reap a reward that will compensate them for their travail and sorrow.

Medical men form a group among scientific workers who have particular reason to hate war and to seek after peace: the wholesale maiming, poisoning and starvation involved in war is in extremest contrast with their lifework for the maintenance of health and the alleviation of human suffering. A campaign to arouse the interest of the medical profession in the promotion of peace has lately been launched, with much devoted work and considerable success: similar efforts have been in progress at Cambridge, Oxford and elsewhere, among scientific workers of other kinds. During the recent National Peace Congress in London, among the several Commissions which considered special aspects of the peace question was one on science and medicine, reference to the proceedings of which appears elsewhere in this issue (p. 993). It is hoped that, as a result of the meetings of this Commission, local groups of scientific workers will be formed in many other places, for the promotion of peace by study, research and propaganda.

We do not overlook the fact that urgent reasons can be given in favour of the present British rearmament, or that there is little likelihood that our vast military preparations will be devoted to selfish aggression. But it cannot be denied that a Europe armed to the teeth will be an unstable Europe, living under the shadow of fear that some spark may produce a disastrous conflagration. What we suggest is that some part of this great effort and expenditure on rearmament would be more fruitful for the peace of Europe and the world, if employed in other ways. The greater part of that expenditure might, indeed, be saved by a more active policy of international co-operation and appeasement.

The main argument against such proposals is that our very safety is threatened by other well-armed nations, so that rearmament is essential for the defence of our lives and ideals. We know ourselves that our intentions are wholly non-aggressive, but can we expect the rest of Europe to welcome a *pax britannica*, imposed on 'the lesser breeds' by means of our great national wealth? Surely the only kind of peace likely to endure in Europe is one that is corporately maintained by the community of European nations, whose instrument of co-operation is ready at hand in the League of Nations The best means to achieve this cannot now be discussed here, but a determined effort, and indeed lead, in this direction seems incumbent on the British Government to assist movements for the promotion of international peace and thus avoid the impression that recent activities are solely concerned with military measures for national defence in case of war.

Science and Social Responsibility

What Science Stands For

By Sir John Boyd Orr, Prof. A. V. Hill, Prof. J. C. Philip, Sir Richard Gregory, Sir A. Daniel Hall, Prof. Lancelot Hogben. Pp. 132. (London: George Allen and Unwin, Ltd., 1937.) 5*s*. net.

THE future historian of science will not fail to chronicle that the early part of the twentieth century was notable for the gradual emergence of a social conscience among scientific men, which, he will aver, was greatly stimulated by the mis-use of certain scientific discoveries for inhuman ends (for example, poison gas against civilians), and by the recognition that extending application of science to industry did not appreciably improve the status or the prospects of the working classes.

The effects of the so-called impact of science upon social life have for long been made prominent in the columns of NATURE, but it is only of late that they have engaged general attention, for example, at recent meetings of the British Association. Incidentally, the word 'impact' seems ill-chosen, for science has been penetrating, not merely impinging on, the material social fabric for at least a century. At last year's meeting in Blackpool, some notable addresses were given on this theme, of which five are reproduced in the volume before us. Covering as they do a diversity of subjects, the choice of an apt title could not have been an easy one; hence the use of the woolly preposition-verb 'stand for'. If the question implicit in the title had been put to T. H. Huxley, his reply would have been immediate: "For intellectual honesty and the fearless pursuit of truth". Pasteur would have said that science stands primarily for the alleviation of human suffering; Dr. Herbert Dingle that it stands for the co-ordination of sense observations; and a modern political dictator would see in science merely means of controlling the popular will. Sir Daniel Hall, in his vigorous and outspoken address on "Knowledge and Power", sees in science the means to enrich life, and he is as insistent on the non-material benefits as on the material. Sir Richard Gregory, writing on "Cultural and Social Values", elaborates this view, and strongly emphasizes the part played by science in developing the human mind, intellectually, æsthetically and morally.

Although the material fruits of scientific discovery are by no means ignored—Sir John Orr writes on nutrition and Prof. J. C. Philip on the ubiquity of chemistry—the ethical and educational issues which they raise, to wit, social responsibility for the applications of science and the place of science in education, are treated with the prominence they deserve. Sir John Orr thinks that the State has a moral responsibility for seeing that all its citizens obtain the food which health demands; and all the authors would agree that a one-sided training in letters, languages, or art is a very poor preparation for a modern statesman or ruler of men. A background of science is also essential for adapting our antiquated economic theories to modern actualities; and for encouraging the habit of acting on reason instead of on emotion. As Sir Daniel Hall says, "Everywhere we see individuals and nations responding to crude emotional impulses. . . . One function of an education based upon Science is to . . . teach boys and girls in their earliest formative years that all the world over men and women are . . . very much alike. Diversity exists among the individuals, and civilisation largely consists in giving that diversity full play". Prof. L. Hogben, the Sir Galahad of modern progress ("with manly grace, yet maiden meekness in his face"), demands nothing short of a transvaluation of all educational values.

After reading these interesting and valuable addresses, one is more than ever convinced that in real education for a full individual life and for good citizenship—the two are not incompatible—lies the one remaining hope for civilized humanity. As H. G. Wells so well put it: history is coming more and more to be "a race between education and catastrophe". E H. T.

Experimental Embryology

Experimentelle Beiträge zu einer Theorie der Entwicklung

Von Hans Spemann. (Deutsche Ausgabe der Silliman Lectures gehalten an der Yale University im Spätjahr 1933.) Pp. viii+296. (Berlin: Julius Springer, 1936.) 29.60 gold marks.

IN this book, Prof. Spemann has collected the main results of his life-long series of experiments on animal development and of those of his school, and he takes stock of the present position in regard to the problems of form-production. He is careful to warn his readers that this is not a text-book, but a record of a line of scientific thought pursued with the help of experimental methods. It is all the more welcome, for his acute analysis and logical progress from question to (experimentally provided) answer are most acceptable and helpful as guides through a field where isolated data are legion, but general principles few.

One of the most interesting of these principles is that known as 'double assurance'—the existence of two mechanisms which function independently to produce one and the same structure. Advanced to cover the case of the operculum of Anuran larvæ which can be perforated by an arm-bud and also without an arm-bud, the notion of double assurance has recently fallen out of favour since the realization that the perforation is brought about by other structures (the atrophying gills). But in regard to the lens, which in certain frogs can be induced by the eye-cup but can also develop without an eye-cup, Prof. Spemann shows that a duplicity of formative methods undoubtedly exists: one involving diffusion of a presumed chemical substance from the eye-cup, the other involving 'determination' *in situ* of the lens before closure of the neural folds. The question how such independent sets of processes are correlated and initiated in ontogeny, or have evolved in phylogeny, is not the least of the fascinating problems which this work raises. Special attention is devoted to fundamental definitions such as 'potency' and 'determination', and also to the results of biochemical analysis of the mode of action of the organizer.

Perhaps one of the most important sections of Prof. Spemann's book is that in which he reviews the hypotheses of 'gradients' and 'fields' that have been advanced to account for certain aspects of development. These he has difficulty in accepting; in particular: that the graded rates of tissue-activity postulated by the gradient hypothesis can be the specific causes of the movements of cell-groups that result in gastrulation and form-production; that the long adaptive history of the presence of certain highly differentiated structures in the head-region of animals can be condensed developmentally into a matter of differential oxygen supply to different parts of the egg; that quantitative differences of rate of activity can result in qualitative differences of structure; and so on.

To consider these objections here would take too long, and it must suffice to direct the reader's attention to them. Some of them can probably be met; for example, it seems that yolkless cells cleave faster than yolk-laden cells, not directly because of greater activity of their protoplasm, but indirectly because the greater activity has oxidized and prevented the deposition of yolk in them. For the rest, it is probable that Child and his followers, in wanting to avoid appealing to *chemical* localizations to account for the *earliest* phases of differentiation, and being therefore driven back on to *physical* regional differences, have assumed too lightly that these differences are manifested in rates of metabolism or protoplasmic activity. It is, of course, the peculiar position of the gradient hypothesis that it is the only concept so far framed which covers the outstanding phenomena of development and regulation, but that it is exceedingly difficult to devise or perform experiments to prove its validity satisfactorily.

Without doubt, however, the greatest debt in which Prof. Spemann has placed his readers is for the admirably clear, and, it may be added, delightfully sympathetic, account he has given of the discovery and properties of the amphibian organizer. Many other authors have written about it in their books, and now at last here is a book dealing with these fundamentally important matters with the first-hand knowledge of their discoverer. The Silliman Lectures, on which the book is based, were delivered in 1933; but the book is brought completely up to date and includes the advances made during the past few years. G. R. DE BEER.

German Physics

Deutsche Physik
Von Philipp Lenard. In 4 Bänden. Band 1: Einleitung und Mechanik. Pp. xv+249. (München: J. F. Lehmann, 1936). 10 gold marks.

PROF. P. LENARD is known to fame in two capacities, as the great experimenter whose work on phosphorescence and electronics is fundamental for modern physics, and as the politician, the stalwart fighter against the Jewish evil, of whom Herr Rosenberg has said: "As a thinker, however, Professor Lenard has taught that all knowledge is not the same, but that souls of alien race produce bodies of knowledge of a quite different spiritual content". The present book, which is the first of a series designed to present the elements of physics to young students, shows him likewise in two capacities, as a profound political thinker and patriot on one hand, and as physicist on the other. The two are spatially separated, the one activity being confined to the preface and introduction and having, apparently, very little influence on the rest of the book, which has something in common with the excellent little work of the non-Aryan Warburg.

The preface is a clear exposition of Prof. Lenard's views on the harm done to physics by the Jewish people. The author states that every race has its own kind of physics: in the past there was a physics of the Arabs; to-day one can perhaps speak of a physics of the Japanese. There is no Negro physics, but recognition of the fact that there is a Jewish physics has been delayed simply because Jews write not in one language, but in many. "Jewish physics is then, a delusion and a sign of degeneration from the fundamental Aryan physics. It was necessary to stress this here with emphasis, for only when the fundamental opposition between Jewish and Aryan physics has become clear can the full appreciation of the value of the latter come into being again after having been lost so long." Einstein's theory of relativity is cited as particularly pernicious, as is also the Jewish division of physics into classic and modern, a piece of trickery designed to delude the German student. The preface, in fact, shows Prof. Lenard's competence in a field in which he is now an acknowledged master, for he has been entrusted with the task of reporting upon the question "Jewry in Science" for the Reichsinstitut für Geschichte.

The book itself consists of an introduction and a treatise on mechanics: it is being followed by three other volumes, dealing with the rest of physics. In the introduction, Prof. Lenard insists that all natural laws are simple, and that for an understanding of the fundamentals of physics very little mathematics is necessary. He shows himself particularly skilful in expounding the laws of mechanics, including such matters as the dynamics of rotating bodies, with a minimum of mathematical analysis: even those students who have mastered the conventional exposition in the ordinary text-books of rigid dynamics will probably find that Lenard's method of presentation helps them to realize what it is all about. It is, however, hard to understand why the editor of Heinrich Hertz and the admirer of Maxwell should speak as deprecatingly of theoretical and mathematical physics as does Lenard. He is probably thinking on one hand of those physicists who conceal their lack of real understanding behind a mist of formulæ, and on the other hand of Faraday, who discovered basic quantitative laws without any mathematical knowledge; but there are theoretical physicists who discover new truths, while Faradays cannot be expected even once a generation. Lenard's book shows how far a man with a real grasp of physical laws can go without mathematics, how clearly many fundamental matters, even the elements of hydrodynamics, may be expounded almost without symbols. It is the work of a great lecturer and teacher. At the same time the simplicity is sometimes a little misleading—to say that "the measure of inertia is called mass. This is the definition of the conception 'mass'" is scarcely a fair solution of the difficulty.

The book is in the best German tradition, as exemplified, for example, by Riecke, from whose book some of the illustrations are, apparently, taken. It does not touch upon recent work, but limits itself to physics as known at, say, the end of the past century. This is possibly not at all a bad thing in a book intended to ground the student in the really fundamental parts of physics; but at the same time the interest could have been widened by reference to some more recent matters, such as the lift of an aeroplane wing in the section on hydrodynamics.

As a record of the methods of one who, besides being an investigator of the first rank was also one of the best teachers of his time, the book has a claim on the attention of all who have to present the facts of physics, German or even non-Aryan, to the student.

E. N. DA C. A.

International Co-operation in Telephony

Comité Consultatif International Telephonique (C.C.I.F.)

Proceedings of the Xth Plenary Meeting, Budapest, 3rd–10th September 1934. Translated into English by the Technical Staff of the International Standard Electric Corporation. Pp. 660. (London: International Standard Electric Corporation, Ltd., 1936.) 25*s*. net.

IT is quite impossible in a short review to give an adequate account of the material, highly compressed and specialized in scope, which appears in the present volume of 660 pages. For the information in the field covered, that of telephonic communication between countries, it provides a bargain for those who can understand. There is so much that it takes the translators some two years to turn the five French volumes of the original into one volume in English. A detailed discussion is therefore not called for, especially since the material is not the work of individuals but of a large number of committees, the members of which may be located in several countries and do their work through the post.

The important thing about the Comité Consultatif International Telephonique (C.C.I.F.), which deals with telephony, and its parallel organizations, the C C.I.T. and C.C.I.R., which deal with telegraphy and radio respectively, is that they form an excellent example of what can be achieved internationally if the problem to be solved—here telephonic communication at the lowest cost and with the highest speed—can be stated clearly and given to investigators who are prepared to find a solution which is acceptable to the majority. The interesting thing about the system is that it has no power of compulsion on its members to carry out any instructions. It sets up a sub-committee to report on the data of a particular aspect of the general problem; the report may say that research must be done, and this is allocated to the particular telephone authority which has the facilities for carrying it out. When this is done and further considered, the C.C.I.F. makes its recommendations, and it is up to the participating administrations to carry out these recommendations so far as is desirable at the time in order to co-operate with similar organizations in other countries.

As contrasted with the world of politics, the countries lose little time in adopting recommendations for the improvement in international telephony. Further, the principles adopted by the C.C.I.F. soon find themselves prevalent in the domestic sphere of the individual countries, since for telephony the greatest measure of uniformity in practice makes for greater general effectiveness in what we now regard as the indispensable method of communication. If engineers were given other problems within their competence to solve, the world would be a better place.

L. E. C. H.

Flora of West Tropical Africa

the British West African Colonies, British Cameroons, the French and Portuguese Colonies south of the Tropic of Cancer to Lake Chad, and Fernando Po. By Dr. J. Hutchinson and Dr. J. M. Dalziel. Prepared at the Herbarium, Royal Botanic Gardens, Kew, under the supervision of the Director. (Published under the authority of the Secretary of State for the Colonies.) Vol. 2, Part 2. Pp. 293–651. (London: The Crown Agents for the Colonies, 1936.) 8*s*. 6*d*.

The publication of the second part of vol. 2 completes this "Flora". The part contains the account of the Monocotyledons, which are represented by thirty-five families. The arrangement, as in the previous parts, follows Dr. J. Hutchinson's "Families of Flowering Plants". An artificial key to the families which are dealt with in this part is provided, and an index to families, genera and synonyms contained in the entire work occupies forty-three pages at the end. A short account of the principal vegetational types, accompanied by a map, is given. The illustrations, many of which occupy full pages, are by Mr. W. E. Trevithick and Miss S. Ross-Craig.

The most important family from the economic point of view is the Gramineæ, the key to the tribes and genera of which is by Mr. C. E. Hubbard. 137 genera, and 503 species of grasses are included. The account of the Orchidaceæ is by Mr. V. S. Summerhayes and is of especial interest as Schlechter's classification of the Angræcoid genera is used for the first time in any flora. The remaining families have been dealt with by Dr. Hutchinson, with the exception of one or two genera: *Cyperus* Linn. by Miss E. A. Bruce, *Pycreus* Beauv. with Mr. B. L. Burtt, and *Sorghum* Pers. with Mr. J. D. Snowden.

The number of new species is considerable, whilst many names published by Dr. A. Chevalier without description have been adopted, and will be validated by Latin diagnoses in future numbers of the *Kew Bulletin*.

The accounts of certain families such as Zingiberaceæ, Marantaceæ, and Palmæ have suffered from the imperfect nature of the specimens which were available, whilst the paucity of the material of a number of the species is at once noticeable on glancing through the pages: many have only once been collected within the area covered.

Commonwealth Bureau of Census and Statistics, Canberra

Official Year Book of the Commonwealth of Australia. No. 29, 1936. Prepared by Dr. Roland Wilson. Pp. xxxii + 1015. (Canberra: Commonwealth Government Printer, 1936.) 5*s*.

This useful yearbook follows the same arrangement and embraces the same scope as previous issues: in statistics and to a less extent in description it gives a full account of nearly every aspect of Australian life, with further chapters on the territories of the Commonwealth including Papua, New Guinea and Nauru. History also finds a place in the detailed chronological table of events and a full reprint of the Commonwealth Constitution Act. Two excellent features are notable in the statistical matter: one being the comparable figures for other countries, and the other the figures for recent years in the Commonwealth.

As usual in every issue, there are certain distinctive features. Vital statistics, which are always treated fully, this year include analyses of the causes of death and also details of the dwellings of the population at the time of the census. There is also a special article on Australian population mortality.

The list of books and other publications dealing with Australia has been revised and is classified under subject headings. Maps show the distribution of rainfall and the location of the various artesian basins.

Mercury Arcs

By Prof. F. J. Teago and J. F. Gill. (Methuen's Monographs on Physical Subjects.) Pp. vii + 104. (London: Methuen and Co., Ltd., 1936.) 3*s*. net.

This little monograph formed the basis of a course of lectures on design given at the University of Liverpool. The subject of the conversion of alternating to direct current is very much to the front at the present time. The crystal detector for converting the rapidly alternating currents employed in radio transmission work, into direct current, so that they make an audible signal in the telephone, is an example of their use. Liquid rectifiers can be used for converting an alternating current into a direct current, so that the A.C. supply can be used to charge an accumulator. This is a useful practical application. Copper oxide valves having unilateral conductivity are much employed for handling the large outputs used in industry. The introduction of the A.C. grid in Great Britain has also introduced an ever developing demand for these electrical valves.

Some engineers may think that too many mathematical theorems are given in this book, but examination shows that they are simple and easy to understand, and as a rule they explain very satisfactorily some of the physical phenomena.

Control of Electrical Motors

By Paisley B. Harwood. Pp. vii + 390. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 22*s*. 6*d*. net.

Every year many thousands of motors are used for driving machinery. Each of these motors requires a controller of some kind. A simple manual starter might suffice for a small fan, but for the control required for a newspaper press something much more complicated has to be provided. Some engineer has to specify the duty of the controller required and someone else usually has to design and build it. In addition, it has to be installed and workmen trained to operate it. This book describes the working characteristics of the various kinds of motors and explains how these characteristics can be used for control purposes. Problems frequently encountered such as motor acceleration, dynamic braking and 'resistor' design are discussed fully. This book is easy to understand, and will be found useful by both engineers and operators.

Water-Power in the United States*

By Dr. Brysson Cunningham

III. NORRIS AND WHEELER DAMS

ON the side of the North American continent opposite to the valley of the Columbia River lies another notable valley—the Tennessee Valley, mainly in the State of that name, but also including parts of Mississippi, Alabama, Georgia, North Carolina, Kentucky and Virginia, with a basin comprising 40,600 square miles. For the co-ordinated development of this great territory, considerably larger than the whole of Ireland, a special body, the Tennessee Valley Authority, has been created by U.S. Congress with the duty of improving navigation, controlling floods, generating hydro-electric power and arresting soil erosion. For this purpose a series of ten dams of varying heights, and at irregular intervals, has been designed and in part executed along the course of the River Tennessee and its tributary the River Clinch. Perhaps the most notable of these, until recently, was the Wilson Dam, 137 ft. high and 4,860 ft. long, impounding a reservoir with a capacity of half a million acre-feet and generating power to the extent of 261,400 horse-power. The Wilson Dam was completed in 1925; but since that date, two other and even more striking dams have come into existence, the Norris Dam and the Wheeler Dam, completed as recently as last year.

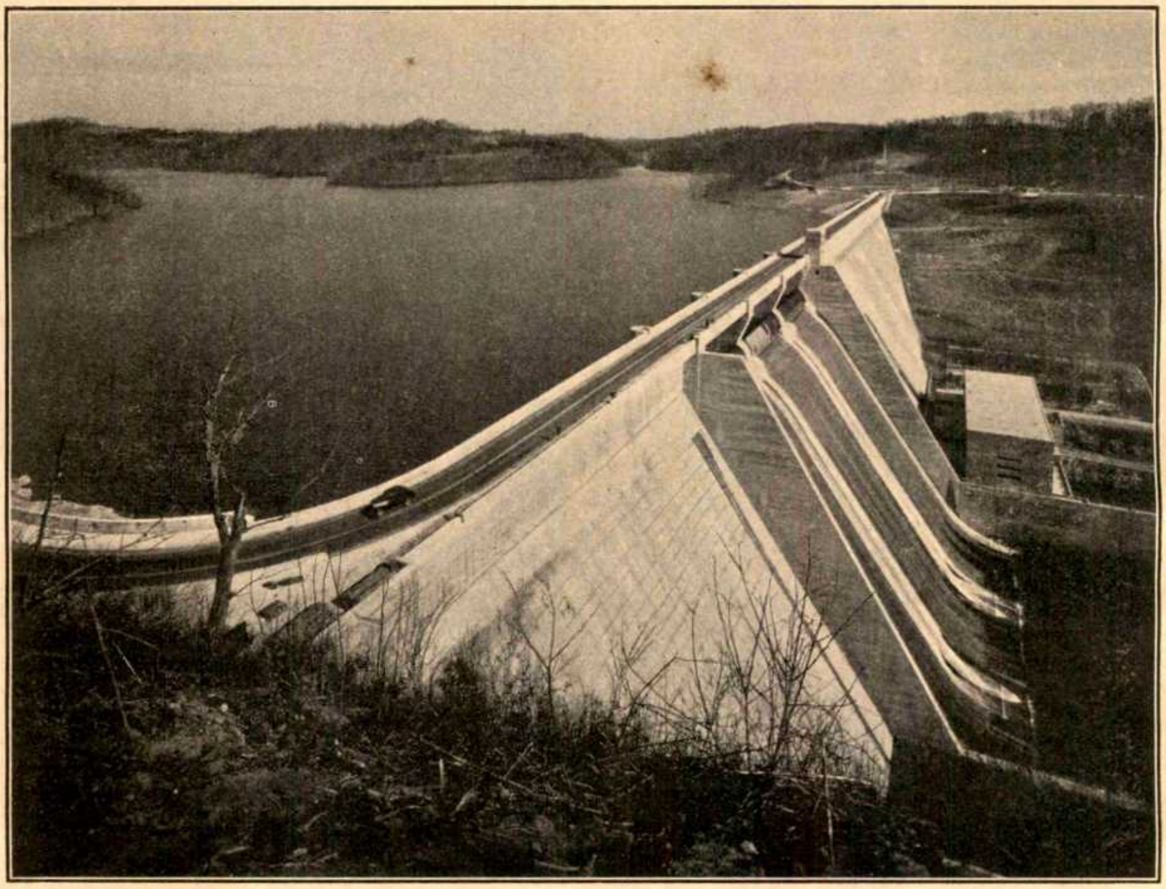

Fig. 1.

GENERAL VIEW OF THE NORRIS DAM ON THE CLINCH RIVER, TENNESSEE, SHOWING THE POWER HOUSE AND IMPOUNDED LAKE.

Of the two, the Norris Dam (Fig. 1) located on the Clinch River in north-eastern Tennessee, about 25 miles north-west of Knoxville, is the loftier and impounds a reservoir of greater capacity. The impounded area is more than 50 square miles, with a shore line of over 700 miles, winding in and out of many valleys formed by the hills above the dam. The reservoir capacity is 2,570,000 acre-feet at normal water-level, but may attain a maximum of 3,400,000 acre-feet. The dam itself is a straight mass-concrete structure, with a total length along its crest of 1,872 ft. It has a height of 265 ft above the lowest foundation level and is 204 ft. thick at the base. The spillway, confined within side walls of concrete, discharges into a concrete hydraulic 'jump pool', which extends 215 ft. downstream from the toe of the dam. Along the crest of the spillway, between two 12-feet concrete piers, are three hydraulically-operated steel drum gates, each 100 ft. long, designed to retain water at flood peak-level.

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* Previous articles in NATURE, May 1, p. 738, and May 22, p. 823.

Though primarily a flood control and navigation work for the Tennessee and Mississippi Rivers, the Norris Dam is provided with power-generating plant consisting of two 66,000 horse-power generators. The cost of the entire installation was 35 million dollars (£7,000,000).

The Wheeler Dam (Fig. 2) is not remarkable for its height, which is only 72 ft., but it has a length of 6,335 ft.—1,475 ft. more than the Wilson Dam and 4,463 ft. more than the Norris Dam. It is located on the Tennessee River, 275 miles above Paducah, Kentucky, where the Tennessee joins the Ohio. Situated at the upper end of Wilson Lake, it is 15½ miles above the Wilson Dam at Muscle Shoals. It impounds a volume of water aggregating 1,260,000 acre-feet in a reservoir which has a shore line of 951 miles.

The dam is a gravity concrete structure, with the above mentioned length of 6,335 ft. composed, successively, of a non-overflow section 177 ft. long, 613 ft. power house, another non-overflow section 718 ft. long, 2,700 ft. of spillway, 1,756 ft. of non-overflow, 162 ft. of navigation lock structure and a final non-overflow section of 209 ft. to the north bank of the river. The spillway is divided into sixty bays, each bay being surmounted by a radial gate, 15 ft. high and 40 ft. long.

The power plant is of the outdoor type, with no housing over the crane or the generating units, the generators being protected from the weather by metal covers. The station is designed to accommodate eight main generating units of an

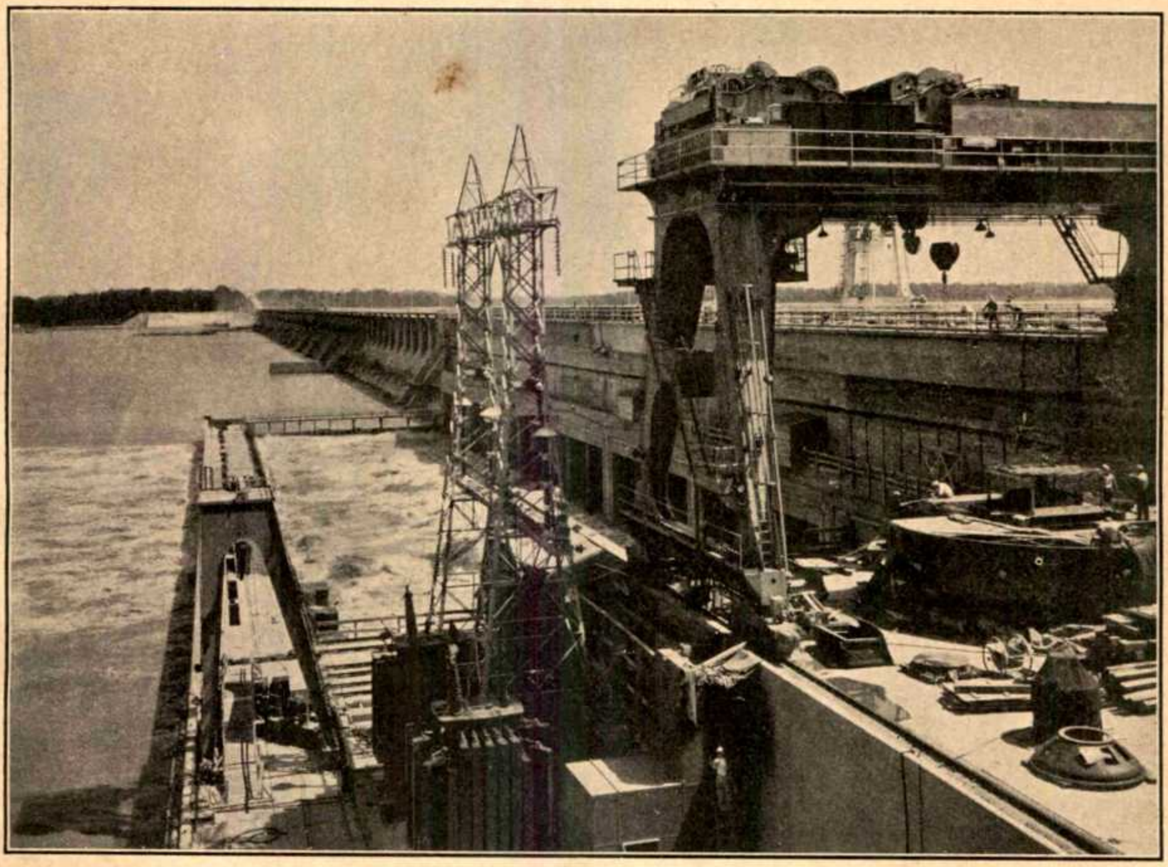

Fig. 2.

DOWNSTREAM VIEW OF THE WHEELER DAM ON THE TENNESSEE RIVER IN ALABAMA.

aggregate capacity of 360,000 horse-power. Only two units of 45,000 horse-power each, have as yet been installed. The system came into operation on November 9 last.

The individual projects, which have been described above, form part of an organized design for the utilization of the resources of the whole of the Tennessee watershed, by means of storage reservoirs in the headwaters, which will retain the run-off during the rainy season and release it during the dry season, so regulating the flow during the whole year to suit the requirements of navigation and to remove the danger of flooding.

Another interesting and important feature of the undertaking is the arrest of soil denudation. Under the influence of heavy rainfall, millions of tons of fertile top soil are removed from the hillsides, and further large quantities are lost by sheet erosion on the plains. This silt would normally be transported by the river currents over long distances, but the interposition of a series of dams causes it to settle and enables it to be reclaimed. But, going a step further back in preventive measures, the Authority is engaged in treating the eroded hillsides and encouraging the growth of vegetation with the aid of plant foods, and in particular, phosphates. At Muscle Shoals, a demonstration unit has been built to produce triple superphosphate from the raw phosphate rock found in central Tennessee. The electric power used for this purpose is derived from the hydraulic energy converted at the impounding dams.

The information on which the foregoing article has been based has been courteously supplied by the Tennessee Valley Authority, to which also I am indebted for the photographic illustrations.

Natural and Artificial Membranes

THE late Sir William Hardy was responsible for the foundation of the Colloid Committee of the Faraday Society, the duties of which were periodically to call meetings at which biologists, physicists and chemists could meet to discuss topics of mutual interest. The fifth meeting of this character was held on April 22–24 at University College, London, under the presidency of Prof. M. W. Travers of Bristol and the chairmanship of Prof. R. A. Peters of Oxford, the subject of discussion being membranes, their properties and functions. This particular meeting was graced by the presence of a number of distinguished foreigners, amongst whom we may include Dr. Ancel Keys of Rochester, Min., L. R. Blinks of Stanford, Mrs. Brooks of Berkeley, Cal., Prof. E. Gorter of Leyden, Prof. R. Collander of Helsingfors, Prof. E. Manegold of Dresden, Prof. Kurt H. Meyer of Genthod-Genève, Dr. W. Teorell of Uppsala and Dr. W. Wilbrandt of Bern, who all took part in the discussion. We were also pleased to note the presence of Profs. H. Mark and W. Ostwald, constant visitors to these meetings. It was to be regretted that several distinguished scientific workers were unable to present their papers; these included Profs. A. Krogh, Newton Harvey, E. Ponder, W. J. V. Osterhout and Cole.

It was clear from the contributions and from the discussion that in spite of the importance, both structural and functional, of membranes in organized living systems, we are still a long way from obtaining a complete description of the microstructure of even one of these or a general interpretation of their behaviour. It would appear that all natural membranes are composite in the sense that they contain both a lipoid-like and a non-lipoid component. The structural relationship of the components to each other is still *sub judice*. Exponents were not lacking of the extreme view of complete stratification of each component, one possibly in a monolayer, as well as those who upheld the view of a systematic mosaic or even haphazard intermingling. Some species of interaction, at least between the components of each 'phase', appears necessary to account for the physical properties of the complete membranes.

Whilst cationic and anionic permeability of the protein component of the membrane and the 'solubility of organic substances' in the lipoid component, as well as the ionic partition as defined by the Gibbs – Donnan membrane equilibrium are readily understandable in general terms, it appeared to many that these now well-recognized and important factors do not suffice to account for all the observed phenomena. So many questions were asked by our biologist friends at the meeting for the consideration of the physicist and chemist that it seemed difficult at times to realize how much progress had been made since the first meeting summoned by the Colloid Committee. There were three questions raised of unusual interest to many non-specialists present, to which no generally satisfactory answers could be given. These were the apparently abnormal behaviour of the potassium ion, the origin of bio-electric phenomena and the mechanism of narcosis.

In a medium containing a variety of salts, no satisfactory mechanism has been proposed for the relative enrichment in potassium of a portion separated from the bulk by means of a membrane, for example, red cells as discussed by Dr. M. Maizels. It was doubtful whether membrane charge, ionic size, solubility or complex formation could be the operative factors. It may be significant that not only is the lipoid/water partition coefficient for many potassium salts or complexes favourable for such separation, a view supported by Prof. Osterhout, but also that the ionic mobility of the potassium ion is some fifty per cent greater than that of the sodium ion, and thus in a dynamic system with migrating water as medium some separation should be possible.

According to Profs. S. C. Brooks and W. Stiles, separations due to mobility difference might be effected by exchange with ions, for example, those of carbonic acid produced in the metabolism. But if the final dynamic distribution of ions be calculated on the basis of a steady Donnan diffusion equilibrium, Dr. Teorell showed that under biological conditions the accumulation due to interdiffusion could not amount to more than 2 per cent.

If separation be accomplished by continued ionic transport involving an electric potential or a counter current of flowing liquid, it serves to emphasize the fact frequently forgotten by the non-biologist that these interesting properties are exhibited by living systems, and as such their dynamic state, involving possibly a continuous and steady flux of ions or liquid, may prove of paramount importance.

Such a theory demands the existence and the maintenance of an osmotic or an electrical gradient present within the membranes. From the discussion supported by Dr. G. S. Hartley, it was considered that diffusion or non-polarizable potentials could perform work; Prof. H. Freundlich suggested that work could also be obtained from temperature gradients (Soret effect). Drs. D. Gatty and R. B. Dean pointed out that redox potentials cannot be responsible for ionic accumulation. Dr. F. C. Steward and Dr. Ancel Keys inclined to the view that water and salt transport through plant cells and gills were due to metabolic processes oxidative in character.

Similar considerations may apply to the phenomena of bioelectric potentials. Some confusion exists owing to the misapprehension of the facts concerning the Donnan potential; namely, that the membrane potential can only be measured either electrostatically by the use of non-reversible electrodes in the two solutions separated by the membrane, or by the difference in the potentials given by each solution separately to a reversible electrode against a standard electrode in a solution containing the common ion. In spite of the fact demonstrated beautifully by Prof. Kurt Meyer that both acidophil and basophil membranes can be detected by staining methods in systems exhibiting bioelectric phenomena, it is not only doubtful whether these methods are certain criteria for selective ionic permeability, but also the serious difficulty that currents can be drawn from these presumably readily polarized systems does not appear to be surmountable unless a dynamic mechanism is operative.

A number of papers, including those of Profs. K. C. Cole, L. R. Blinks and Drs. Dean and Gatty, involved the use of electrical measurements to obtain information as to the equivalent electrical circuit which a cell with various hypothetical structures would present; *inter alia* it was brought out that Frickes' previous estimate for the thickness of the red cell wall must be considered in error.

An excellent summary of the views as to the origin of potential differences obtained in nerves was given by Dr. S. L. Cowan, who showed that diffusion potentials alone are not adequate. Dr. H. Rosenberg elaborated the core conductor system, whilst Mr. J. Z. Young discussed the chemical evidence as to the structure of the axon and the myelin sheaths of the nerve. He suggested in a general way that radially orientated lipoid layers may be responsible for nervous stimulation. It may be significant in this connexion that the phase boundary potentials exhibited by monolayers at interfaces are generally much larger than those potential differences obtainable by a Gibbs–Donnan distribution in biological systems containing a relatively high salt concentration; such monolayers on polarization naturally accumulate ions, and provided there exists some mechanism for destroying or changing the monolayer on stimulation, the result would be an ionic flow. Papers were communicated on the properties of protein monolayers by Prof. E. Gorter, by Dr J. S. Mitchell and Dr. J. H. Schulman. The Overton lipoid solubility hypothesis of narcotic action was revived in new form by Prof. Kurt Meyer, utilizing oleic acid as the model for the lipoid in evaluating the critical partition coefficients.

Prof. A. J. Clark, in a critical review, pointed out that the problem did not appear as simple as suggested by either Overton or by Traube, and that it appeared probable that selectively narcotizable and differentiated areas were involved. Several anæsthetics do not appear to conform to the oleic acid solubility rule, and the response of various types of nerve systems is not identical. The hypothesis advanced by Dr. Schulman and the present writer, in which interaction of the polar head or the non-polar portion of a narcotic with a lipo protein complex, appears to overcome the disadvantage of the older theories, but in its present state of development is too general and vague to be of much practical utility.

Papers dealing with the more practical side of artificial membranes were presented by Prof. Manegold and Dr. W. J. Elford. Dr. G. S. Adair gave a paper dealing with refinements of the Donnan membrane equilibrium.

The meeting was one full of interesting topics, but somewhat discursive owing to the attempt to deal with too many diverse phenomena at one time.

ERIC K. RIDEAL.

The Soviet Expedition to the North Pole

THE institution of a station for scientific research within a few miles of the North Pole marks a new phase in polar exploration, and is a development of the intensive exploration which the Soviet Union has pursued in Arctic regions during the last few years. The earliest attempts to penetrate high northern latitudes, away back in the sixteenth and early seventeenth centuries, were inspired by the hope of direct trade routes with the Far East and were alternatives to the still older attempts to find the North-West and North-East Passages. The early nineteenth century saw a revival of the northern ventures, and the Franklin disaster in the middle of that century led to a focusing of interest in polar regions, and stimulated journeys that were more adventurous than scientific in their outlook. But in an age of exploration that relied on man-hauled sledges and preserved food, that feared low temperatures and had to reckon with inevitable scurvy, the inner polar regions maintained their isolation.

Petermann's hypothesis of an open polar sea led to more than one failure and was utterly refuted by Nares, Greely and others. Then Nansen, imbued with scientific aims, brought a new technique to bear on the problem. The pack-ice that had thwarted his predecessors was to afford him the means of advance, and so in the drifting *Fram* he penetrated to lat. 86° N., and on foot some miles farther north. Nansen discovered a deep, landless polar ocean covered with drifting pack-ice. There the solution of the polar problem was to rest for some years. Even if Cagni beat Nansen's record by a few miles and Peary actually reached the Pole in 1909, these expeditions were mainly adventurous achievements and added little to scientific research. Amundsen's attempt to emulate Nansen had its value but failed to gain a high latitude.

Sledge and ship had both played their part in different ages: air-voyaging was next to be tried. Early attempts were naturally failures. In 1925 Amundsen reached 87° 43′ N. by air and returned with difficulty. In 1926, with Nobile, he crossed the Pole by airship, and in the same year Byrd also reached the Pole. These attempts showed not only the possibility of flying in arctic regions but also revealed large smooth floes with a relative lack of pressure ridges in the vicinity of the Pole. None of these expeditions, however, stayed more than a few hours, and others much less, at the Pole or anywhere in inner polar regions. Thus observations were casual and of little help, while little or no oceanographical work could be done.

Prof. O. J. Schmidt, who is in charge of the Soviet expedition to the Pole, aims at a more valuable type of exploration in placing a party in the vicinity of the North Pole for at least twelve months. The experience of arctic flying and arctic conditions generally that Soviet aviators and explorers have gained in recent years makes this possible. In connexion with the northern sea route between Europe and the Siberian rivers, of which much use is now being made, meteorological observations from the far north will be invaluable, especially in relation to the movements of the pack-ice. These observations are to be taken both at sea-level and at high altitudes. The direction of the ice drift will be studied and Prof. Schmidt points out that the station will be shifting continually in position, but it is not known if this shift will be steadily in one direction or rotatory around a certain point. In any event, these movements will facilitate soundings of the depths of the Arctic Ocean, of which little is known.

Chemical and physical analyses of the water are important in relation to the inflow of Atlantic water, and the bearing of that inflow on ice formation and ice-wastage. Good and bad ice years have long been recognized at Spitsbergen, Greenland and in the Kara Sea, but the factors involved are not understood and prediction is impossible. Magnetic and geophysical researches are also planned and biological examinations of the sea-water will be made. The station will be in radio communication with Moscow, and, it is hoped, in flying communication through many months of the year. The smooth floes afford a suitable aerodrome, and shelters are being constructed. The Soviet Union Year Book Press Service, to which we are indebted for information, lays stress on the importance of the researches in establishing regular communication by air between Europe and America across the Arctic Ocean, a modern revival in new guise of the earliest dream of a transpolar route.

Prof. Schmidt has chosen as the resident leader of the station I. D. Papanin, who has had long experience in Franz Josef Land and at Cape Chelyuskin. With him are three other experienced men, E. T. Krenkel, P. P. Shirshov and E. K. Federov. The winter dwelling is to be a tent of duralumin and rubber lined with eiderdown, reindeer hide and canvas. It is 3 7 m. long, 2 7 m. wide and 2 m. high, and has windows of unbreakable glass. The whole tent weighs only 350 lb. This will replace the silk hut used on the expedition's arrival on May 21. Paraffin is to be used for cooking and for generating electric light. The original site of the station was 20 kilometres from the North Pole on the Franz Josef Land side

R. N. R. B.

Obituary Notices

Prof. Alfred Adler

ALFRED ADLER, who died suddenly on May 28, was the son of a Viennese merchant. He was born in 1870 and educated in Vienna. He decided to study medicine and qualified at the age of twenty-five years. Soon after qualification he fell under the influence of Freud, and formed one of that close little group which developed the new science of psychoanalysis. He stood some of the almost universal abuse which was flung against the Psychoanalytical Society when the new ideas became known.

In spite of this, Adler's ideas never accorded closely with those of Freud and almost from the beginning he showed that he intended to take a different road from his master. Whereas Freud developed elaborate psychic entities based upon the unconscious—the id, the superego and so on—Adler tended to simplify instead of elaborate.

So early as 1907 Adler described the influence of what he called 'organ inferiority'. He described cases which showed that the inferiority of an organ or group of organs might occur as a tendency in one individual or even in a family. He noticed that one person might have a series of diseases all attacking, for example, the urinary system. In the case of a family, one member after another would suffer from diseases all centred on one organ.

From this idea of the inferiority of an organ or group of organs, Adler developed the theory of 'overcompensation'. He felt that not only did the body try to compensate itself for the weakness but even succeeded in fortifying itself to an unnecessary degree, as, for example, when the scar following a wound is thicker and stronger than the original skin. He believed that this 'overcompensation' was not limited to the somatic or body-structure but also invaded the psychic superstructure. The result of this was that the organ which started as inferior was finally so overcompensated that it became superior to the other organs. He gave Beethoven as an example of this process, his early deafness only increasing the capacity to compose more and more magnificent music.

Adler found that he could explain every phenomena by his principles of inferiority and over-compensation. He put forward his views openly, and as they did not accord with those of infantile sexuality which Freud was developing at this time, there was a feeling of tension in the Vienna group of the newly formed Psychoanalytical Society. Adler was therefore asked to read a paper in which he could put his ideas before the Society. The result was a tremendous storm and, in spite of the fact that he was president of the Vienna Group, he was asked to withdraw. He did so and took nine other members with him. He then founded the Society for Individual Psychology (first called the Society for Free Analysis).

Away from the trammels of the Freudians, Adler developed better and applied his views to all types of neurosis. He thought that all neurotic illness was caused by a feeling of inferiority and a wish to dominate the environment through illness. This feeling of inferiority was engendered in childhood by the infant's weakness and its relation to its parents and brothers and sisters. This view is, of course, in direct contradiction to that of Freud, who believes that neurosis is the result of maldevelopment of the sexual instinct, which produces fixations at various psychic levels.

Adler felt that since man has the greatest strength, women must have a desire to be masculine and that neurotic illness in them is to be attributed to their wish to possess the strength of a man. He called this the 'masculine protest'. He believed that this was the cause of prostitution, homosexuality and even crime, as well as neurosis. Much of the neurotic illness in men, he thought, was due to the feeling of inadequate masculinity. All symptoms were explicable as symbolic attempts to express a purpose—in fact all neurosis was the expression of a purpose; fear of falling, for example, was explained as a fear of 'falling' sexually. Vomiting was a desire to reject some unpleasant thought or fact, and so on. He called this symbolization 'organ jargon'.

Adler's psychology is explanatory and easy to understand, but it lacks a coherent systematization such as one finds in the psychoanalytical theories. This looseness allows anyone to interpret the theories as he fancies, and tends to reduce them to art rather than science. Adler himself felt this, and a year ago told the writer that he thought that many who preached his views did not properly understand them. He was reluctant to build a rigid system, however, since he felt that the human mind was not easily crushed into any inflexible mould.

Adler worked in Vienna until a few years ago, when he left and accepted a professorship in America. He has visited England nearly every year since in order to lecture. He was a lecturer of singular patience, and would answer questions long after his lectures were supposed to have finished. He was a man of great friendliness—those who knew him might differ from him in theory but they could not quarrel with him in person for he never showed the aggression of which he wrote so much.

Major J. H. Hardcastle

MAJOR JOHN HERSCHEL HARDCASTLE, who died at Sidcup, Kent, on April 21, was born on May 9, 1870, at Netherhall, Bury St. Edmunds, a son of the late Henry Hardcastle, barrister. His maternal grandfather was Sir John Herschel, the astronomer, and his great-grandfather was the famous discoverer of the planet Uranus.

Hardcastle was educated at Haileybury and the Royal Military Academy, Woolwich, passing out ninth from the latter; thence he received his commission in the Royal Regiment of Artillery in 1889. He was promoted to captain in 1899. In 1902 he joined the advanced class for artillery officers at the Ordnance College, Woolwich, and there came under the influence of Sir George Greenhill. After obtaining the 'p.a.c.' certificate he was employed by the Ordnance Board at Woolwich in 1904–6 on important research work on the resistance of the air to artillery projectiles. This work culminated in the production of the official Ballistic Tables, in the compilation of which he assisted. These tables are still used.

Retired from the Army in 1906, Hardcastle thereafter devoted himself to research work in internal ballistics and small arms, working successively with the firms of Kynoch and Nobel's Explosives. During this period he introduced the pointed bullet. At the beginning of the Great War he returned to Woolwich, and was given charge of the small arms range in the Arsenal. Here he continued his researches into the ballistics of small arms, and towards the end of the War, produced formulæ which facilitated the rapid calculation of small arms ballistics. He remained at Woolwich until 1924 and assisted in the compilation of the "Text Book of Small Arms". After his retirement from the Service he acted as ballistic consultant to Imperial Chemical Industries, Ltd., and B.S.A. Guns, Ltd.

Most of Hardcastle's publications are in the form of papers and articles in the *Royal Artillery Journal*. He put his scientific knowledge of small arms to practical use, as he was a very fine rifle shot and was in the English Elcho team. F. R. W. HUNT.

Prof. W. Natanson

POLISH science has sustained a heavy loss by the death, on February 26, of Prof. Władysław Natanson, who had occupied the chair of physics at the Jagellonian University of Cracow since 1904, after having been assistant professor there since 1894.

Natanson was born in Warsaw on June 18, 1864, his uncle, Jacob Natanson, being a Polish chemist of some distinction. He graduated as doctor of philosophy at Dorpat in 1888, having previously studied at St. Petersburg, Graz and Cambridge. He then went to Cracow, where his post-graduate researches in physics gained him the doctorate of that university too (1891). Three years later he became *Docent* and continued his work at Cracow until his death.

Practically all his life, Natanson was working in adverse circumstances. It was never easy for him to secure adequate equipment for his laboratory from the Austrian authorities in pre-War days, nor had the Polish Government funds to spare for several years after the country had regained its independence. In spite of this, Natanson succeeded in making valuable contributions to his science, particularly by his publications on the kinetic theory of gases, which he developed to explain phenomena connected with diffusion, expansion by heat, vortex rings, molecular collisions, etc.

Theoretical and mathematical papers from his pen and dealing with isothermal formulæ, Clerk Maxwell's law, the kinetic theory and dissociation phenomena have appeared from time to time in British periodicals, but most of his work was published in Continental journals. In 1903 he observed the accidental double refraction of liquids, which he endeavoured to explain by a molecular theory of refraction, reflection and extinction. He is perhaps best known in Great Britain for his investigations on the dissociation of nitrogen peroxide on heating, and its re-association on cooling.

For his own countrymen, Natanson contributed articles on scientific phenomena (several, for example, dealt with the blue colour of the sky) to the semi-popular reviews and he also wrote some standard text-books of physics. His "Elements of Physics", first published at Lwów in 1894, has gone through five editions. Prof. Natanson also had a wide knowledge of the history of science, and his biographical sketches of Bacon, Newton, Lord Kelvin and others did much to stimulate an interest in British culture and science among the Polish people. He was one of the original members of the Cracow Academy of Sciences, and was for seven years the editor of its publications. Later his work gained him recognition abroad, and among other distinctions he held the office of vice-president of the International Union of Physics. G. D.

WE regret to announce the following deaths:

M. Louis Ravaz, *correspondant* for the Section of Rural Economy of the Paris Academy of Sciences.

Prof. J. M. Reade, professor of botany in the University of Georgia, on May 8, aged sixty-one years.

News and Views

Science and Peace Problems

DURING the National Peace Congress held in London on May 28–31, under the presidency of Dr. E. W. Barnes, Bishop of Birmingham, one of its commissions considered the attitude which members of the scientific and medical professions should adopt towards peace questions. The chairman, Prof. S. Chapman, who also gave the opening address in place of Prof. P. M. S. Blackett, who was absent through illness, advocated the establishment under international auspices of a world service of information on current events, as objective as possible, without comment or propaganda: controlled by a body of men chosen internationally according to some carefully devised scheme (like the judges of the Hague Court), for their personal qualities of judgment and impartiality; the daily bulletin being broadcast in the principal national languages, to provide men and women everywhere with a basis on which to form their political judgments. Dr. H. Joules and Dr. Howard Hughes described the organization and work of the Medical Peace Campaign.

THE meeting devoted much time to the discussion of the present rearmament programme; criticism was made of its exclusive emphasis on imperial defence rather than on collective security, and its execution by private firms for profit, without the safeguards recommended by the Royal Commission on Armament Manufacture. The official plans for air raid precautions were also discussed, and the experiments in progress by peace groups of scientific workers at Cambridge and Oxford, which question the efficacy of those precautions (see NATURE of April 10, p. 606). Members of these groups outlined the means which had been found effective in arousing interest among laboratory workers and maintaining discussion of peace. While it was judged unlikely that scientific workers would be able to reach common ground on the question whether or no they should participate in military preparation, tolerance between men taking different attitudes on this question was urged, and co-operation in peace work to the utmost possible extent. It should be made clear that men of science, in common with most members of the public, regard war as degrading to human progress as well as futile, and are willing to help in national and international work aimed at discovering and removing its causes and preventing its recurrence.

Relations between Science and Philosophy

THE fourteenth 'Unity School' organized by Mr. F. S. Marvin was held in the last week-end in May at Farnham Castle, and was a great success. The subject for discussion was the "Relations between Science and Philosophy", and as both sides were well represented and a large proportion of the disputants were fairly young people, the debates were as lively and vigorous as they were invariably friendly. Though it was remarked afterwards that there seemed little 'unity' in the arguments, it may well be that a perfectly frank statement of difference in an atmosphere of friendly feeling is the best way to reach a useful working agreement. There was certainly no attempt to set up any water-tight compartment for philosophic thinking on one side, or any rejection of the useful function of philosophy by the men of science on the other. The only body of people who seemed to stand isolated and not acceptable to either side were the 'logical positivists'. But Wittgenstein was only a name—if so much—to most of the audience, and further investigation was clearly necessary.

ON the side of science, the most novel and striking contribution was made by Dr. Redcliffe Salaman, director of the Potato Virus Research Station at Cambridge. His demonstration of the infinitesimal size of these organisms introduced one into a region where vital and inanimate objects seem to exist indistinguishably side by side. He gave full details of the discoveries which have lately been made in this sphere in the United States, especially by Stanley. A full and useful discussion followed as to the nature and working of the protein crystalloid bodies now revealed in certain viruses. It turned largely on matter which has been communicated to NATURE, and left many of the audience wondering whether in these crystals something has not been found which is an actual link between living and non-living. It was decided at the close of the proceedings to continue the series of 'Unity Schools' on somewhat similar lines next year. Mrs. Innes, of Coneydale, Welwyn Garden City, will be glad to answer any inquiries. Contact between the various branches, especially of physical and social science, was felt to be the most useful line of approach to 'unity' at the present time.

Total Solar Eclipse of June 8

FROM Press reports, it appears that the total eclipse of the sun was observed under perfect conditions on June 8 at Canton Island in the South Pacific, where the American expedition organized by the U.S. Naval Observatory and the National Geographic Society of Washington had established its stations (see NATURE, April 24, p. 698). The *Daily Telegraph*, in co-operation with the National Broadcasting Company of America, arranged for Prof. A. Fowler to speak from a studio in Broadcasting House, London, to leading astronomers observing the eclipse on Canton Island, and the conversation is described in the issue of June 9. It appears that many photographs were taken, and that the corona, as was expected, was of the type of maximum solar activity.

The spectroscopic programme also seems to have been carried out successfully. The *Daily Telegraph* is to be congratulated upon its enterprise in obtaining direct information by radio of observations of an eclipse from a station more than 9,000 miles away. This very remarkable achievement merits a place in astronomical history.

Blood Groups in Africa

AT the beginning of April, Dr. Ronald Elsdon-Dew and Mr. J. de Bruijne, of the South African Institute of Medical Research, left Johannesburg on a prolonged tour of investigation of the blood groups of African peoples, and more especially of the Bantu. They propose to examine various tribes in Southern and Northern Rhodesia, Nyasaland, Tanganyika, Kenya, the Anglo-Egyptian Sudan, Uganda and the Belgian Congo. Dr. Elsdon-Dew, who holds the appointment of assistant pathologist in the Medico-legal Department of the South African Institute of Medical Research, has been engaged on an intensive study of the African blood-groups since 1932, and has examined the blood grouping of more than five thousand South African Bantu. In publishing his results, and the somewhat startling inferences as to the racial history of Africa to which in his opinion they appeared to point, he emphasized the fact that theorizing on the serology of African peoples must of necessity be tentative, for in this respect Africa is still the Dark Continent. The present expedition has been undertaken to remedy the lack of material for purposes of comparison which gave to his ethnological argument a highly speculative character, more especially as regards the existence of a hypothetical primitive black race, possessing neither the *A* nor the *B* groups, to which his results appeared to point, and with which, serologically, the Southern Bantu apparently showed a closer affinity than any other people of which the blood groups were known. The expedition, which is travelling by motor caravan, will be at work for about six months.

Local Archæological Studies in Nottingham

PUBLICATION of the first annual report of the Excavation Section of the Thoroton Society of Nottinghamshire falls opportunely at a moment when attention has been directed in Parliament to the opportunity open to local archæological and scientific societies to educate their neighbours, the local authority and the local public generally, as to the desirability of preserving for posterity buildings and erections of historical or æsthetic interest and places of natural beauty (see NATURE, Feb. 27, p. 345). The Excavation Section of the Thoroton Society has been formed as an outcome of the enthusiasm of a small number of students of the past history of the city of Nottingham, but more especially through the efforts of Mr. G. F. Campion, who was anxious that the work of local excavation carried out by himself and his father before him over a number of years should be placed on a permanent footing. Very wisely it was decided not to form a new society for this purpose, but to join forces with the Thoroton Society, the long-established centre of archæological and antiquarian interest in the county. Thus the activities of the newly established section will be directed not only to continuing the work of excavation, but also to the expert examination and record of the numerous evidences of the city's past cultural history which are being brought to light with increasing frequency in the building operations in progress in connexion with the improvement and enlargement of business and other premises in Nottingham. It should at least be able to ensure that nothing worthy of note is overlooked—a matter of much importance in an area like Nottingham which is honeycombed with underground caves. The record of the first year's operations covers not only the excavations in Nottingham's Norman and Plantagenet castle, and a Roman fortress, but also the supervision of excavations for building operations on eight sites, which produced some interesting samples of medieval pottery, including a fabric unknown from any other area and thought to be an exclusive product of Nottingham.

Miocene Implements

A NUMBER of years ago, the late Mr. Edward Westlake collected a very large series of specimens of flaked chert and flint from Upper Miocene deposits at Aurillac, and other sites, in the Cantal, France. These specimens, which number several thousands, are now housed at the Museum, Ipswich, where they are being studied by Mr. Reid Moir. When his examination of the collection is completed, Mr. Reid Moir proposes to describe it; but it may be said that a great many of the specimens exhibit, in a marked degree, certain characteristics which have been generally accepted as indicative of artificial shaping. Archæologists, and those interested in the antiquity of man, owe a debt of gratitude to Mr. Westlake's insight and care in getting together such a vast and important collection, which, from many aspects, is unique. There would seem to be no doubt as to the Upper Miocene age of the deposits from which the specimens were derived, and their adequate description may well prove to be a significant contribution to the solution of the problem of the antiquity of the human race.

Dry Crossings of the Nile

WITH reference to the two letters to the Editor in NATURE of June 5, p. 961, under the title "Dry Crossings of the Nile", from E. J. Wayland and Dr. H. E. Hurst, we have received the following from Dr. A. E. H. Tutton: "It may be of interest to add to the record of the observations by Dr. Wayland, from the air in 1930 and by an actual passage on foot in 1933, that a natural bridge does from time to time exist across the higher reaches of the Nile, strong enough to bear the elephant, a still more remarkable observation by my late brother-in-law, Mr. Leonard Loat, made and recorded by him in the year 1902, during his survey of the fishes of the Nile for Lord Cromer's Government and the British Museum (Natural History). In a letter to me describing the difficulties then being met with, owing to the remarkable density and solidity of the 'sudd' between Fashoda and Gondokoro, he states that he had just observed a herd of over two hundred elephants walking on the sudd over the river. When he returned to England for a short leave, before undertaking a similar survey up the Blue Nile, I asked him whether he had recorded a solid fact or was indulging in a traveller's tale, as it seemed a very extraordinary circumstance, if true. He was most emphatic, however, as to its being literally true, and that he had ceased to count the elephants after the two hundredth; also that he had been accompanied by a big-game hunter friend at the time, as well, of course, as by the Egyptian skipper and Sudanese crew of his little survey vessel, a specially fitted dahabeyah, all of whom were greatly interested in the unusual spectacle. It is referred to in the obituary notice of Mr. Loat's work which appeared in *The Times* of April 30, 1932."

Memorial Tablet to Telford

DURING the conversazione of the Institution of Civil Engineers held on June 2, the president, Sir Alexander Gibb, unveiled a small tablet in the newly completed extension of the main library recalling Telford's gift of books to the Institution. When Telford accepted the presidency in 1820, he wrote: "As proof of my sincere desire to promote the prosperity of the Institution, I beg leave to present it a collection of Books connected with the profession of a Civil Engineer; they will form no inconsiderable portion of a suitable library, destined, I trust, at no distant period to become a valuable one. . . ." The library now contains 62,300 volumes, and Telford's books, with some others, have been placed in cases under the window in the west wall of the extension. Hollin's bust of Telford stands on the top of the cases, just above the tablet recalling his gift, while the oil paintings which the great engineer bequeathed to the Institution of the Pont Cysylltau Aqueduct and the Menai Bridge have been hung one on each side of the window.

Hooker's Aneroid Barometer

THE British Association has recently received from Miss Hooker, daughter of Sir Joseph Hooker, a gift of the aneroid barometer which used to hang by the fireplace in Charles Darwin's 'old study' at Down House, where it will now be replaced. A small repair has been kindly carried out by Messrs. Negretti and Zambra, and the aneroid is in working order. The face bears the words "Holosteric Barometer" and beneath them the figure 19, but no maker's name; the usual verbal indications of weather conditions are provided, and the dial is graduated continuously round the whole circle, figured from 25 in. up to 31 in., the remaining arc, between 31 and 25 in., being also graduated, as the whole scale is, in fiftieth parts of an inch. A small label, affixed perhaps when the instrument came into Hooker's possession, bears the name of "C. Darwin".

New Central Botanical Gardens for Moscow

BOTANICAL gardens, to be known as the Central Botanical Gardens of the U.S.S.R., will shortly be constructed on the southern and northern slopes of the Lenin Hills, on the outskirts of Moscow, according to the Soviet Union Year Book Press Service. The gardens will occupy a site of 825 acres, bounded by the projected Rublevskoye Chaussee, the Palace of Soviets, the Andreyev Canal and the Moscow River. A considerable part of the site will be used as a scientific research station. Special hothouses and structures will be put up in this section for the purpose. The middle of the Gardens will have a group of hothouses with varying artificial climates for the growing of plants from all over the world. A model orchard will be used for showing Michurin and other horticultural experiments. The Botanical Gardens will be attractively laid out with terraces, fountains and waterfalls. A funicular railway will connect the Moscow River Embankment with the top of the Lenin Hills. The Academy of Sciences of the U.S.S.R. has appointed a special commission to take charge of the designing and construction of the Gardens. The Commission includes V. L. Komarov, president of the Academy, Prof. N. I. Vavilov, Prof. B. A. Keller, A. M. Lezhav, director of the Central Department of Sub-Tropical Crops of the Commissariat of Agriculture of the U.S.S.R., and I. S. Gorshkov, director of the Michurin Central Laboratory of Genetics.

Future of the Coal Gas Industry

THE seventy-fourth annual meeting of the Institution of Gas Engineers was held on June 1–4, under the presidency of Mr. Stephen Lacey, of London. The papers contributed illustrated the problems and trends of the gas industry to-day—the tendency gathering in momentum on one hand to replace the consumption of raw coal by smokeless fuels and methods, and on the other to use fuels in a 'fluid' form amenable to ready and automatic control. The gas industry as a producer of smokeless fuels—both solid and fluid—is deeply involved in this trend, and the papers read retailed divergent opinions as to the future. A major problem of the industry is to maintain an economic balance between coke and gas. In Great Britain, gas engineers do not anticipate an early displacement of solid fuels; the industry must look for a combination of the two. Mr. C. F. Broadhead, of Melbourne, Australia, influenced by the acute instability of markets for by-products in that country, favoured concentration on complete gasification of coal. This idea, which is by no means new, is attracting renewed attention, and as Mr. Lacey said, is now the aim of an important branch of the Institution's research work. The uncertainty about the future of the supplies of suitable gas coal has stimulated interest in this problem. It has long been felt that the service of the gas industry would be more efficiently rendered if organized into larger units. Such an organization of the electrical industry has been imposed by law and a somewhat analogous process is now proceeding in the gas industry, but voluntarily, and by the formation of corporations or holding companies. This process has evoked a mixed reception, and a paper by Mr. G. M. Gill records how the holding companies have already given technical and financial assistance to many small isolated companies, enabling them to pursue a more progressive policy.

A Meteorological Chronology

GEOPHYSICAL MEMOIR No. 70 of the Meteorological Office, by C. E. Britton, is entitled "A Meteorological Chronology to A.D. 1450". It is a symposium of various compilations of historical references to the weather of the British Isles, and a full bibliography of these is given at the end of the memoir. The main body of the work is in diary form, each year for which any notable meteorological event has been recorded appearing in turn, with particulars of such events. The first year is 2668 B.C., but it is pointed out that these very early dates, derived from such sources as the Irish Chronicles, are "largely legendary", being probably in the nature of oral traditions. The events chronicled in these years are chiefly the overflowing of various Irish lakes and rivers. The traditional period is followed by the Roman period, and the author points out that the very large number of meteorological events assigned to those times by various annalists and chroniclers do not appear to have been recorded by any contemporary writer; many indeed appear for the first time on record in the eighteenth century, with no information from the chronicler as to where the information was obtained. A typical specimen of this class of record is that of Dr. Thomas Short of Sheffield, who published a "General Chronological History of the Air, Weather, Seasons, Meteors, Etc." in two volumes in 1749—a work that occupied the worthy doctor for fifteen years. Without disputing the interest attaching to a work of the character of this symposium, one may doubt if its scientific value for meteorology is appreciable. It is amusing to notice the sobering of the record in its later years—the gradual dying out of such events as several days' downpour of blood, for example—with its suggestion that a very large part of the events before, say, A.D. 1000, are pure inventions or unrecognizable distortions of happenings not so very different from those of modern times.

A Theory of Atomic Structure

OUR attention has been directed to a theory of atomic structure which has been elaborated by Mr. C. F. Krafft, of Washington, D.C., and published by him in book form under the title "The Mechanistic Autonomy of Nature, with 1935 and 1936 Supplements". In this theory the atomic nucleus has been discarded in favour of a system of vortex rings arranged in the form of polygons, which may break up into chemically active groups and then fuse with other similar groups to form larger polygons. Thus the valency 'bonds' are made up of protons as well as electrons and the structural centre of the atom is apparently void. Whether this theory will survive the critical examination of the physicist is not certain, but the author claims that it enables him to interpret the chemical structures of compounds like diborane B_2H_6, etc., which are apparently anomalous. He asserts that "the very existence of diborane flatly disproves the entire nuclear theory of atomic structure, and not even its endorsement by high authorities can save it". In view of this bold statement, it is interesting to recall the fact that this very problem was brilliantly solved quite recently by Dr. E. Wiberg, an account of whose work on the subject was published in NATURE of February 27, p. 381.

Storage Battery Cars

RECENT progress in the design of storage batteries has turned the attention of traction engineers to developing storage battery cars for use on rails. These cars are very trustworthy in service and simple to operate. The maintenance costs of the equipment are much lower than when Diesel engines are used. Battery maintenance is usually carried out by the manufacturers on the basis of the number of miles run, and the cost depends on the current price of lead. The 'standstill' charges affect about ten per cent of the total stock in service, and due to battery overhauls they are usually out of commission for three or four days during the year. According to *Electrical Industries* of May 19, charging the batteries is very simple. It is carried out at night by connecting them to a power supply, and when fully charged the current is automatically switched off. At the terminal points of the system the whole battery can be replaced in a quarter of an hour. The distance that can be covered in a single battery charge is now 185 miles. Trials on the German State Railways show that some cars can travel for 250 miles non-stop at 25 m.p.h., and half that distance can be covered at 40 m.p.h. In the first case the power consumption is 18 watt hours per ton mile and in the second 26 watt hours per ton mile. At the present time, there are 170 cars on the German State Railways and their average speed is between 37 and 47 m.p.h. The average yearly car mileage during 1935 was 38,500. In Poland, France and the north of Italy, storage battery cars, mostly of the double bogie type, are run on tramways and suburban lines. Each car carries about a hundred passengers and has four motors giving a total of about 180 horse-power.

The National Physical Laboratory

THE annual report of the Laboratory for 1936 is presented in a new form. Hitherto it has been a quarto volume of about 250 pages, well illustrated and cost 12*s.*; now it is royal octavo of 144 pages without illustrations but costs only 2*s.* 6*d.* The saving of space has been secured by the omission of detail of limited interest. The death of Sir Joseph Petavel, the director, was referred to in the last report and until the appointment of a successor Sir Frank Smith was in charge. Several members of the staff have been transferred to other Government Departments or have been absorbed by industry. Many of the senior members have taken part in conferences at home and abroad and have lectured in provincial centres of industry on the work of the

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On the Origin of Laws of Nature

By Prof. E. A. Milne, M.B.E., F.R.S., University of Oxford

[IN NATURE of May 8, we published an article by Dr. Herbert Dingle entitled "Modern Aristotelianism". The article, as letters from a number of correspondents showed, created considerable interest, and it was decided to invite further contributions on the subject from a number of representative investigators. Prof. E. A. Milne, who was singled out by Dr. Dingle for particular criticism, has sent an article expounding the ideas behind his recent work and touching on many of the points under discussion. This serves as an opening article to a series of contributions, many of them sent in the form of "Letters to the Editor", which have been arranged roughly in the order of their content under the general title of "Physical Science and Philosophy". Finally, Dr. Dingle has summed up the discussion and dealt with some of the main points raised. It is hoped that a useful purpose will have been served by bringing together in this way a number of contributions bearing on the old question of the relation of physics to philosophy.—Editor, NATURE.]

As the status of a recent series of writings by me has been called in question, it may be permissible to give some statement of their general tenour. The following account contains nothing that is not already explicit or implicit in the original investigations, and will be superfluous to those who have followed the details.

The general object of the investigations[1] in question was to determine the consequences of the assumption that the universe is, on the average, homogeneous. Had I used this as an ordinary physical hypothesis, that is, used it in conjunction with the existing body of physical doctrine and laws of Nature, the investigations would probably have passed without challenge. But I did not so use it. By an extreme application of the principle of the economy of thought, I investigated the consequences of this assumption without appealing to any empirical quantitative 'laws of Nature' whatever. I used it as a sole basis of argument. I did so because it early appeared that very much more could be deduced from it than was commonly recognized.* At first, indeed, I used it in conjunction with well-known kinematic laws developed in the so-called 'special' theory of relativity. Hence the provisional name 'kinematic relativity'. But it soon appeared that these kinematic laws were themselves the first deductions from the basic assumption, or from allied but simpler considerations in kinematics. From October 1933, when I first gave in seminars in Oxford the substance of Chap. ii of "World-Structure", I have endeavoured to develop the consequences without any empirical appeal save to the existence of a temporal experience, an awareness of a before-and-after relation, for each individual observer. Such an appeal, as has been emphasized throughout, is necessary before *motion* can be described at all. This is well understood from the works of A. A. Robb, and it has been evident from the time of Zeno. The exclusion of all empirical appeals was not complete in my own writings, but it has been further completed in papers by G. J. Whitrow[2], A. G. Walker[3], H. P. Robertson[4], and others. Some similar work has been developed by L. Page[5], and further work on the meaning of uniform time is in preparation by me in collaboration with Whitrow.

The hypothesis is that the universe is homogeneous on the average in both distribution and motion, both of these being quantitatively measurable, in principle, by any observer by means of measures of angle and temporal experience alone. The single measuring instruments allowed are the clock and theodolite, and it can be shown to be possible for clock graduations to be chosen so that the motion appears to be uniform to all of a class of observers, this mode of clock-graduation constituting the definition of the measure of 'uniform kinematic time *t*'. The indefinable concept of the rigid transportable measuring-rod is avoided, and the vague 'pointer-readings' of current relativity are made explicit. Throughout, full attention has been paid to the theory of knowledge—to Einstein's principle of introducing only elements which can in principle be observed.

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*It is fundamental because it enumerates a set of equivalent frames of reference.

It is an astonishing thing that the elimination of other empirical appeals, including all appeals to quantitative laws of physics, can be carried out as far as it can, however imperfect the present state of the theory. No one has been more astonished than the present writer. It is not an *a priori* belief to be scoffed at; it is a fact of experience to be reckoned with, that when we do thus eliminate such empirical appeals, regularities emerge (as logical consequences of the hypothesis) which play the part of the very laws of Nature which are *observed* to hold good. These regularities have the logical status of *theorems*, and the resulting logical structure has the status (or would have the status if it were perfect) of an abstract geometry based on axioms. It will be well therefore for a moment to consider what is meant by a geometry.

A geometry is a body of deductive inferences from axiomatic definitions which in effect afford the minimal descriptions of the subjects of discourse. The axioms of a geometry are essentially a complete set of definitions which delimit what we are talking about. The elements in the geometry—point, line, etc.—are never explicitly otherwise defined than as entities occurring in certain statements of relations. A geometer never says what a point *is*. Instead he makes a constructive statement about a point—he calls it an axiom—which affords a basis for inference. The logical consequences of the axioms constitute the theorems, and no 'fact' is appealed to in proving a theorem unless it has already occurred in an axiom or earlier theorem. This is what is meant by saying that geometry is an exact science—it makes no use of the principle of induction—it appeals to no empirical generalizations based on experience. The choice of axioms may be guided by suggestions derived from experience, but no recourse to experience is made in establishing the theorems. They depend for their validity on the self-consistency of the axioms and the freedom of the deductive steps from logical errors.

In this way systems are constructed which may or may not have their counterparts in the external world. We then appeal to observation to verify the existence, or establish the non-existence, of entities in Nature corresponding to the entities mentioned in the axioms—exactly or approximately as the case may be. For example, we can identify a given two-spread as a Euclidean plane by verifying (to a certain approximation) that the theorems of Euclidean geometry hold good in it; alternatively the two-spread may be such that the theorems of non-Euclidean geometry hold good in it. But in either case it is not that the theorems depend for their validity on recourse to observation or on any application of the principle of induction. It is their relevance to a particular state of affairs which can be so established. The role of observation is a double one: it is to discover theorems empirically, but it is also to verify the relevance of theorems discovered by inference from axioms, and hence to identify in Nature objects corresponding to, or approximately realizing, the entities mentioned in the axioms. The theorems exist in their own right. Thus when we say that geometry is an exact science, we are paying attention to one aspect—the deductive; we may equally say that it is an empirical science, namely, when we pay attention to another aspect—its relevance to Nature. In early Egyptian days, we understand, geometry was purely an empirical science; the Greeks carried it, though not quite perfectly, to its deductive phase.

Consider now physics. It has clearly an Egyptian aspect and a Greek aspect. The trend of physical investigation is at once to extend the number of known facts by empirical discovery, and to diminish the number of independent facts by establishing some as consequences of others. To the extent to which physics reposes on empirical laws of Nature not deduced from other laws—on 'brute facts'* capable of no further explanation—it is irrational and inexact; irrational because no reason can be assigned for the existence of these irreducible laws of Nature, and inexact because they can only be known to hold approximately, through the principle of induction. But we can contemplate the possibility of the completion of the second of the two trends mentioned, by reduction of the number of brute facts to the minimal description of what is the subject of discourse. Physics would then attain the status of a geometry. The minimal description, the relations satisfied by what *is*, would constitute the axioms. Theorems in the resulting logical structure would play the part of laws of Nature, and the validity of the theorems would depend, as in a geometry, on the self-consistency of the axioms and the correctness of the logical reasoning. The laws would exist not as regularities imposed from without but as a consequence of what *is*. The role of observation would again be to attempt to verify in Nature the existence of entities corresponding to those mentioned in the axioms or any afterwards constructed, by ascertaining whether the resulting theorems hold good in the external world. The relevance of the theorems to Nature would require to be established by observation, but these theorems or laws of Nature would hold good in their own right, as the inevitable consequences of our having said exactly what we were talking about.

Just as geometers have constructed systems and logical entities not realizable in Nature—like a four-dimensional cube—so here the resulting logical structure may not correspond to Nature. But just as results of great value have followed from the construction of non-realizable abstract geometries, so it is valuable to construct an abstract physics for its own sake. It is remarkable that those who are most prone to criticize my procedure on the ground that it is 'mere logic' immediately avail themselves of the results of 'mere logic' by adopting non-Euclidean geometries.

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* It is not known whether this phrase is an insult to the facts or a compliment to the brutes.

In the deductive structure raised, the substratum or smoothed-out homogeneous universe plays the same part as the plane in Euclidean geometry. It is the platform on which, or the background against which, the entities constructed have the properties enunciated in the theorems. Instead of properties of patterns of points, we have properties of sets of fundamental particles. The difference from geometry is that the platform is a moving one (in some of its modes of description). We have superposed *motion* on geometry. Like the plane or any surface of constant curvature in geometry, the substratum is of the same nature everywhere. It is a remarkable fact that the theorems to which one is led cover the successive provinces of kinematics, dynamics, gravitation and (in preparation) electrodynamics, and agree in general outline with the empirically discovered laws of Nature concerning these provinces. Whether the structure in all its details is 'realized' in Nature is an interesting and important question, but it is more interesting that the procedure is possible and at least partially successful. Nature *is* very like the abstract structure. An example of identification by appeal to observation is the identification of kinematic time in terms of dynamical time by comparison of the laws of dynamics obtained deductively with the empirical Newtonian dynamics.

This throws a flood of light on the problem of the 'origin' of laws of Nature. Empirical physics by itself cannot attack this problem. A residue of laws of Nature, not otherwise explained, would partake of the character of magic. To believe in this would be a form of superstition. It would mean that there were two creations, one of the matter of the world, another of a set of laws for the world to obey., The alternative belief is that the universe is rational. By this I mean that given the mere statement of *what is*, the laws obeyed can be deduced by a process of inference. There would then be not two creations but one, and we should be left only with the supreme irrationality of creation itself, in Whitehead's phrase. We can only test this belief by an act of renunciation, by exploring the possibility of deducing from some assumed description of just *what is* the laws which *what is* obeys, avoiding so far as possible all appeal to empirically ascertained laws. Laws of Nature would then be no more arbitrary than geometrical theorems. God's creation would be subject to laws not at God's further disposal. The laws would be consequences of the world-shape.

As for the basic assumption itself, that the world is homogeneous, it is perfectly open for anyone to make a different assumption (for example, that it is not homogeneous, but stratified round a particular centre) and repeat the procedure. Either the laws of Nature would come out different—in which case we should have to attribute new effects to distant unobservable portions of the universe; or they would come out the same—in which case the original axioms would have been shown to be unduly restrictive, but the deductive character of the laws would be more secure still. Progress in this direction has been made by A. G. Walker, in repeating the procedure for a Riemannian space. But it was surely justifiable, in so unconventional a programme as the logical deduction of laws of Nature, first to explore the possibilities in the simple contexts of homogeneity and Euclidean private spaces. Through an unmapped region, one path must first be trodden.

The work was first criticized as being solely kinematical. Now that it has been developed so as to construct a dynamics and account of gravitation, critics appear to resent the fact that laws of dynamics come out as deductions. The individual investigator must be left in peace to state his own problems and solve them by his own methods, and criticism of these on the ground that they go beyond Renaissance science is merely a form of authoritarianism.

One further point may be mentioned. The procedure we have outlined is essentially different from that of general relativity. General relativity, on a basis of empirical experience, proposes certain laws of Nature, but is still, without further assumption, unable to say what are the contents of the world which is to obey them. In almost all its treatments of the cosmological problem, general relativity goes on to make the same assumption that I make, that the universe is on the average homogeneous. The assumption was first made by Einstein. But it now follows that general relativity makes redundant assumptions. For the assumption of homogeneity itself implies the laws that will be followed. It may be that the laws adopted in general relativity coincide with those that can be deduced from the assumption of homogeneity. If so, general relativity is fortunate. Actually investigations given elsewhere throw considerable doubt on the "field equations" of relativity, partly because the latter lead, if pushed to extremes, to inadmissible consequences. But the important point is that it is not legitimate *both* to assume a homogeneous universe *and* to assume laws for it to obey. Laws can be deduced from homogeneity, but the procedure is not reversible.

It may remove misapprehensions to remark that the actual discreteness or local inhomogeneity of the world in detail leads to no difficulties. Technical methods have now been developed for superposing on general homogeneity local variations, and for dealing with such systems as a spiral nebula.

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[1] "Relativity, Gravitation and World Structure" (1935); "On the Foundations of Dynamics", *Proc. Roy. Soc.*, **154A**, 22 (1936), "The Inverse Square Law of Gravitation", *Proc. Roy. Soc.*, **156A**, 62 (1936) and **160A**, 1 (1937); "Kinematics, Dynamics and the Scale of Time", *Proc. Roy. Soc.*, **158A**, 324 (1937), **159A**, 171 and 528 (1937); "The Acceleration-formula for a Substratum and the Principle of Inertia", *Quart. J. Math.* (*Oxford*), 8, 22 (1937); See also my review of Bridgman's "Nature of Physical Theory", *Math. Gaz.*, p. 340 (Dec. 1936)

[2] Whitrow, G. J., "On Equivalent Observers", *Q J.M.*(*Ox.*), 6, 249 (1935); "World Structure and the Sample Principle", *Z. Astrophys.*, **12**, 47 and **13**, 113 (1936–7); "Photons, Energy and Red-shifts on the Spectra of Nebulæ", *Q.J M.*(*Ox.*), 7, 271 (1936–7).

[3] Walker, A. G., "On Milne's Theory of World-Structure", *Proc. Lond. Math. Soc.*, **42**, 90 (1937), Also *M.N.R.A.S.*, **95**, 263 (1935).

[4] Robertson, H P., "Kinematics and World-Structure", *Astrophys. J.*, **82**, 284 (1935), **83**, 187 (1936); **83**, 257 (1936).

[5] Page, L., *Phys. Rev.*, **49**, 254 and 466 (1936).

Physical Science and Philosophy

Sir Arthur Eddington, F.R.S., Observatory, Cambridge

In his entertaining article in Nature of May 8, Dr. Dingle inveighs against a new departure in scientific method, which has grown out of the revolution of thought provoked by relativity theory. For my own part, I will not quarrel with the label 'Aristotelian'. Whether or not my view has anything in common with that of Aristotle, it presents a definite contrast to the 'Galilean' view; and I feel great satisfaction at having shocked a die-hard of the latter school.

But I think Dingle is wrong in identifying the Aristotelians with those whose deductions rest on a supposed uniformity of the universe. (I have toned down his rhetoric a little.) A conspicuous example is Dr. Hubble's deduction that the red-shift in nebular spectra is due to some cause other than velocity. But I would not class Hubble as an Aristotelian; he is more usually held up as a model of orthodoxy to errant theoretical cosmogonists. For my part, I have made a point of exposing a number of fallacies, current at one time, which arose from applying the uniform model to actual conditions without taking account of the irregularity of the universe. The distribution of the galaxies, like the distribution of the planets, comes under the heading "particular events and objects of our experience" which, according to my statement partially quoted by Dingle[1], cannot be deduced from epistemological considerations.

A doctrine is not to be judged by the follies that have been committed in its name. If Kepler concluded by Aristotelian sophistry that there can be only five planets besides the earth, Bode obtained by Galilean induction his law of planetary distances. The planet Neptune contradicts them both impartially. I can only accept responsibility for the "new Aristotelianism" in the form in which it has been promulgated and applied in my own writings. I here offer a short explanation and defence of this form.

In physical science *a priori* conclusions have long been anathema. It has come to be accepted as a scientific principle that we can have no *a priori* knowledge of the universe. Agreed; provided that by 'universe' is here meant an *objective* universe, as was clearly intended when the principle was framed. But I have calculated, for example, the mass-ratio of the proton and electron by an *a priori* method which does not involve any observational measurements. For present purposes we may assume that the calculation is sound, since criticism has not been directed against any particular step in the argument. What follows? We are given—

(*a*) It is impossible to have *a priori* knowledge of an objective universe.

(*b*) The mass-ratio has been found by an *a priori* method.

Therefore: *Knowledge of the mass-ratio is not knowledge of an objective universe.*

After a rather extensive series of researches, I have found that a great part of the current scheme of physics is deducible by *a priori* argument and therefore does not constitute knowledge of an objective universe. When the constant, which I had regarded as the last stronghold of objectivity, namely "the number of particles in the universe", surrendered, I could no longer resist the conclusion: The general laws of Nature (embodied in the fundamental equations of mathematical physics), including the universal constants associated with them, do not express knowledge of an objective universe. If anyone points out that in that case they are not *really* laws of Nature or natural constants, I do not object; but I continue to use the designation applied to them in current physics. Observation, besides revealing laws of Nature, supplies details of particular systems and events. It is in these particulars that the objective element in our knowledge resides; there is no objective element in the general laws.

One consequence of the new outlook, which, I believe, rouses the passions of the Galileans, is that a law of Nature has a compulsory character, and is not merely an empirical regularity which we have hitherto found to be fulfilled in our limited experience. Conflict with the laws of Nature is *impossible.* "Impossible" you may say "is a word which no genuine scientist should use". Very well; let us substitute another—which makes the laws no less compulsory. Conflict with the laws of Nature is *unobservable.* Physical knowledge, as ordinarily expressed, is not stated in terms of observables, and requires translation in order to get at its observational content. Carrying the translation into the language of observables further than it is usually carried in relativity theory and quantum theory, it appears that the supposed deviation would have no observational equivalent. It is like trying to find the English equivalent of a misspelt German word.

In the theory of relativity it was realized for the first time that induction from observation should be based on what the observer observes, not on what he alleges he observes. This elimination of metaphysical speculation and return to the "hard facts of observation", besides purifying and extending Galilean induction, was also the origin of the Aristotelian divagation. Attention was directed, not only to the result of the measurement (*a posteriori* information), but also to the nature of the process of measurement (*a priori* information). We cannot, of course, predict the result of the measurement from our *a priori* knowledge of how the measurement is going to be made; but it does not seem unlikely that we should be able to predict certain general properties that the resulting measurements will have. A valuer may arrive at the generalization *a posteriori* that no article in a certain house is worth more than sixpence; the same conclusion might have been reached *a priori* by noticing that the owner furnished it from Woolworth's. The observer is called upon to supply the furniture of the mansion of physical knowledge. The Aristotelian by watching his method of obtaining the furniture may anticipate some of the conclusions which the Galilean reaches by inspecting the furniture.

Consider an example. A measurement consists in comparing a relation between two entities with a relation of the same kind between two other entities, the latter relation being treated as 'standard'. It therefore concerns four entities in all. Without more investigation we are led to expect that this number four will in some way make itself evident in the world-picture which embodies the results of observational measurement. This expectation in itself tells us practically nothing*; many threads must be woven together before a pattern appears. But the example will serve to show where I get the straw for the bricks which I make—or drop—in my theory.

A more abundant source of *a priori* material is the fact that our inductions are based, not on observations generally, but on "good" observations, that is, observations made in (or reduced to) conventionally defined conditions. It must be emphasized that (according to Dr. Dingle) these conventions are entirely arbitrary. Faithful Galileans, who have no *a priori* theory of Nature, cannot speak of one convention being more 'natural' than another.

As a further example I may as well take what has probably been regarded as the most glaring application of Aristotelianism, namely, the result that the number of particles in the universe, N, is precisely $2.136.2^{256}$. I have not forgotten Kepler's fiasco with the number of the planets; but in attempting to out-Kepler Kepler, we have the advantage of three hundred years' progress. The number N is one of the constants of physics, ascertainable approximately by Galilean methods. I describe it as it is described in current physics; but, of course, if I show that it can also be calculated *a priori*, it cannot represent knowledge of an objective universe and therefore cannot be an arithmetical count of objective particles.

Quantum physicists tell us that a particle (say, an electron) is not normally in a definite place but is smeared over a probability distribution; also that electrons are not distinguishable from one another. That does not seem very promising material for counting. (I would suggest to quantum physicists who suffer from insomnia that, instead of counting sheep in a green field, they should try counting electrons in a probability distribution.) Nevertheless, quantum physicists tell us confidently how many electrons there are in a gram of hydrogen. Ten years ago I wrote with enthusiasm about Dirac's delightful dodge, which turns arithmetic into wave mechanics by means of a wave function whose eigenvalues are the integers—at the same time emphasizing that it was a dodge[2]. By this method the wave function, which describes a system physically, is made to supply an arithmetic for reckoning the number of its particles. When the quantum physicist states the number of particles in a system, whether few or many, he gives the number reckoned by quantum arithmetic. The natural constant N is a number in quantum arithmetic; it could have no other meaning, for Pythagorean arithmetic is a non-starter in the competition. When further we introduce the condition that the wave function of the universe is relativistic, that is, that it is the embodiment of information that has been obtained by observational measurements, we find that in the corresponding arithmetic the integers run only from 1 to $2.136.2^{256}$. This upper limit may be said to replace infinity in relativistic quantum arithmetic in the same sense in which the velocity of light replaces infinite velocity in relativistic kinematics. We can thus obtain the number of "all the particles that there are" from our *a priori* knowledge of the arithmetic that is used for enumerating them. From the philosophical point of view we have 'debunked' N; but here we must stress rather the fact that the Aristotelian method anticipates information, which when obtained *a posteriori* by Galilean induction is counted as a valuable addition to knowledge.

Finally, since the statement of my philosophy[1] quoted without its safeguards by Dingle has also been quoted by almost all the reviewers of my book, I would like to make it clear that it is not the basis but the unexpected conclusion of the investigation.

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* In particular, it does not warrant numerological speculations. I think the number four introduced in this way is responsible for the four dimensions of space-time, *but only indirectly*. In the actual calculation the number of dimensions of space-time is reached by the route $\frac{4.3}{1.2}-1-1=4$.

[1] "Relativity Theory of Protons and Electrons," p. 327.

[2] "The Nature of the Physical World", p. 219 ('Everyman' edition, p. 216).

Prof. P. A. M. Dirac, F.R.S., St. John's College, Cambridge

IN his article in NATURE of May 8, Dr. H. Dingle criticizes my letter to NATURE of February 20, on the grounds that it departs from the Galilean scientific method of building up theory to fit observations. The successful development of science requires a proper balance to be maintained between the method of building up from observations and the method of deducing by pure reasoning from speculative assumptions, and I think my letter satisfies this condition; but as it was written rather concisely, I would like here to restate the main points of the argument in a form which brings its observational basis to the forefront, and is essentially independent of cosmological theory.

We begin by taking all the constants of Nature provided by observation, comprising the atomic constants and some astronomical ones, namely, the gravitational constant, the red-shift of the spiral nebulæ per unit distance, and the average density of matter. (The last has a definite meaning on account of the fact that the spiral nebulæ are distributed with uniform density, as far as can be seen with the largest telescopes.) From these constants of Nature we construct all the simpler dimensionless numbers that we can, and make them all greater than unity by taking the reciprocals of those that are less. A remarkable result now comes to light. The numbers we obtain, instead of being scattered about in a random way, are distributed in clusters, there being one cluster of small numbers (the largest of these being the ratio of the mass of the proton to that of the electron), a second cluster of numbers in the neighbourhood of 10^{39}, and a third cluster of numbers in the neighbourhood of 10^{78}.

From kinematical considerations based on the assumption that the red-shift phenomenon appears the same when observed from different spiral nebulæ (a reasonable assumption in view of the uniformity in the distribution of the spiral nebulæ), one can deduce that the red-shift per unit distance is not constant in time, but is slowly decreasing, at the rate of about one part in 2×10^{9} per annum. Milne's work provides a detailed treatment of this question. One may adopt a picture using the recession explanation of the red-shift, when the red-shift per unit distance will be slowly decreasing because of the increasing distance of the nebulæ. (But one is not obliged to adopt this picture, there being another mathematically equivalent picture without recession, based on Milne's time variable γ.)

The red-shift per unit distance has the dimensions of $\delta\nu/\nu l$, that is, $(\text{distance})^{-1}$. To get a dimensionless number from it, we must multiply it by a constant of Nature with the dimensions of distance, the simplest of these being h/mc, e^2/mc^2, and the corresponding expressions with the proton mass replacing the electron mass. The numbers so obtained are all less than unity and their reciprocals are in the 10^{39} cluster. These reciprocals must be slowly increasing in time, on account of the decrease in the red-shift per unit distance.

I now make the hypothesis that the clustering of the dimensionless numbers is a fundamental natural phenomenon, which will hold for all time. This requires that, since some of the numbers in the 10^{39} cluster are increasing, they must all be increasing in the same ratio, and the numbers in the 10^{78} cluster must be increasing according to the square of this ratio. This is a tentative hypothesis, which one may hope will prove susceptible to experimental verification in its developments, though any direct test would be very difficult on account of the enormous time-scale involved.

S. Chandrasekhar, in his letter to Nature of May 1, makes an interesting contribution which, in the present terminology, would run as follows: if one brings the average mass of a star and of a spiral nebula into the scheme, one gets further clusters of numbers in the neighbourhood of the $1\frac{1}{2}$ and $1\frac{3}{4}$ powers of 10^{39}. From the foregoing ideas one would expect these to increase at the rate of the $1\frac{1}{2}$ and $1\frac{3}{4}$ powers respectively of the rate of increase of the 10^{39} cluster. This would enable one to calculate the rate of increase in the average mass of a star and of a spiral nebula, and hence also the rate of increase in the average number of stars in a spiral nebula.

Prof. W. H. McCrea, Queen's University, Belfast

Dr. H. Dingle's objection to "modern Aristotelianism" seems to be itself what he would call Aristotelian rather than Galilean. For a truly Galilean point of view would be to observe whether Eddington, or Milne, or anyone else, can in fact deduce properties of the physical world from a knowledge of "the system of thought by which the human mind interprets to itself the content of its sensory experience". Should it turn out that such a deduction is possible, the fact would be a new and exceedingly important experimental result, throwing fresh light upon the relation of the "physical world" to the human mind, and worthy of the attention of all true Galileans. On the other hand, to say that, "Nature nothing careth whether her abstruse reasons and methods of operating be, or be not, exposed to the Capacity of Men," is to assert something about Nature which is meaningless in regard to the experimental observation of Nature; by definition, man can experiment or theorize only about that which *is* exposed to the capacity of men—perhaps a trivial remark.

What Dr. Dingle has done is to reopen the question of the relation of mathematical physics to experimental physics, since he claims to detect a new and perverted point of view in the former. Now a system of mathematical physics, apart from the alleged perversion, is the working out of the mathematical consequences of certain hypotheses. The worth of the theory is judged on one hand by the fewness and simplicity of its hypotheses, and on the other by the closeness of the agreement of its predictions with the results of observation, and also the number of phenomena which it can so predict from the one set of hypotheses. Incidentally, some misunderstanding seems to arise because, for mathematical convenience, the hypotheses are generally stated as axioms, postulates, or 'laws', since the purely mathematical part of the theory is not concerned with their truth, in any sense, but only with their mutual consistency. Newton's laws of motion, and the principle of relativity, are examples of the hypotheses of two such theories.

Mathematical physics advances then, in one direction, by reducing the number of its hypotheses. This is well shown by the examples quoted by Dingle. Newton's theory was based on the hypothesis of his laws of motion and *also* upon implicit hypotheses about space and time. General relativity replaced this dual set of hypotheses by a single set. There is now "no such thing as a body in space, but matter is an aspect of the space-time structure" (Veblen and

Whitehead). Also the number and accuracy of the physical predictions were thereby increased. Milne next gives us a theory with still simpler and more easily apprehended hypotheses framed in terms of the equivalence of observers. The emphasis is on this equivalence, rather than on the cosmological principle as a property of the universe, as suggested by Dingle. Also, once again the number of phenomena brought within the scope of the theory has been increased. I think it is fair, in the present state of the theory, to class Milne's equivalences of observers (there are two kinds of equivalence specified) with Newton's laws, or the principle of relativity, as basic hypotheses of a system of mathematical physics; then this system falls naturally into place in the historical development, without being guilty of the type of heresy suspected by Dingle.

However, there is one significant feature in Milne's theory which must not be overlooked. The constancy of the velocity of light was a hypothesis in some formulations of special relativity theory. In Milne's theory it becomes a *convention*. This possibility, that a hypothesis might be discovered to be a convention, or that the theory might be so readjusted that it becomes a convention, was clearly shown by Poincaré in "La Science et l'Hypothèse". There are actually other examples as well in Milne's work.

This leads us on to inquire how far back this process of reducing hypotheses may be pushed. Now there is one set of 'hypotheses' implicit in all these theories. They all inevitably postulate or spring from the processes of human thought. Is it then possible that we may dispense with all other hypotheses, that is, that all other hypotheses will be revealed as conventions of thought or the expression of thought? Eddington's theory, presented in the "Relativity Theory of Protons and Electrons", and referred to by Dingle, may be regarded as, in fact, an effort to do this. The scientific attitude is, not to cavil at the attempt, but to see if it is successful. The theory is still too new for a consensus of scientific opinion to have been expressed; it is the purpose of this note merely to suggest that it is in harmony with the historic evolution of mathematical physics*. I fear, however, that I may have intruded into a region where angels might well fear to tread.

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* Some of these ideas were developed in an inaugural lecture on "Mathematics and Cosmology", before the Queen's University on October 25, 1936.

Prof J. B. S. Haldane, F.R.S., University College, London

DR. DINGLE's spirited attack on Prof. Milne and Sir Arthur Eddington, in NATURE of May 8, will inevitably excite some sympathy among workers in sciences such as biology, where chains of reasoning are shorter than in cosmology. If Milne really attempted "to derive the laws of dynamics rationally —without recourse to experience", he would perhaps merit the title of traitor which Dingle awards him. But in actual fact his cosmological principle is based on the hypothesis that observers on the earth are not unique, and that observers on other stars would form a world-picture similar to our own. Now this hypothesis would have appeared fantastic to Aristotle, Ptolemy or St. Thomas. It is based on the deduction from astronomical observations that our own sun is one of a very large number of stars in one of a very large number of galaxies. The fact that it can be used as a basis for dynamics is remarkable, but Milne certainly did not frame it "without recourse to experience".

Similarly Eddington states that "An intelligence, unacquainted with our universe, but acquainted with the system of thought by which the human mind interprets to itself the content of sensory experience, should be able to attain all the knowledge of physics that we have attained by experiment". May be, but the system of thought in question happens to be determined, at least to a considerable extent, by the sensory experience. If Sir Arthur Eddington's entire sensory experience had been confined, say, to listening to the music of Bach, I venture to suggest that his system of thought would have been different. Actually this system is a highly specialized social product. I doubt whether the system of thought employed by the Australian aborigines to interpret their sensory experience would be so sound a basis for theoretical physics as that current in Cambridge.

However this may be, I trust that Dr. Dingle's article will not prevent biologists and geologists from studying Milne's cosmology, which, if accepted as a working hypothesis, will profoundly affect their sciences. For example, kinematical time, which is finite in the past, appears to be appropriate for describing chemical events, whilst many physical phenomena, such as the earth's rotation, proceed uniformly on a dynamical time scale which is infinite in the past, and corresponds to the logarithm of the kinematical scale.

Now many of the properties of matter are relations between chemical and physical events. For example, a given mass of a particular mixture at a certain temperature and pressure generates so many ergs per second. Clearly such properties of matter must change with time if Milne is correct; and $1\cdot5\times10^9$ years ago on the kinematic scale they may well have been sufficiently different to make life as we know it impossible. The conversion of chemical into kinetic energy is an essential feature of animal and even plant life; and in terms of our ordinary dynamical units this was, according to Milne, less rapid in the remote past.

There was, in fact, a moment when life of any sort first became possible, and the higher forms of life may only have become possible at a later date. If this is accepted, it cannot but alter our conceptions of evolution. Similarly a change in the properties of matter may account for some of the peculiarities of pre-Cambrian geology.

It is to be hoped that Prof. Milne and his colleagues will work out the secular changes in properties of matter such as density, rigidity, viscosity, surface tension, conductivity and the like, which may be expected to follow from his cosmological principles. If the results serve to illuminate the history of geological and organic evolution, we shall be kept too busy to find much time to blame him for a perhaps unduly idealistic account of their origin.

Dr. Harold Jeffreys, F.R.S., St. John's College, Cambridge

Dr. Dingle's article in Nature of May 8 seems to me an excellent statement of the position, and I am in full agreement with it. It is curious that advocates of the views criticized in the article usually refer to Mach, a large part of whose work was devoted to attacking the 'inherent necessity' view of causality and to showing how the laws of mechanics, then and usually still taught as a deductive science, were derived from experimental considerations. The principle of the rejection of unobservables, which is a practical working rule of induction, has now become misapplied, so that anything that an author does not wish to talk about can be disposed of by being called 'unobservable', however clearly observable it may be; and 'unobserved so far' and 'unobservable' are taken to mean the same thing, thus denying that there can be any knowledge that we have not already.

Milne[1] remarks that "the laws of dynamics are exact and simple, and hold good, because they are logical inferences from axiomatic definitions, obtained by a fairly short deductive train of thought. It is thus no longer necessary to appeal, as a warrant for a belief in the 'truth' of these laws of nature, to the so-called 'principle of induction', which has never been satisfactorily stated, much less demonstrated . . . observation vindicates, not the truth of the theorems . . . but the applicability of the definitions to the things occurring in nature".

We may admit the legitimacy of giving definitions and axioms as intuitive suggestions, working out the consequences deductively, and then testing the results by comparison with observation. But, as Whitehead and Russell point out, a definition depends for its validity on the existence of the thing defined, and therefore requires either a postulate or an existence theorem. It is perfectly possible to write down a definition of a plane equilateral right-angled triangle, but that is not the end of the matter. Where the existence has to be tested by experience the postulate depends on experience for its verification; and without a principle of induction there is no reason to suppose that it is true in any instances beyond those yet discovered. The fact that the principle of induction cannot be demonstrated from the axioms of logic has been known for centuries; but that merely shows that additional axioms are necessary. The axioms of logic also cannot be demonstrated; the great achievement of Whitehead and Russell was to reduce their number. Without using induction, Milne and Eddington could not order their lives for a day, and what they are really asserting is that they are entitled to use special axioms in physics, for which no need has been shown.

As for the statement of the extra postulates needed for a theory of induction, the essentials are better stated in Karl Pearson's "Grammar of Science" than in any other work known to me. Following on Pearson's lines, I think that I have given a set of simple postulates that will enable any type of observational data to be assimilated into the theory, without any need to assume that different fundamental principles of learning are needed in different subjects[2]. Other systems have been given by Prof. R. A. Fisher and other statisticians. Enough has been said already about the differences between these. The important point at the moment is that they are all satisfactory in the senses that (1) they do not treat any hypothesis as *a priori* certain; (2) they provide methods of choosing between hypotheses by means of observations; (3) they give estimates of the parameters involved in any hypothesis consistent with the observations; (4) they recognize that decisions made by them will sometimes be wrong, and give estimates of, alternatively, what degree of confidence we can reasonably attach to a decision, or how often, supposing that we use the rules regularly, we may expect the decisions to be right; (5) they all contain provision for correcting wrong decisions when observations become capable of giving further tests, thus recognizing that scientific progress is by successive approximation.

I should expect the decisions by my methods to lead to the correct decisions most rapidly, because the method contains more explicit provision for allowing for the whole of the data; but many rules given by Fisher, and others accepted by him, are of exactly the same form as mine and would in practice be used in the same way, while in other cases where there are differences the actual limits recommended are such that it would be extremely rarely that the decisions would differ in any specific application, and then we should both be doubtful. I should much prefer Fisher's system to any that asserts that only one hypothesis is to be considered at all, and, apparently, that a subject is meaningless until its laws have been predicted in terms of this hypothesis.

In one respect the position is even worse than is stated in Dr. Dingle's article. An author's preference for what he believes to be a deductive system may lead him to omit arguments that tend in favour of his main thesis. Einstein's theory was not the first explanation of the excess motion of the perihelion of Mercury. A completely satisfactory theory, as it then appeared, of the motion had already been given by Seeliger, attributing it to the attraction of the zodiacal matter. This accounted also for the excess motion of the node of Venus, which is 3·5 times its standard error, and was not explained by Einstein's theory. A larger random error would be expected to occur about once in 2,500 times; even allowing for the fact that the residual is selected as the extreme one out of 15 we should still not expect it more than once in 170 times. Newcomb had such confidence in this determination that he proposed to use it to determine the solar parallax dynamically. Yet writers on relativity all say that the residuals are perfectly satisfactory. De Sitter's last reference to the subject[3] gives a recalculation, which increases the residual, but he calls Newcomb's standard errors probable errors. Enough extra matter to account for the node of Venus would put the perihelion of Mercury hopelessly wrong. It might just possibly be a random error, but it was not legitimate to assert this until the alternative of additional matter near the sun was disposed of, particularly as such matter was seen. The question was whether there was enough of it. Similarly the refraction of a gas near the sun could account for the eclipse displacement of star images. Being prepared to take Einstein's theory seriously, but not being satisfied with the purely *a priori* arguments given for it, I obtained estimates of the quantity of matter present from its observed luminosity, and found that it would not account for 1/100 of the observed effects[4]. Consequently Einstein's theory was the only one suggested that was in accordance with the facts.

Now the remarkable thing is that, so far as I am aware, no exponent of relativity has ever mentioned this work or any improvement on it, the possibility of which I fully admit. It is apparently considered satisfactory to give a purely deductive theory from premises that are capable of being questioned, leaving with only a passing mention a residual with a natural alternative explanation that would not ordinarily be exceeded more than once in 170 times; while the fact that the theory is the *only* suggested one that is observationally tenable is not thought worth mentioning. Or is it not mentioned *because* mention of it would admit that the postulates of the theory are not *a priori* certain? In any case mention of the matter would make the theory more convincing to those who are not dazzled by the mathematics.

Milne similarly is trying to combine the phenomena of light and gravitation into one system, but the only observed facts that appear to involve the velocity of light and the constant of gravitation together, the three Einstein crucial tests, are postponed for treatment to an indefinite date as minor effects. As most of his work rests on the hypothesis of the universal applicability of the Lorentz transformation, I should expect it to lead to the same predictions as Silberstein's, which *a priori* seemed as reasonable as Einstein's, but made the perihelion of Mercury go round the wrong way and had to be dropped when there appeared to be no reasonable possibility of enough extra matter to put it right[5]. At all events, there is still no reason to believe that Milne's theory will lead to the correct predictions.

I think the source of the trouble is the belief that there is some special virtue in mathematics. Instead of being regarded as what it is, a tool for dealing with arguments too complicated to be presented without it, it has become emotionalized to such an extent that many people think that nothing but mathematics has any meaning; whereas the opinion of some of the best pure mathematicians is that the characteristic feature of mathematics itself is that it has no meaning. Russell has described mathematics as "a subject where we do not know what we are talking about, or whether what we are saying is true". Its function in science is to connect postulates with observations. The utility of deduction is that in investigating the consequences of a well-supported law it is a convenient approximation to induction.

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[1] *Proc. Roy. Soc.*, A, 158, 326 (1937)

[2] "Scientific Inference", 1937, and references there given.

[3] *Univ. of Calif. Math. Publs. in Math.*, 2, 152 (1933).

[4] *M.N.R.A.S.*, 77, 112–118 (1916); 80, 138–154 (1919).

[5] *Phil. Mag.*, 36, 94–128, 203–205 (1918).

Dr. Norman R. Campbell

SCIENCE, as Dr. W. H. George has lately told us, is the activity of scientists; it has no heresy but orthodoxy. Accordingly when we find fellows of the Royal Society indulging in speculations that would have been dismissed as fantastic (or, even worse, metaphysical) a few years ago, the proper course is not to accuse that body of disloyalty to its seventeenth-century traditions, but to inquire why new interests have appeared so suddenly. The answer to that question is very simple: the new developments could have been (I think they were) predicted before they occurred.

Science (or at least physics) has long consisted of two distinct but complementary activities. The distinction between them has been obscured, because they were practised by the same individuals; but now that physicists are rapidly segregating into experimenters who evolve no theories and theorists who make no experiments, there is no excuse for ignoring it.

One activity consists in the discovering of demonstrable experiments and their description (so far as that is possible) by laws. Its procedure is induction, which is the building up of experiments of higher rank out of elements which are themselves experiments of lower rank. It is peculiar to science; its products grow by accretion with little secular modification; it is the source of the practical utility of science.

The other activity consists in devising theories to explain the laws. Explanation is not peculiar to science, and is subject to fashion. But it always consists essentially in some substitution of ideas more intrinsically acceptable for ideas less acceptable. The process can be analysed into three steps: the formulation of hypotheses involving the acceptable ideas alone, the deduction of consequences from these hypotheses, and the translation of these conclusions into propositions concerning the less acceptable ideas by means of a 'dictionary'. The peculiarity of scientific explanations is that they often (not always) predict new laws in addition to explaining old ones.

Until the end of the nineteenth century, the hypothetical ideas introduced by scientific explanations owed their acceptability to an analogy with terms used in stating laws, an analogy so close that the same word was usually used for both, and the distinction between them was overlooked by the careless. But the more thoughtful always realized that (for example) a statement about the density of water was nothing but an imperfect way of describing a demonstrable experiment, while a statement about the density of the æther meant something that could not be demonstrated by experiment at all.

At the beginning of the twentieth century, laws were discovered for the explanation of which no 'mechanical' theory of this type could be found. At first it seemed as if the second activity of science might have to be abandoned. But propositions were found from which, by the aid of dictionary, laws could be deduced and actually predicted. They resembled the conclusions of a mechanical theory in this, and also in involving ideas (such as a wave-function or an imaginary co-ordinate of space) that had no relation, apart from the dictionary, to any demonstrable experiment; they differed in not being deducible from any intrinsically acceptable hypothesis.

If the older structure of science was to be restored, hypotheses had to be found from which these propositions could be deduced. Since the propositions were mathematical and invented by mathematicians, it was inevitable that the hypothetical ideas should be highly abstract and that the acceptability of the resultant theory should lie in a conformity to mathematical ideals, that is to say, in the rigid deduction of elegant conclusions from the minimum of self-evident axioms. The work that makes Dr. H. Dingle so indignant appears to me a laudable attempt to solve this problem, and, if I read his "Principles" aright, so it does to Prof. Dirac. If the attempt succeeds, experimenters will not, of course, gain the satisfaction that they derived from mechanical theories—that appears a vain hope; but even the horror of logical rigidity that inspires the average experimenter may permit him to prefer a logical theory to none at all. Moreover, it is not necessary that all traces of the old analogies should be lost. It is noteworthy that both Dirac and Milne introduce as fundamental an idea closely analogous to the agreement between observers, which is implied in the conception of a demonstrable experiment. (Here, of course, Dr. Dingle is definitely wrong. If only a single observer existed, neither the Doppler nor any other experimental effect could be detected; he would have no means of distinguishing fact from his individual illusions.)

The rest of Dr. Dingle's objections appear to arise partly from a trivial dislike of the term universe —which I share, partly from a flat denial of the duality of physics and a persistent confusion of theories and laws. If he does not deem it important to observe the distinction between what is and what is not demonstrable experiment, surely he should welcome a movement to amalgamate the Royal with the Aristotelian Society.

By Prof. L. N. G. Filon, C.B.E., F.R.S., University College, London

WITHOUT necessarily endorsing all that Dr. Dingle has written about "the New Aristotelianism", one may be permitted to welcome a protest against the modern tendency in physics to proceed from abstract and universal *a priori* mathematical theories, which seem to spring up nowadays in disconcerting numbers.

The real trouble seems to be that, instead of starting from the facts of observation and gradually building up by induction particular laws, which may or may not eventually be linked up, some men of science appear to think that they can solve the whole problem of Nature by some all-inclusive mathematical intuition. What they are really doing is not to explain Nature, but to explore the possibilities of the human mind. If Prof. E. A. Milne's statement, which Dr. Dingle quotes, is really to be taken literally, it would probably lead to the conclusion that all science reduces to pure nominalism, a view to which few would care to subscribe.

Surely it is time that we got back to the more secure, if more pedestrian, methods of the nineteenth century. I seem to remember a phrase, to which at any rate a good deal of lip-service used to be paid, about hypotheses "which were crushed in the solitude of the study". Judging by much of the scientific literature which gets published nowadays, something seems to have gone wrong with the crushing-machines.

Prof. W. Peddie, University College, Dundee

THE recent timely strictures (NATURE, May 8, p. 784) made by Dr. Dingle on modern Aristotelian tendencies in some theoretical investigations in physics suggest that a change in the line of (metaphysical) attack on physical problems might be of value.

For example, if we *postulate* (1) an at least four-dimensional plane universe, (2) motion in our three dimensional part of which is responsible for our idea of space, while, (3) constancy of speed of an observer in the four dimensions originates our idea of absolute time, (4) local time is measured out by the fourth dimensional component of speed, we can deduce the necessity for special relativity.

By modification of some of these postulates we can revel in general relativity.

The difference in effect is that we can blame the objective physical universe for the formal laws of thought, instead of the laws of thought for the structure of the universe. We can escape from Aristotle and get back to Galileo and Newton.

Prof. R. A. Sampson, F.R.S., Royal Observatory, Edinburgh

I HOLD that we are limited beings, limited as regards our senses, which are our only means of understanding the world, and limited also in time. We cannot enlarge our reliance upon our senses. The microscope, for example, is taken as a means for extending our observations. But any observations made must be afterwards interpreted by the senses, so that we can infer what they represent. We are limited, too, in regard to understanding any communicator. Anything we hear must pass through two barriers: first, whether it expresses correctly what the communicator feels—many professional writers have complained of the difficulties of expression—and second, whether we can understand it. Many cases will occur to anybody when these limitations prove a total blank. I hold all this so strongly that I am not even interested to discuss the question with anyone who holds the opposite view. That means that I am *not* a "modern Aristotelian". But I doubt whether anyone is. Even in the case of those whose words may bear the fair conclusion that they *are* modern Aristotelians, and suppose that they *are* independent of experience, I think that their practice belies their words. It is a very difficult thing even to express oneself so as always to be consistent. Even with the advantage of consisting of the same skin and bone, one often says contradictory things. Then there is the certainty that the statements are not absolute, but depend upon the refinement of our means of expression. The same problem of understanding the world must present itself to primitive peoples, who have no adequate means of expressing their meaning.

The means that are supplied to us provide a distinctly partial means of understanding the world. The senses are very crude, and can only be extended in the way shown above. We cannot tell what time is. Probably it is no more than a physical displacement, like other physical displacements. If this is so, Nature, which depends upon the isolation of events, disappears as an entity, for it depends upon the separation of the time co-ordinate from the others. As I have remarked in another place, it would be a very convenient thing to foretell the future—even to foretell it roughly. We have memory, but not foresight. Descartes' dictum "*je pense, donc je suis*" ought to be supplemented with "*I thought and so I was*", for this is constantly used for prediction, in fact it supplies the second proposition upon which we can base a third. Indeed most of our devices seek to extend the intellect into the future. Ignoring the primitive claims to do so—like 'second sight'—the rules of logic are just such another device, a more subtle device but of just the same sort. For where logic works, it offers to tell us what will happen in another place and time, of which, *ex hypothesi*, we have no experience. Of course a large part of logic is merely explanatory, a mere unfolding of what is implied in the statements. Take, for example, mathematics. The statements found in Euclid are contained in the definitions, postulates and axioms. They are mere statements. None of them can be proved or disproved, and their interest is derived from the way in which they accord with the external world. All the rest is a process of unfolding; and so for other cases—all follow the same model.

To resume, however, the question of predicting the future. It is the greatest error that mathematics makes, that it slurs the distinction between the past and the future—the quantities that it handles being timeless. Of course, in a minor way, the distinction *is* recognized in thermodynamics, in the proposition that entropy must always increase in the future. But this is the sole case, and it might even be traced to a formal expression of the proposition that there is a notorious difference between the past and the future.

The fact is that Nature is becoming enormously complicated—almost too complicated to use. In the old days the same man might be a doctor of medicine and an astronomer. The same word was used to describe an astronomer as an astrologer. Those days are past. We must now be content with theories which express the *essentials* of what we wish to express; to take again an instance from mathematics, the ordinary theory of rotating liquids, which alone is workable, is indefensible hydrodynamically; yet it expresses what is essential of 'centrifugal force', and would collapse without it. So it contains what is requisite, and we extrapolate from it confidently. All statements that we reach are extrapolations from experience, and, as such, their interest depends upon their being approximately true. With our imperfect means of recognizing the truth, we cannot expect any statement to be more than approximately true.

What then is 'observable'? Ought we to limit theorems strictly to what is observable? To confine oneself to what is observable, seems to mean confining oneself to mere verification of experience. For before it is experienced, a prediction is of no value, and after it is experienced, the theory that has led us to look in the right place, must be replaced by the experiment made. Expectation, in fine, depends upon theory. The Brownian movement, for example, must be shown to accord with expectations. A theory will be more or less extensive according to the man that frames it. Some will be complicated by things which must for ever remain unobservable. Some will be directed to a single point. Some will be very extensive, like the law of gravitation or the theories of general dynamics. All are mere guesses at truth. This seems to supply the point of reconciliation for framing a theory independent of experience, such as is denounced in Dr. Dingle's article, and also with the work of a poet or other humanist, who gives us at most a number of illustrative cases.

Prof. C. G. Darwin, F.R.S., Christ's College, Cambridge.

THE most interesting moral to be drawn from Dr. Dingle's article has nothing to do with his detailed criticisms of the theories of the "Aristotelians"; but raises the matter of the curious relationship which at present subsists between metaphysics and science. This has somehow gone wrong. On one hand, we have the philosophers claiming that their metaphysics underlies all possible knowledge, so that they may tell us what we are allowed to think; surely at first sight one would have expected that they could settle the present controversy with authority. On the other hand, we have the men of science, each with his own philosophy, most usually formed without any professional study of the subject, often held with a most polemic enthusiasm, and showing the wildest divergencies.

The noticeable point is that these contradictious views do not seem to matter in the very least; we none of us doubt that both Dingle and Milne will help on the progress of science, and that the advances they make will have scarcely anything to do with their opposite metaphysical ideas. Each of us must have a philosophy of things in general, and this will include our philosophy of physics; it may be extracted from us with the methods of Socratic dialogue by some more expert philosopher, and the inquiry will usually reveal inconsistencies and impossibilities in our system, so that we shall end by wanting to do to our inquirer what the Athenians did to Socrates. That is not the point; for the fact remains that it is the science and not the philosophy that matters, and that most men of science do not find it worth their while to read the works of metaphysicians. Is not the salient fact about the philosophy of science that no professional philosopher can write a book that a man of science wants to read? Ought there not to be a meta-metaphysics which would bring a message of comfort telling us not to bother about our philosophy—a command most of us already obey—because we can get on with our business without it? A book on this subject would show what a lot of things there are that do not matter much, and it would have the advantage that *a fortiori* no one at all need read it.

Coming down to the details of the controversy, Dr. Dingle seems to want to hamper speculation by forbidding all but the most pedestrian forms of inductive reasoning. It is surely hard enough to make discoveries in science without having to obey arbitrary rules in doing so; in discovering the laws of Nature, foul means are perfectly fair. If Dirac is not to be allowed to conjecture the age of the earth from certain curious numerical coincidences, then Maxwell committed quite as great a crime in conjecturing that the velocity of light was the same thing as the ratio of the electric and magnetic units. It is absurd to maintain that such guesses are illegitimate. On the other hand, some of Dingle's antagonists have held the view that all Nature is contained in our own minds. Surely even if this is true it is a very unimportant statement. Is it not like asserting that anyone who knows the rules of chess has the whole game in his mind, and therefore will always win?

G. J. Whitrow, Christ Church, Oxford

Dr. H. Dingle, in his recent article "Modern Aristotelianism", not only attacks the particular methods adopted by contemporary mathematical investigators in relativistic cosmology, but even refuses to admit that this subject is worthy of scientific investigation as it is based not only on experience but also on reason. This point of view, like most *anti-intellectual* philosophies, is based on a pure myth—in this case a mythical interpretation of the history of scientific method.

Since modern scientific method originated with the Copernican theory of the universe, let us consider the attitude which Dingle, as an empiricist, would have adopted towards the then new cosmology. With the instruments of the day, there were no known celestial phenomena which were not accounted for by the Ptolemaic system. Consequently, he would have regarded Copernicus's system as a "pseudo-science of invertebrate cosmythology", and would have preferred the laborious Ptolemaic inductions built up through centuries of patient observation, since to the many serious objections which were advanced against his theory Copernicus could only plead mathematical simplicity. It follows that Dingle himself would have been in the 'Aristotelian' camp.

It is well known that the driving force of Kepler's work was his belief in the existence of mathematical harmonies in Nature. Similarly, Galileo regarded mathematics as the appropriate instrument for scientific investigation. "We do not learn to demonstrate from the manuals of logic but from the books of demonstration which are the mathematical"[1]. It is of course true, as Dingle points out, that he said "Nature nothing cares whether her reasons and methods of operating be or be not understandable by man". This, however, as Dingle does *not* point out, was merely an expression of his rejection of Scholastic *teleology*. In point of fact, Galileo's whole life's work was based on the firm belief that Nature *is* understandable by man. "Philosophy is written in that great book which ever lies before our eyes—I mean the universe. . . . This book is written in the mathematical language"[2]. Indeed there is little doubt that Galileo regarded mathematical demonstration as an *a priori* method of reaching truth. As Mr. J. J. Fahie has shown, "in order to be able to demonstrate to his opponents the truth of his conclusions he had been forced to prove them by a variety of experiments, though to satisfy his own mind alone he had never felt it necessary to make any"[3].

We thus find, *pace* Dingle, that the methods of modern cosmologists are not so opposed to those of Galileo as he would have us believe. The three fundamental rules on which scientific investigation has proceeded since the days of Copernicus are: (1) belief in the simplicity and uniformity of Nature; (2) belief in the possibility of a mathematical description of Nature; (3) gradual discarding of all anthropocentric concepts. In particular, the last rule has recently found expression in the principle of relativity which, in general terms, can be said to signify the autonomy of individual points of view in the description of Nature. Prof. Milne's concept of equivalent observers is one way of making this idea precise. Relativistic cosmology, as based on these three rules, is therefore in the true spirit of all natural philosophy since the Renaissance.

In conclusion, I should like to direct attention to the extreme outburst of irrationalism which leads

Dingle to declare that "Even mere verbal heresies such as the statement that science is based on faith in an 'Order of Nature' have been few and harmless; we may have said such things, but we have always acted as though Nature might nothing care for what our minds call order". Actually, the exact opposite has been the case, for, as Prof. Whitehead points out, "there can be no living science unless there is a widespread conviction in the existence of an Order of Things and in particular of an Order of Nature"[4].

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[1] "Opere", 1, 42 (1842)

[2] "Opere", 4, 171 (1842).

[3] Singer, "Studies in the History and Method of Science", 2, 251 (1921).

[4] "Science and the Modern World", 5 (1926).

Fr. W. McEntegart, S.J., Heythrop College, Chipping Norton

Dr. Dingle's contribution to Nature of May 8 is a notable portent, and his challenge is happily juxtaposed with Lord Rayleigh's article on "Optical Contact". The inarticulate many who are pining for a return to reality in physics must be heart-stirred to find themselves possessed of such a champion. But one small protest must be entered. Why does Dr. Dingle dub his unrealist targets Aristotelians? Let him, if he so wishes, name them Kantians, Hegelians, or even Fichteans. But Aristotle and every loyal Aristotelian are on his own side. No experimenter, aiming, in Dr. Dingle's own words, "at rationalizing observations", ever did, or ever can, dispense with philosophy. Sound metaphysics will not compensate for an insufficiency of observation, culpable or otherwise; but the absence of a solid metaphysical foundation will vitiate all attempts to rationalize observations, howsoever abundant they be.

The fiction that the peripatetic philosophy is an airy tissue of aprioristic deduction should by now be outworn. It is, itself, a rationalization of experience, firmly keyed to reality. It is the mould the impress of which is still unmistakable in the language and thought of the civilized world, and some serious acquaintance with it would have a salutary and sobering effect on the 'universe' fabricators of whom Dr. Dingle complains. Sir Arthur Eddington, for example, would find it a philosophy ample enough to accommodate all the intuitions he can command, and might cease to claim for epistemology a super-comprehension of the existing physical world.

Dr. Dingle bewails the new 'cosmolatry' engendered "by metaphysics out of mathematics". If, in the spirit of true science, he would but disregard the traditional taboo, and discover for himself what metaphysics is, he could not impute such disreputable offspring to so noble a sire: and is his confidence that "the theory of relativity appears to be the *innocent* cause" (italics mine) securely founded as touching the innocence? The 'hall-marks' alleged recall a wise saying of Whitehead's, "The history of science is strewn with the happy applications of discarded theories."[1]

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[1] "The Principle of Relativity", p. 3.

Dr. H. Stafford Hatfield

Dr. H. Dingle's rather drastic remarks concerning present-day physical speculation seem to overlook one main factor in the progress of science—the capture of young minds of the highest order of genius. The genius of every age turns mainly in that direction which offers the greatest scope for the creative imagination. Since the time of Galileo, physics has seemed (however wrongly, according to some philosophers) to promise an eventual view of all time and all space, just as biology seems to offer an approach to the secret of life and mind. Most of their greatest exponents have combined a vigorous care for fact and sound reasoning with a delight in imaginative speculation. The great army of lesser workers, experimental hobbyists, mathematical cross-worders, even competitive careerists, find their world brighter for the speculative flights of men who, furthermore, often beat each at his own game.

A science kept strictly to facts and formulæ by 'pale Galileans' would recruit very few geniuses, fewer rank-and-file workers, and—fewer endowments!

Prof. G. Dawes Hicks, emeritus professor of philosophy, University College, London.*

I find it difficult to discuss profitably Dr. Herbert Dingle's article, because, although I think there is a certain amount of justification for the protest he raises against some current ways of presenting theories of the physical world, yet it seems to me he lays the blame upon the wrong things, and draws a contrast for which there is really no warrant.

Let me dwell, first, on the latter point. There were doubtless bastard "Aristotelians" at the time of the Renaissance, as there have been bastard "Galileans" since. But no genuine follower of Aristotle would have admitted for a moment that "Nature is the visible working-out of general principles known to the human mind apart from sense-perception", or that "reason could, apart from sense, dictate the course of experience". As a matter of fact, in handling the question how we come to reflect on general principles, Aristotle consistently maintained that it was by induction from experience. The human intellect was not supposed by him to operate *in abstracto*. On the contrary, general principles came to be apprehended in and through the matter furnished in sense-perception. Aristotle never questioned the validity of the data of sense. Indeed, the human mind or consciousness, as he conceived it, was just a capacity of becoming aware of the facts presented in sense-perception, and of dealing with them by certain processes which constitute the mental life itself. At the basis of all these was the process of sense-perception (αἴσθησις), and sense-perception had for its objects individual things (τὰ ὄντα). Not only so, sense-perception was not viewed as merely passive receptivity. It was a natural discriminative faculty

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* This contribution, and another by Prof H. Levy, were not received in time to be submitted to Dr. Dingle for possible comment. Prof H. Levy's article arrived after this Supplement had been made up, and is printed on p 1025 of this issue.

(a δύναμις κριτική). Out of it, in its cruder forms, memory comes to be, and out of frequently repeated memories of the same thing experience (ἐμπειρία) is developed, from which again "originate the skill of the craftsman and the knowledge of the man of science". "These states of knowledge are neither innate in a determinate form, nor developed from other higher states of knowledge, but from sense-perception" (*Post. An.*, ii, 19, 100^a). The human subject is capable, that is to say, of comparing experiences of various kinds with each other, and of concentrating attention upon one characteristic of a concrete thing to the exclusion of other characteristics. Thus, on the basis of familiarity with concrete things, the human subject can build up an abstract science.

Aristotle certainly distinguished between the way in which we come to be aware of general principles and the evidence there is for their truth. He did not fall into J. S. Mill's error of supposing that the instances used in an induction serve not only to lead us to recognize the general principle they exemplify but also to guarantee likewise its validity. Aristotle held, indeed, that the ultimate principles of science neither permit of nor require proof. When through induction the scientist has attained to such a principle, reason enables him to see by a kind of intellectual intuition that it is true. We may, or may not, acquiesce in this view; but, at any rate, it does not involve the inconsistency of first pronouncing induction by imperfect enumeration to be (as it obviously is) fallacious, and then assuming that the ultimate premiss of natural science is established by this fallacious method.

That Aristotle failed to recognize the importance of observation in scientific investigation is simply contrary to all the information that has come down to us. In biology particularly, whether we have regard to his powers of observation, his collation of what others had observed, or his theoretical deductions therefrom, we cannot but be struck by his remarkable achievements. "All the general propositions which he expresses are", said Cuvier, "inductions, resulting from observation and the comparison of particular facts; never does he impose a rule *a priori*". "Linnaeus and Cuvier have been my two gods", wrote Darwin, "though in very different ways, but they were mere schoolboys to old Aristotle". It is worth while mentioning here a significant example of the trait we are referring to. After having discussed in detail the manner of the generation of bees, Aristotle adds, "the facts, however, have not yet been sufficiently grasped; if ever they are, then credit must be given rather to observation than to theories, and to theories only if what they affirm agrees with the observed facts" (*D. G.*, iii, 10, 760^b).

There was, indeed, among the ancients generally no lack of appreciation of the need of careful and accurate observation; and they probably made more use of experiment than appears at first sight from the accounts we have of their work. Not then in this respect did their outlook differ from ours. The acceptance of the Copernican system may, from some points of view, be looked upon as the beginning of the modern scientific era. Yet clearly it was not merely by patient observation of the facts that this revolution came about, for such observation by itself could have led no one to question what seems, on the face of it, to be an obvious fact, that the sun moves round the earth. Rather was the Copernican hypothesis adopted because it enabled the movements of the heavenly bodies to be expressed in simple mathematical formulæ. But, so far as mere observation of the facts was concerned, there was nothing to suggest that the simplest explanation could be accepted as the true one. It was because it had come to be seen that science requires, in order to get under way, the recognition of some theory of what explanation means, that the Copernican hypothesis in the long run prevailed. It is noteworthy that Galileo himself expressed his admiration for that trust in reason which induced Copernicus to adhere to his view, in spite of its apparent discrepancies with the facts, until more delicate observations in the end confirmed it. The great claim of Copernicus to fame rests, he said, upon this, "that he did constantly continue to affirm (being persuaded thereto by reason) that which sensible experiments seemed to contradict".

Now, this "rape of reason upon the senses", as Galileo styled it, really means that in order to make headway the scientific investigator is constrained to adopt, either explicitly or implicitly, as a necessary preliminary, some general philosophic view, good or bad, of the nature of things. "If science is not to degenerate into a medley of *ad hoc* hypotheses, it must", writes Whitehead, "become philosophical and must enter upon a thorough criticism of its own foundations." It is not because Sir Arthur Eddington and other writers on relativity approach their theme from a philosophic point of view, but because the particular philosophic point of view which they adopt so often evinces itself as thoroughly unworkable, that one finds their treatment unsatisfactory. For example, when it is laid down, at the start, that "the task of physical science is to infer knowledge of external objects from a set of signals passing along our nerves", or rather that "the material from which we have to make our inferences is not the signals themselves, but a fanciful story which has been in some way based on them", that "it is as though we were asked to decode a cipher message and were given, not the cipher itself, but a mistranslation of it made by a clumsy amateur", we are confronted not with a "new Aristotelianism" but with a theory of knowledge which leaves us gasping when we try to put its parts together. It is not a question, as Sir Arthur Eddington appears to think, between idealism and realism; neither on idealistic nor on realistic grounds could a notion of this sort be sustained. There are certain well-established truths concerning the nature of knowledge which simply put a view of the kind indicated altogether out of court. The unfortunate thing is that the excessive specialization of the present day renders it well-nigh impossible for the scientific investigator to keep himself abreast of what is being done in the fields of epistemology and the logical scrutiny of scientific method.

Deductive and Inductive Methods in Science: A Reply

By Dr. Herbert Dingle

LET me begin by removing misapprehensions. I did not, as Prof. J. B. S. Haldane suggests, attack Prof. E. A. Milne and Sir Arthur Eddington: "Milne", "Eddington" and "Dirac" were merely symbols to facilitate reference to certain passages of literature with which alone I was concerned. Nor did I award Prof. Milne the title of traitor. My point was that the present menace was *not* one of the ordinary cases of treachery to a cause; it was the creation, through the aberration of some of our most gifted minds, of an atmosphere in which treachery can flourish. I have the greatest respect for Prof. Milne, but I cannot speak too disrespectfully of the cosmological principle.

To Aristotle also let justice be done. The answer to Father McEntegart's question is that I called my "targets" Aristotelians because they have revived the fallacy maintained by those whom Galileo and Newton called Aristotelians and who never, to my knowledge, disowned the name. To avoid libelling Aristotle, I put the word in quotation marks at its first appearance.

Except in one instance, I will not comment on matters of history: the facts are open to anyone who is able and willing to read them without prejudice. But I feel that I must put in a mild protest on behalf of Newton. Referring to modern mathematical physics, Prof. W. H. McCrea tells us that "for mathematical convenience, the hypotheses are generally stated as axioms". I had noticed that, and I can see the convenience when one comes to interpret the results, though its advantage at other times escapes me. But it must be remembered that Newton's mathematics was much cruder than ours, and since he repeatedly said that he did not make, and strongly deprecated, hypotheses, the probability would seem to be that he meant what he said: and when you try to discover what he did mean by hypothesis, you find that it was something so like Prof. Milne's cosmological principle that, if you relied only on the effete process of inspection for comparing them, you would scarcely know the difference. It appears, therefore, that Prof. McCrea, in classifying Newton's laws of mechanics with Milne's principle, has credited Newton with a mathematical facility not available in his day.

Several questions have been raised relating to the theory of knowledge and such subjects, which interest me very much, but I must keep to the main point. If anyone is interested in my attitude to these matters, he will find it expressed in a book now passing through the press; having tried to be explicit in 100,000 words I do not wish to court misunderstanding in fifty. For the purpose of this discussion, therefore, I adopt the view that the aim of science is the discovery of the truth about Nature. I do not think those are the best terms of expression, but they are simple and familiar and are perfectly applicable here. The question is then whether we can discover the truth about Nature rationally without recourse to experience.

I am delighted at Sir Arthur Eddington's admission that "we can have no *a priori* knowledge of the universe". His further statement that "*Knowledge of the mass-ratio* (of proton to electron) *is not knowledge of an objective universe*", for all its italics, comes a little late to be impressive, for it is what a die-hard of the Galilean school has been vainly trying to tell him for years. Even so lately as in his "New Pathways in Science" he wrote (pp. 20–21) that protons and electrons have "the same kind of connection with human experience as . . . sticks and stones and stars".

Sir Arthur's new discovery confirms my statement that his philosophy lags far behind his instinctive ideas. Without any of his genius, I saw clearly nearly a decade ago what has been revealed to him only through the agony of giving birth to an intricate theory; my 'hunch' that there is a lot in the theory is accordingly strengthened. But since for one person who tries to understand it there are a thousand who are guided, or misguided, by his philosophy, I venture to assure him that his new vision does not include the requirement that conflict with the laws of Nature is impossible or unobservable. That is even farther from the truth than his earlier belief in universal indeterminacy, which presumably cannot remain undisturbed in the face of inviolable laws. However, all in good time: meanwhile, let me also have my italics—"*We can have no* a priori *knowledge of the universe*". *Vicisti, Galilei*!

Prof. Milne simply makes it more clear than before, if possible, that he is not concerned with science at all. He does not want to find out the truth about Nature; he wants to make a theory. "Systems are constructed which may or may not have their counterparts in the external world". We then appeal to observation "to discover theorems empirically" and "to verify the relevance of theorems discovered by inference from axioms". (I thought some observers tried to discover facts, but apparently I was mistaken; physics based on facts is "irrational and inexact".) But the appeal is really idle, for "theorems exist in their own right", which is by no means affected if observation should prove them irrelevant. We go on looking, presumably, through a kind of race-memory generated in the old days of superstition.

I have no objection to theorems existing in their own right, any more than to the Choral Symphony existing in its own right, but I should very much like to know by what right Prof. Milne steals a march on Beethoven by publishing his creations in scientific journals. He is not interested in the standard metre because it is "undefinable". It is a part of the external world, of course, but he does not want to know about the external world; definitions are all that matter. He writes about hypotheses because they can be defined as axioms, but he will not write about Nature. Since when has the Royal Society been dedicated to the study of definitions?

I am not, I repeat, trying to stifle newly-born methods of research; the situation is quite other. Let us see by an actual example what this theory is. It made its debut early in 1933 in a 95-page article[1] arising out of the problem of the apparent recession of the nebulæ. After four years, crammed with developments and amendments of the fundamental idea, the solution of the problem is reached; here it is: "Imagine a nebular nucleus joined to ourselves by a material bar, supposed rigid; would the end of the bar and the nebular nucleus separate? The answer is that they would if the bar is deemed rigid Deductive and Industive Methods of Science, etc. 2 on the kinematic scale but not if the bar is deemed rigid on the dynamic scale."[2] Everything depends, it seems, on what we "deem"; what, then, shall we deem the standard metre? Ah, we cannot say; that is undefinable. Well, perhaps not enough has been published yet; suppose we wait a few years longer? No, that will not do, for the question is settled already; this is the "solution of the much-disputed problem" (p. 345)—"we resolve the controversy" (pp. 328–9). And, indeed, Prof. Milne's problem *is* solved, because it is not a problem about Nature but about "axiomatic definitions" existing in their own right. On the *scientific* problem, which is concerned with the actual world, we get no help. I hope Prof. Haldane is not building too much on the possible contribution of the theory to the problem of organic evolution. When an observer in a spiral nebula can define an organism in terms of clock-readings, some light *may* be thrown on the clock. Since a non-observer on the earth can never define the standard metre in any terms, the prospect can scarcely be called bright.

I did not overlook Dr. H. Stafford Hatfield's point concerning the "delights of imaginative speculation" or "the capture of young minds". These practices, like armament racing, add to the joy of life, and the capture of young minds can be illustrated well enough (though more serious and equally relevant examples exist) by the last paragraph of Mr. G. J. Whitrow's contribution (p. 1008), in which he calls a statement of mine an "extreme outburst of irrationalism" because he has found a remark by Prof. Whitehead which exemplifies it. That before criticizing it all at he should have found a contribution to science by Prof. Whitehead or another that would collapse if one removed the presupposition of an "Order of Nature"; and that, if he had found it, he would have shown my statement to be inaccurate (contrary to fact) and not irrational (contrary to reason)—did not occur to him. Having been well captured, he has lost the faculty for distinguishing fact from reason, and, using Milne's device of "an extreme application of the principle of the economy of thought", he rushes into print in my support. Mr. Whitrow might have made brilliant and valuable contributions to science—and this is what kinematical relativity has made of him. Yes, it is fine sport, and may even bring endowments. If I were a rich would-be dictator, I would endow it myself.

Once more, I do not want to hamper speculation in the way Prof. C. G. Darwin suggests. I cited Prof. Dirac's letter not as a source of infection but as an example of the bacteria that can flourish in the poisoned atmosphere; in a pure environment it would not have come to birth, and we should still have had the old, incomparable Dirac. One may fly as well in pure as in foul air, and with better prospects. But my concern is with the general intellectual miasma that threatens to envelop the world of science, and I emphatically disagree with Prof. Darwin's opinion that it does not matter what you think about science so long as you advance it: as well say that it does not matter what you burn so long as you make a bonfire. If I never added a jot to science, but succeeded in discovering and making clear what science is doing, I should consider that I had served my generation at least as well as if I had discovered a new universe. In the last resort, this matters almost more than anything else. How many physicists to-day feel confident that they can read a statement concerning our ordinary everyday consciousness of time, for example, and say, not whether it is true or false, but even whether it is sensible or nonsensical, a serious idea or a clever hoax? The criterion for distinguishing sense from nonsense has to a large extent been lost: our minds are ready to tolerate any statement, no matter how ridiculous it obviously is, if only it comes from a man of repute and is accompanied by an array of symbols in Clarendon type.

If this state of mind exists among the *élite* of science, what will be the state of mind of a public taught to measure the value of an idea in terms of its incomprehensibility and to scorn the old science because it could be understood? The times are not so auspicious that we can rest comfortably in a mental atmosphere in which the ideas fittest to survive are not those which stand in the most rational relation to experience, but those which can don the most impressive garb of pseudo-profundity. There is evidence enough on the Continent of the effects of doctrines derived "rationally without recourse to experience". To purify the air seems to me an urgent necessity: I wish it were in other and better hands.

[1] *Z. Astrophys.*, 6, 1 (1933).

[2] *Proc. Roy. Soc.*, A, 158, 345 (1937).

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Laboratory. In addition to the maintenance of standards of measurement and testing of instruments and materials, much research work has been done on these subjects and on others submitted by industry. A noise meter and an instrument for measuring the penetration of daylight into rooms have been devised. Light magnesium alloys of greatly increased strength have been produced, and the eight wind tunnels have been in full use. The use of protective coatings on steels liable to corrosion and the reasons for the superiority of certain oils as lubricants are being investigated, while the ship testing tank has been requisitioned for 78 per cent of the merchant shipping constructed in Great Britain.

Motion Pictures of Solar Prominences

VOL. 3, No. 1 of *Publications of the Observatory of the University of Michigan* contains a detailed description by R. McMath of the tower telescope of the McMath-Hulbert Observatory which has recently been built near Lake Angelus, Michigan. The telescope, which comprises a modified form of spectroheliograph ("the spectroheliokinematograph"), has been used to take successful motion pictures of solar prominences. A specimen film, taken in K_2 light and showing various types of prominences, was recently exhibited at one of the monthly meetings of the Royal Astronomical Society. The gradual movements of comparatively stable prominences, the eruptive motions of others, and the frequent occurrence of descending streams of prominence matter from points of origin above the chromosphere were beautifully shown (*The Observatory*, 85, April 1937). It may be noted that the founders and designers of the Observatory and its equipment, R. R. McMath, H. S. Hulbert and F. C. McMath, are non-professional astronomers. Acknowledgment is made by them in the present memoir for assistance received in advice, expert supervision and financial assistance during the building of their tower telescope.

The Zoological Society of London

"THE Zoo" progresses from strength to strength. A hundred years ago the then Earl of Derby announced that its income had mounted to £19,123; now it is £154,172; then the visitors numbered 363,392, now they are 1,962,122 plus another 484,453 at Whipsnade. The members who now number 8,307 were then 3,050. The stock of animals has increased slightly more rapidly than the members, 3,867 as against 1,025 in 1837. One of the outstanding exhibits of the year (according to the report submitted to the annual general meeting on April 29) was a group of young Hainan gibbons, but the first giant forest hogs to reach any zoological garden and several white-tailed gnus, a species now extinct in a wild state, will arouse equal interest when they are shown to the public. The only important building erected during the year was the Studio of Animal Art, opened on April 21 by Lord Snell; but an innovation which obviously met a popular need was the launching of the *Zoo* magazine, the circulation of which has been maintained at close upon 100,000 copies.

Dr. Marie Stopes's Coronation Ode

IN his broadcast speech on Coronation Day, May 12, H.M. King George referred to the Royal office to which he has succeeded as the symbol of the constitutional link of Empire and to the service which he desired to render while occupying it. Dr. Marie Stopes has been inspired by the occasion to compose a lyrical poem in which she happily expresses these and other attributes of kingship as represented by his present Majesty. Four lines may be appropriately quoted here: they are:

Thou art the centre of a world-wide plan
To make new triumph out of world-worn things.
Thou art the symbol of a nation's pride,
The dazzling spear-point of an Empire's van.

The ode has been attractively printed upon a card, and copies may be obtained from The Eclipse Press, 108 Whitfield Street, London, W.1, at the price of 1*d*. each or twenty for 1*s*.

Jubilee Number of *The Observatory*

THE inception sixty years ago of a monthly magazine, *The Observatory*, familiar in its blue covers to astronomers the world over, is commemorated in a special number, No. 755, of April 1937. The magazine was founded in 1875 by Sir William Christie, who was then Astronomer Royal, and it has been carried on voluntarily ever since, without any monetary grants whatsoever towards its publication, by successive editors, mainly from the observatory staffs at Greenwich and at Cambridge. The present number includes three special articles. In the first, Sir Frank Dyson reviews "Sixty Years of Meridian Astronomy"; the second article is by Sir Arthur Eddington (himself one of the joint editors in 1913–19) who writes on "Interstellar Matter"; while the third is from a veteran contributor (editor, 1893–1912), Mr. H. P. Hollis, whose article deals with Airy's water telescope. A unique feature of the past which found an appreciative circle of readers was the monthly anonymous contributions "From An Oxford Notebook" by the late Prof. H. H. Turner; these notes ran without a break from 1894 until Turner's death in 1930. The current numbers of *The Observatory* carry on the useful work of providing a report of the discussions at the meetings of the Royal Astronomical Society (including Geophysical Discussions), in publishing articles by astronomers of international repute, and in airing views in the pages devoted to correspondence.

Inland Water Survey

CAPT. W. N. MCCLEAN is publishing, in graphical form on standard sheets, the continuous record of water-levels, flows and storages, and of rainfall and temperature, for the Rivers Garry, Moriston and Ness, the three principal rivers of the Ness Basin of 700 square miles area. The records cover the period September 1929 to the end of the year 1935, and are obtainable in separate sheets or as a complete series for each river in a portfolio. The river survey work has been organized and carried out by the staff of River Flow Records, under the direction of

Capt. W. N. McClean. Capt. McClean's activity in the development of inland water survey in Great Britain is well known, and, in addition to the practical survey and record work, he initiated and organized the discussion on the need for this survey which the British Association staged at the York meeting in 1932. That discussion gave birth to the committees of the British Association and Institution of Civil Engineers, and these two bodies induced the Government to appoint the present Inland Water Survey Committee of the Ministry of Health. The graphical records of the Ness Basin rivers, which are similar to those published for the Aberdeenshire Dee, are the first of their type in Great Britain, and bring together the hydrological and meteorological records in a form from which statistical data may be derived or any desired analysis of river flow and storage may be made. A list of the published records can be obtained from "River Flow Records", Parliament Mansions, Victoria Street, S.W.1.

American Society of Ichthyologists and Herpetologists

AT the twentieth annual meeting of the American Society of Ichthyologists and Herpetologists, held in Washington, D.C., on May 4–8, the following officers were elected: *Honorary Presidents*, John T. Nichols and Dr. Leonhard Stejneger; *President*, Prof. William K. Gregory; *Vice-Presidents*, L. M. Klauber, Leonard P. Schultz, and Dr. Hobart M. Smith; *Secretary*, M. Graham Netting; *Treasurer*, Dr. Arthur W. Henn; *Editor-in-Chief*, Mrs. Helen T. Gaige, of *Copeia*; *Ichthyological Editor*, Lionel A. Walford; *Herpetological Editor*, Karl P. Schmidt. The election of four honorary foreign members was announced at the meeting; namely, for 1936, Prof. David M. S. Watson, University College, London, and Prof. Franz Werner, University of Vienna; for 1937, Dr. Leo S. Berg, Academy of Sciences, Leningrad and Dr. W. Wolterstorff, Museum fur Natur- und Heimatkunde, Magdeburg. Dr. G. A. Boulenger is the only previously elected honorary foreign member.

Systematics in Relation to General Biology

WHILE taxonomy has, in the past, been based mainly on morphology, the advances of the past two decades in cytology, ecology, genetics and other branches of biology have made it necessary to consider their contribution to the subject. As a result of meetings of members of the staffs of the John Innes Horticultural Institution and the Royal Botanic Gardens, Kew, and of zoologists interested in taxonomy, a "Committee on Systematics in Relation to General Biology" has been formed, the first open meeting of which will be held in the rooms of the Linnean Society, Burlington House, London, W.1, on June 25 at 3 p.m. All biologists interested in the general aims of the Committee are invited to attend. The chairman of the Committee is Dr. Julian S. Huxley, and the two secretaries are Mr. J. S. L. Gilmour, Royal Botanic Gardens, Kew (botany), and Mr. H. W. Parker, British Museum (Natural History), South Kensington, S.W.7 (zoology).

U.S. National Academy: New Members

THE following have recently been elected members of the U.S. National Academy of Sciences: Dr. C. B. Bridges, geneticist at the California Institute of Technology; Dr. O. E. Buckley, assistant director of research in the Bell Telephone Laboratories; Prof. A. J. Dempster, professor of physics in the University of Chicago; Prof. E. W. Goodpasture, professor of pathology in Vanderbilt University; Dr. C. G. Hartman, research associate in the Department of Embryology, Carnegie Institution of Washington: Dr. D. F. Hewett, U.S. Geological Survey; Prof. Leo Loeb, professor of comparative pathology in Washington University (St. Louis); Dr. D. A. MacInnes, associate member (physical chemistry) in the Rockefeller Institute for Medical Research; Dr. G. R. Minot, Boston City Hospital; Prof. J. von Neumann, professor of mathematical physics in the Institute for Advanced Study, Princeton; Dr. S. B. Nicholson, astronomer at Mt. Wilson Observatory; Prof. Otto Struve, director of Yerkes Observatory; Dr. F. B. Sumner, professor of biology in the Scripps Institution of Oceanography; Dr. Charles Thom, soil microbiologist in the U.S. Department of Agriculture, and Prof. E. C. Tolman, professor of psychology in the University of California. Prof. August Krogh, of the University of Copenhagen, known for his work in animal physiology, has been elected as a foreign associate of the Academy.

Announcements

DR. W. L. BURGESS, Dr. W. R. Wooldridge, Sir Louis J. Kershaw and Sir Joseph Barcroft have been appointed members of the committee set up in November 1936 to review the facilities available for veterinary education in Great Britain (see NATURE, 138, 837; 1936). Dr. Thomas Loveday, vice-chancellor of the University of Bristol, has been appointed chairman.

PROF. JAMES YOUNG, director of the Department of Obstetrics and Gynæcology at the British Post-Graduate School, has been elected chairman of the Medical Advisory Board of the British Social Hygiene Council in succession to Sir Farquhar Buzzard.

PROF. WLADIMIR KOPPEN, the eminent Graz meteorologist, has been awarded the shield of nobility by the German Chancellor.

DR. RICHARD HESS, professor of zoology at the University of Berlin, has been made an honorary member of the Bavarian Academy of Sciences.

THE British Homœopathic Congress will be held at the Langham Hotel, London, W.1. on June 17–18. Further information can be obtained from the Secretary, 69 Elizabeth Street, S.W.1.

THE Fourth General Assembly of the International Union for the Scientific Investigation of Population Problems will meet in Paris on July 28 in connexion with the International Population Congress, organized by the French National Committee, which takes place on July 29–August 1.

Letters to the Editor

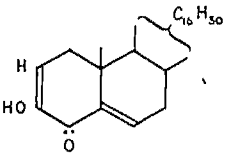
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1022.

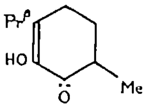
CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Cholesterol and the Adrenal Cortical Hormone

THE discovery that carbon atom C_4 of the cholesterol molecule is the first point of attack by oxygen, leading to the formation of *cis* $\Delta^{5,6}$-cholestene-3 : 4-diol, suggested that this reactive primary oxidation product may play an important role in the metabolism of cholesterol and the sexual hormones. Experimental confirmation of this view was obtained by feeding experiments, which showed that the diol, as well as its intermediate dehydration product cholestenone, were converted into coprosterol by the animal organism[1]. We have now obtained by mild oxidation of the 3-monoacetate (or 3-benzoate) of the *cis*-diol what is probably the oxide of 4-ketocholestenol 3-acetate (or 3-benzoate). These compounds yield on hydrolysis a highly reactive substance $C_{27}H_{42}O_2$ (I) which possesses the typical grouping —C=COH—CO— of diosphenol (buchu-camphor) (II).



I



II

As the substance, like diosphenol, functions in several tautomeric forms, it would be arbitrary to assign a definite structural designation to it, and we propose to call it *diosterol* (abbreviated from diossterol). Diosterol reduces ammoniacal silver solution, reacts with Schiff's fuchsin reagent and, as a phenol, is extracted by strong alkali from its ether- or benzene solution, forming yellow insoluble sodium or potassium salts (see forthcoming publication in conjunction with W. W. Starling and V. A. Petrow). The intensity of the ultra-violet absorption spectrum of diosterol is $\epsilon_M = 22,000$ at 320 mμ, that is, twice that of diosphenol at 270 mμ [2]. Diosterol was found to be identical with the "substance $C_{27}H_{42}O_2$" of Inhoffen[3] and Butenandt and Schramm[4], which is obtainable by a complex debromination process from certain bromination products of cholestenone.

Since it has now been shown that the same substance arises from cholesterol in definite stages by a process which may easily be visualized as a biological oxidation occurring in the animal organism, a hint is afforded in explanation of the unknown position and function of the fourth oxygen atom in the adrenal cortical hormone. This labile hormone, essential for life, possesses the remarkable property for a steroid of reducing ammoniacal silver solution, usually attributed to the terminal —CO.CH$_2$OH group in ring IV.

It is tempting to suggest that the diol and its immediate oxidation products may be steps in the biological formation from cholesterol of the labile cortical hormone of the adrenals. A new experimental approach to the system from the sexual hormones and other steroids has become available by the further discovery that the conversion of cholesterol into *cis*-cholestene-3 : 4-diol can be effected by simple treatment of cholesterol dibromide with silver acetate in pyridine at room temperature. This reaction, which is probably a general one, is at present being applied to steroids with a 5 : 6 ethylenic linkage.

O. ROSENHEIM.
H. KING.

National Institute for Medical Research,
London, N.W.3.

May 29.

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[1] Rosenheim and Webster, NATURE, **136**, 474 (1935). Rosenheim and Starling, *J. Chem. Soc.*, 377 (1937); cf. Schoenheimer, Rittenberg and Graff, *J. Biol. Chem.*, **111**, 185 (1935).

[2] Walker and Read, *J. Chem. Soc.*, 238 (1934).

[3] Inhoffen, *Ber.*, **69**, 1702 (1936).

[4] Butenandt and Schramm, *Ber.*, **69**, 2289 (1936).

Inhibition of the Gonadotropic Activity of Pregnancy Urine Extract by the Serum of Rabbits injected with an Extract of Male Urine

THE fact, first noted by Bachmann, Collip and Selye[1], that the serum of an animal which has received prolonged treatment with gonadotropic substances may acquire antigonadotropic properties, has been confirmed by many other workers. Twombly[2] was able to produce active antisera by the use of solutions of pregnancy urine extract, most of the initial gonadotropic activity of which had been lost during storage, and his results suggested that the presence of active gonadotropic substance, in the material used for repeated injection, might not be essential. We were able to confirm this supposition.

A precipitate was prepared from the urine of normal male factory workers, by a method known to be suitable for concentration of the gonadotropic substances in pregnancy urine. 3·9 mgm. of this preparation (representing 50 c.c. original urine) yielded no trace of a gonadotropic reaction in immature female rats ; 22·5 mgm. (representing 300 c.c. original urine) produced œstrus in six treated rats, with luteinization in one of them.

An adult female rabbit received 10·0 mgm. daily for 30 days (representing 130 c.c. original urine daily). The ovaries were apparently not influenced by this treatment, for autopsy showed ripe follicles only. Each of six immature female rats then received a total dose of 1·2 c.c. of the blood serum of this rabbit at the same time as 5 units of gonadotropic hormone from pregnancy urine (Pregnyl Organon). The serum was injected on the left, the Pregnyl on the right side of the rat, the number and interval of the injections being the same as in pregnancy tests according to Aschheim and Zondek. Œstrus, enlargement of the uterus and luteinization were completely inhibited by the addition of the rabbit serum, occurring only in the controls. Each of six immature male rats then received 12 R.U. of Pregnyl and 3 c.c. serum during six days. Addition of the serum to the gonadotropic preparations here inhibited the enlargement of seminal vesicles, preputial glands and testes produced in controls which had the same dose of hormone without serum.

Our experiments prove that it is possible to obtain rabbit serum with antigonadotropic properties by repeated injection of a negligibly gonadotropic extract of male urine. It is just possible that the effect is due to the traces of the gonadotropic hormone; more likely, in view of the experience of Twombly, it is due to the presence of a different substance with similar antigenic properties.

Rabbits treated with serum from a non-pregnant mare failed to produce a serum that would inhibit the gonadotropic activity of pregnant mare serum in immature female rats.

P. de Fremery.
B. Scheygrond.

Organon Laboratories,
Oss, Holland.

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[1] Bachmann, C., Collip, J. B., and Selye, H., *Proc. Soc. Exp. Biol Med.*, **32**, 544 (1934).

[2] Twombly, G. H., *Endocrinology*, **20**, 311 (1936).

Coupled Oxidation of Ascorbic Acid and Hæmochromogens

Hæmochromogens catalyse the oxidation of ascorbic acid at a pH below 7 at which there is no autoxidation of ascorbic acid. We can confirm this result of Barron and co-workers[1], but the authors have overlooked that the hæmochromogens also undergo oxidation under these conditions, as first observed by Karrer and co-workers[2]. The product of this oxidation is verdohæmochromogen, a bile pigment iron compound[3].

We have studied in detail the coupled oxidation of ascorbic acid and pyridine hæmochromogen, with the double purpose of investigating whether or not the physiological hæmoglobin breakdown and the bile pigment formation can be assumed to proceed in this way and of getting information on the mechanism of hæmin catalysis.

Hæmin was measured spectro-colorimetrically as hæmochromogen after reduction with hyposulphite, ascorbic acid iodometrically or with the indicator method in the hydrogen cyanide trichloroacetic acid filtrate. In air, with a 2 mM. vitamin and a 0·2 mM. hæmin concentration, half the hæmochromogen is transformed into verdohæmochromogen during 1 minute at 37°, and after 10 minutes this oxidation is complete. The catalytic effect of pyridine-hæmochromogen, studied by Barron and co-workers over periods of hours, was thus largely due to verdohæmochromogen. The oxidation of 1 mgm. of vitamin is accompanied by that of 0·2-0·3 mgm. hæmin, rather independently of the hæmin and vitamin concentrations; at lower oxygen pressure relatively more hæmin is oxidized. The oxidation of vitamin leads to dehydroascorbic acid. Glutathione does not inhibit verdohæmochromogen formation in presence of ascorbic acid, but protects ascorbic acid by back reduction of dehydroascorbic acid; with glutathione alone, not verdohæmochromogen, but a hæmatin compound of hæmatin *a*-type is obtained. In the system oxygen—hæmochromogen—ascorbic acid—glutathione—glucose dehydrogenase—glucose, the oxidation of a hæmatin to a bile pigment is coupled with the final oxidation of glucose alone.

The mechanism of the coupled oxidation is interesting. Peroxides do not produce a verdohæm compound with hæmatin in pyridine, or if acting on pyridine hæmochromogen in the absence of atmospheric oxygen. Catalase, however, inhibits the oxidation of hæmin, though not of vitamin. Incubating hæmin in dilute pyridine with ascorbic acid and a small amount of hydrogen peroxide in nitrogen, the formation of a brown-green compound with an absorption band at 639 mμ is observed; by its properties it can be clearly distinguished from acid hæmatin and from hæmochromogens possessing a similar absorption band. It is retransformed to hæmochromogen by hyposulphite, by catalase and more slowly by ascorbic acid alone, and is oxidized to ferric hæmochromogen (parahæmatin) by ferricyanide or by an excess of hydrogen peroxide. We conclude from these observations that the substance is a ferrous hæm-hydrogen peroxide compound containing pyridine and perhaps also ascorbic acid. In nitrogen it is relatively stable in presence of an excess of ascorbic acid, but on admittance of air it is rapidly oxidized to verdohæmochromogen. For the oxidative splitting of the porphyrin ring to the bile pigment chain the action of oxygen on the hæm-hydrogen peroxide compound (combined action of oxygen and hydrogen peroxide) appears to be necessary.

The absorption band at 639 mμ is also observed during the initial stages of the coupled oxidation of hæmochromogen and vitamin by atmospheric oxygen. Here the hæm-hydrogen peroxide compound may arise by the transfer of hydrogen (Wieland) from ascorbic acid to a hæmochromogen peroxide (Warburg) formed initially by the action of oxygen on hæmochromogen; or hydrogen peroxide may be formed first in a radical chain mechanism[4] and then combine with hæmochromogen. The formation of the hæm-hydrogen peroxide compound from hæmochromogen, oxygen and ascorbic acid, and its reaction with hydrogen peroxide and ascorbic acid (peroxidase action of the hæmochromogen) constitute a catalytic cycle in which hæmochromogen acts as oxidase on ascorbic acid.

At the moment we are not yet certain how great a part of the vitamin oxidation proceeds in this way. Ferric hæmochromogen oxidizes ascorbic acid and ferrous hæmochromogen is re-oxidized by molecular oxygen. 10^{-3} mol cyanide inhibits very little, but ascorbic acid can reduce cyanhæmatin in pyridine. We have, however, additional evidence that the vitamin oxidation cannot be explained on this basis alone. If vitamin were to act in the reduction process only, we should find a greater percentage of the hæmatin in the form of hæmochromogen, when a higher vitamin concentration is applied; the contrary is true. For this reason, it must be assumed that ascorbic acid catalyses the oxidation of ferrous hæm, which is to be expected from the reaction mechanism described above. Again, vitamin may be oxidized and ferric hæmochromogen (in addition to verdohæmochromogen) arise in the reaction of the hæm-hydrogen peroxide compound with oxygen.

The absorption spectrum of the new hæm-hydrogen peroxide compound differs totally from that of the methæmoglobin-hydrogen peroxide compound[4] and from the catalase-hydrogen peroxide compounds[6] of Keilin and Hartree. In its properties it seems more closely related to the former.

An absorption band at 639 mμ has been observed by Warburg and co-workers[7] when *B. pasteurianum* was exposed to air in presence of cyanide. There is reason to assume that it is due to the same substance. Cyanide inhibits catalase and causes the accumulation of hydrogen peroxide in the cell, thus producing conditions under which the substance is formed from protohæmochromogen. Quite different are the substances with a band at 628 mμ, occurring as cytochrome a_2 in several bacteria; they are probably biliviolin-hæmochromogens[8].

R. LEMBERG.
B. CORTIS-JONES.
M. NORRIE.

Institute of Medical Research,
Royal North Shore Hospital,
Sydney. April 22.

[1] Barron E. S. G., De Melo, R. H., Klemperer, F., *J. Biol. Chem.*, **112**, 625 (1936).

[2] Kariei, P., v. Euler, H., Hellstrom, H., *Ark. f. Kem. Miner. Geol.*, B, **11**, No. 6 (1933).

[3] Lemberg, R., *Biochem. J.*, **29**, 1322 (1935).

[4] Weiss, J., NATURE, **133**, 648 (1934).

[5] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **117**, 1 (1934).

[6] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **121**, 173 (1936).

[7] Warburg, O., Negelein, E., Haas, E., *Biochem. Z.*, **266**, 1 (1933).

[8] Lemberg, R., and Wyndham, R. A., *Proc. Roy. Soc. New South Wales*, **70**, 343 (1936).

Visual Purple System in Fresh-water Fishes

THE visual purple of mammals, birds, amphibians, and certain marine fishes [1,2] absorbs light maximally at 500 mμ and participates with retinene and vitamin A in a retinal cycle[3,4]. I shall refer to this substance specifically as *rhodopsin*[5]. The visual purple of freshwater fishes possesses different spectral properties[1]; I shall refer to it as *porphyropsin*.

I have examined the porphyropsin system in white perch (*Morone americana*), yellow perch (*Perca flavescens*) and pickerel (*Esox reticulatus*).

Isolated dark-adapted retinas from these fishes are purple in colour. Exposed to bright light they turn russet, then fade slowly to very pale yellow. The fading from russet to yellow occupies about ¾ hour at 25° C. and possesses a high temperature coefficient. Russet retinas, replaced in darkness, regenerate porphyropsin, though always markedly less than is present in the dark-adapted retina. The light process is therefore reversible. Completely faded retinas do not re-form porphyropsin; isolation of the retina from the eye abolishes this reaction.

The nature of these changes is revealed further in the following experiment. Right and left retinas of six dark-adapted white perch were prepared separately. One set was extracted by shaking with benzine in the dark, then was bleached in bright light and immediately re-extracted. The second set was bleached and allowed to fade completely before extraction. The three benzine extracts were brought into carbon disulphide and their spectra measured. They were concentrated in chloroform, and spectra of the blue products obtained on mixing with antimony trichloride were examined. The results are summarized in the following table:

Retinal condition	Colour	Benzine extract in CS_2	Antimony chloride reaction
(*A*) Dark-adapted	Purple	Faintest yellow: simple end-absorption in violet	Very small band at 696 mμ
(*B*) Bleached	Russet	Deep orange-yellow. end-absorption with inflection (band ?) at about 400 mμ	High band at 703 mμ
(*C*) Bleached and faded	Faint yellow	Light yellow: simple end-absorption	High band at 696 mμ; broad flat hump at 640 mμ

No trace of either vitamin A or retinene was found in these tissues (compare Wald[3]). The orange-coloured 703 mμ chromogen, liberated from porphyropsin by light (*B*), is transformed by the facing process into the yellow 696 mμ chromogen (*C*), a small quantity of which (about 1/5) is present also in the dark-adapted retina (*A*).

Solutions of porphyropsin from the three species examined possess identical properties. Spectra of a neutral preparation from white perch in 2 per cent aqueous digitonin, measured against an equal depth of distilled water, are shown in Fig. 1. Curve *g* is the spectrum of the solvent alone.

Porphyropsin in solution possesses a broad absorption band maximal at 522–525 mμ (curve *a*). The secondary rise in absorption following a minimum at 430–440 mμ has appeared consistently, but may be due to impurities. The preparation was exposed to bright light (about 700 ft. candles) for ½ minute. It was then left in complete darkness and its spectrum measured periodically, curve *b* at 1·2 min., *c* at 4·6 min., *d* at 12·5 min., and *e* at 64·5 min. from the onset of the irradiation. The initial orange-coloured photo-product (curve *b*) slowly turned to yellow, the extinction falling in the region of 520 mμ and simultaneously rising below 444 mμ. Dark processes in this instance account for 34 per cent of the total fall in extinction at 520 mμ.

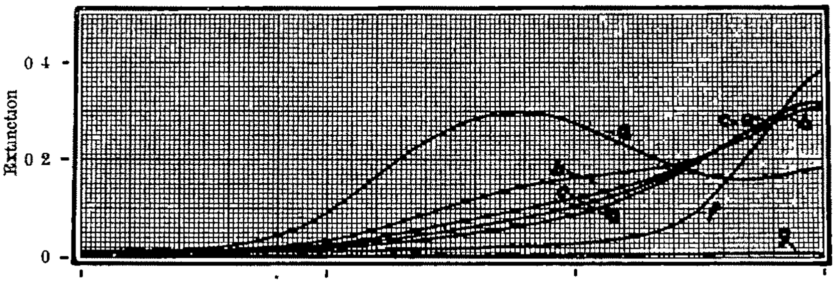

Fig. 1.

The final yellow product (curve *e*) changes colour reversibly with *p*H, tending toward orange in acid and pale yellow in alkaline solution. The present residue, brought to *p*H 11, yielded curve *f*.

This final bleached product yields all its colour on shaking with benzine containing 1 per cent ethanol. The benzine extract, brought back into neutral aqueous digitonin solution, possesses a spectrum-like curve *e*. It changes in colour with *p*H, as does the whole bleached residue. It appears to be the same pigment as is extracted from bleached (russet) retinas (extract *B* in the table above).

If curve *e* is subtracted from *a*, a function roughly symmetrical about a maximum at 540 mμ is obtained, similar to that observed by Kottgen and Abelsdorff[1]. Below 455 mμ this function assumes negative values. Obviously it does not, as commonly supposed, represent the spectrum of porphyropsin itself.

In every detail so far examined, the porphyropsin system faithfully reproduces the behaviour of the rhodopsin system, but with quite different components. It appears to consist in a retinal cycle of the form: porphyropsin $\underset{(1)}{\overset{\text{light}}{\rightleftarrows}}$ russet pigment (703 mμ chromogen + . . .) $\underset{(2)}{\rightarrow}$ yellow pigment (696 mμ chromogen + ...) $\underset{(3)}{\rightarrow}$ porphyropsin. Isolation of the retina from the eye cuts the cycle at (3); extraction of porphyropsin from the retina eliminates in addition reactions (1) and (2).

It is curious that the possession of porphyropsin divides all freshwater fishes so far examined—eleven species in all—even from certain very closely related marine forms[3,5]. The division may not be absolute, for recently a number of marine fish visual purples have been reported to possess intermediate properties[6]. These are possibly mixtures of rhodopsin and porphyropsin. The coincidence in a single retina of a number of visual systems accurately parallel in behaviour but differing in spectral properties should serve as an appropriate basis for colour vision.

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Thermal Decomposition of Ethylene Oxide

IN a series of papers communicated to the Faraday Society, an attempt has been made to prove that the thermal decomposition of a number of simple organic compounds may be accounted for on the assumption of the following mechanism.

The compound *A* first undergoes change in accordance with an equation,

$$A = B\ (+\ C). \qquad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

This process, which is called the *background reaction*, is readily reversible when *A* and *B* represent ethane and ethylene, propane and propylene, and probably acetaldehyde and vinyl alcohol, but in the case which we are considering it is sensibly irreversible.

The main reaction, following on the background reaction, is represented by the equation,

$$A + B = AB = (AB) = C + D, \text{ etc.} \qquad . \quad (2)$$

where *AB* and (*AB*) represent the activated complex, and what has been termed an *unstable intermediate*. The latter may decompose, or even react with some other substance such as hydrogen, to form one or more products, but it is the rate of formation of the unstable intermediate which we measure.

Further study of the thermal decomposition of ethylene oxide furnishes confirmation of this theory. This compound decomposes in the neighbourhood of 400° according to the equation,

$$(CH_2)_2O = CH_4 + CO. \qquad . \quad . \quad . \quad . \quad (3)$$

A little acetaldehyde is formed at the same time, and it has been suggested that this compound is an intermediate between ethylene oxide and the final products. However, it seemed likely, according to the theory referred to above, that the reaction,

$$(CH_2)_2O = CH_3CHO, \qquad . \quad . \quad . \quad . \quad (4)$$

might really be the background reaction for the decomposition of ethylene oxide, in which case the main reaction would be initiated by the collision of molecules of ethylene oxide and acetaldehyde, represented by,

$$(CH_2)_2O + CH_3CHO = [(CH_2)_2O, CH_3CHO] = 2CH_4 + 2CO. \qquad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

To test this theory, quantities of ethylene oxide and acetaldehyde were heated separately in a silica tube for 30 minutes at 400°. In a third experiment the same quantities of ethylene oxide and acetaldehyde was heated similarly, mixed together. As was anticipated, the quantity of carbon monoxide and methane obtained from the mixture was about ten times the sum of the quantities obtained in the experiments in which the two compounds were heated separately.

So far, it is only in the case of the hydrocarbons that it has been possible to eliminate the effect of the background reaction, and to study the main reaction by itself. However, by experimenting at temperatures at which ethylene oxide and acetaldehyde alone decompose very slowly, it is found to be possible to study in detail the process represented by equation (5).

This hypothesis enables us to dispense with the conception of the unimolecular reaction, and also of that of free radicals, in order to account for the thermal decomposition of simple organic compounds. The processes are accounted for on the supposition that the reactions involve simple bimolecular processes.

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Inhibitions of Organic Decompositions by Nitric Oxide

STAVELEY and Hinshelwood have recently shown that the thermal homogeneous decompositions of certain substances such as ethers and aldehydes are to a greater or less extent inhibited by small amounts of nitric oxide, and they have used this as a means of establishing the extent to which these reactions proceed via a mechanism of reaction chains[1]. With dimethyl ether the effect is most marked, and in this case, when the decomposition is about half completed, the reaction velocity rises fairly abruptly to its 'normal' value.

We have attempted to discover the fate of the nitric oxide by photographing the absorption spectrum of the gaseous reaction mixture at intervals during the course of a run. About ten photographs were usually taken, with exposures of some seconds each, in a run of about thirty minutes in all. The spectrograph was a small quartz - fluorite instrument with dispersion 2000–7000 A. and the source was a hydrogen discharge.

With dimethyl ether at the beginning of the run, only the doublet nitric oxide bands at 2265 and 2151 A. were observed. As the reaction proceeds, these bands gradually weaken, and are replaced with increasing intensity by the strongest bands of ammonia at 2210, 2166, 2127, etc. . . . The stage of the reaction at which the nitric oxide disappears agrees entirely with that expected from the kinetic measurements. This seems to indicate that whatever the primary stage in the interaction of radicals with the nitric oxide may be, a final product, which does not affect the rate of the reaction, is ammonia. The process

$$NO + CH_3 \rightarrow CO + NH_3$$

would be expected to be exothermic, but we regard this process (occurring in one stage) as unlikely. Other experiments shortly to be described suggest that formaldoxime may be an intermediate product, while the condensation from the reaction mixture by liquid air of a blue product may indicate an unstable nitroso compound.

When the above experiment is repeated using diethyl ether, the nitric oxide bands are gradually replaced as the run proceeds by a continuous absorption which extends towards 2300 A. from shorter wave-lengths, and there are indications of a few feeble diffuse bands in the region of 2350 A. This result might well arise from the presence of methylamine, formed by the process :

$$C_2H_6 + NO \rightarrow (X) \rightarrow CH_3NH_2 + CO$$

The experiments are being extended to other cases such as the decomposition of alkylene oxides.

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[1] NATURE, 137, 29 (1936); *Proc. Roy. Soc.*, A, 154, 335 (1936); A, 159, 192 (1937). *J. Chem. Soc.*, 812, 818 (1936).

Photochemical Reduction of Ceric Ions by Water

IT has been shown previously that in the absorption of ultra-violet light by several ions in aqueous solution, the photochemical primary process consists in a transfer of an electron from the ion to a water molecule, with a consequent evolution of gaseous hydrogen. This was shown to occur both with negative ions[1] and positive ions[2].

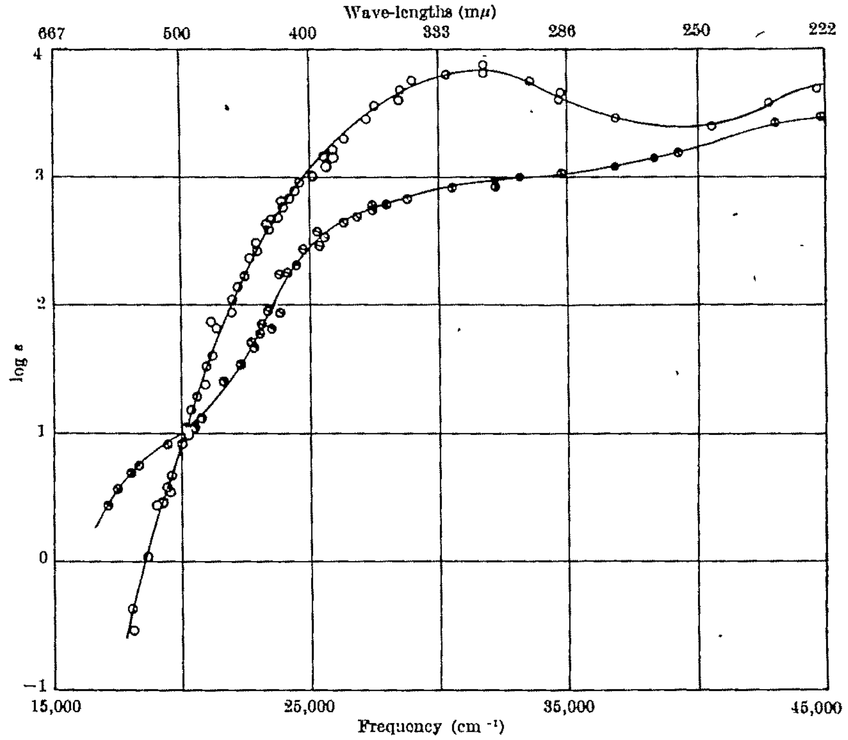

Fig. 1.

MOLECULAR EXTINCTION COEFFICIENTS OF CERIC PERCHLORATE (⌀) AND CERIC SULPHATE (O).

Some form of inverse process has been shown to occur in the elementary process of the quenching of fluorescence of dyes and in the photo-reduction of dyes in solution[3]. By exciting the dye molecule an electron goes into a higher level, leaving an empty electronic level behind into which an electron from a neighbouring molecule may be taken up. In this process the electron affinity of the excited molecule is increased by the amount of its excitation energy.

Our experiments have shown that a similar photochemical process can take place between ceric ions and water. By irradiating an aqueous solution of ceric perchlorate with the ultra-violet light of a strong mercury arc (described previously[2]) we found a considerable evolution of a gas which was shown to be pure oxygen. For example, in one of our experiments, which was carried out with a solution containing 0·1 mol ceric perchlorate (complete absorption) and about 1 mol perchloric acid per litre, 2 c.c. of oxygen (N.T.P.) were evolved per litre per minute at the beginning. The speed of the reaction decreases while the reaction is going on. This was found to be due to the formation of cerous ions, this view being confirmed by experiments where cerous salt was added directly. Cerous ions also appear in the presence of traces of organic substances in the solution which are easily oxidized by ceric ions.

The rate of the reaction remains unchanged by filtering the light through 20 per cent perchloric acid solution. The perchlorate ion, in fact, is practically non-absorbing in the near ultra-violet and is also not decomposed to any appreciable extent under the conditions in question. We did not observe the reaction on irradiating a solution of ceric sulphate (in sulphuric acid solution). This must be attributed to the fact that ceric sulphate solutions contain practically no free ceric ions[4] (which are present in the perchlorate solution) and are responsible for the reaction observed. This is also indicated by the difference in the absorption spectra, which we have determined (Fig. 1).

The following mechanism is proposed for the observed reaction:

(1) light absorption:

$$Ce^{4+} + h\nu = Ce^{4+*} \text{ (excited ion).}$$

(2) decomposition of water:

$$Ce^{4+*} + H_2O = Ce^{3+} + H^+ + OH.$$

(3) oxygen formation:

$$2OH = H_2O + O,\ 2O = O_2; \quad \text{or}$$

(4) reverse process.: $Ce^{3+} + OH = Ce^{4+} + OH^-$.

It is possible that hydrogen peroxide is formed as an intermediate product which is then decomposed by the ions or by light. Reaction (4) is responsible for the influence of cerous ions and also for the low quantum efficiency, which was found to be of the order of 0·1 in solutions containing practically no cerous ions at the beginning.

In conclusion, we should like to express our sincere thanks to Prof. F. G. Donnan for his continuous help and encouragement.

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[4] cf Williams, E, Ph.D thesis, University of Wales (1931)

Polarographic Investigations in Serological Cancer Diagnosis

IT has been mentioned in these columns[1] that the polarographic 'wave' produced on the current-voltage curve by sulphydryl or disulphidic groups of serum proteins can be used to distinguish between normal and carcinomatic serum. In the case of cancer the height of this characteristic protein 'wave' is always found a little lower than that in the normal serum However, when the sera are treated with alkali hydroxide, the height of the protein 'wave' increases in the carcinomatic serum less than in the normal serum. Thus the differences between them are considerably increased. This circumstance has to be ascribed to the liberation of sulphydryl or disulphidic groups of serum proteins as the result of their alkaline denaturation. (Cf. Mirsky and Anson[2].)

The same increase of the height of the protein 'wave', leading to a similar difference between carcinomatic and normal serum, can be obtained when the proteins are denatured with diluted hydrochloric acid (c. 0·05 N). The denaturation under these conditions proceeds at room temperature very slowly, but can be hastened at a higher temperature (c. 40° C.).

A polarographic study of the kinetics of the peptic cleavage of native and coagulated proteins has revealed an increase of the protein 'wave'. This effect has now been applied to show the differences between the protein 'wave' of carcinomatic and normal serum, since they should be largest when the active sulphydryl or disulphidic groups are liberated. For that purpose, to 5 c.c. of 0·05 N hydrochloric acid containing 5 mgm. of pepsin, 0·2 c.c. of serum was added, the temperature being maintained at 40° C. After 5, 10, 15, 30 minutes the solution was withdrawn by 0·2 c.c. and added to 10 c.c. of $1{\cdot}6 \times 10^{-3}$ N cobalt chloride in 0·1 N ammonium chloride in 0·1 N ammonia. The polarographic curve due to this solution showed the expected increase of the protein 'wave'. Thus this method of procedure leads to a quick differentiation—in about 15 min.—between carcinomatic and normal serum. From the material examined polarographically up until now (more than 250 different samples), the height of denatured protein 'wave' in carcinomatic cases is smaller by 3–50 per cent than the height of that from normal serum. The decrease depends on the stage of development of cancer. It must be remembered, however, that some acute cases of inflammation and fever yield a serum reaction similar to that of cancer.

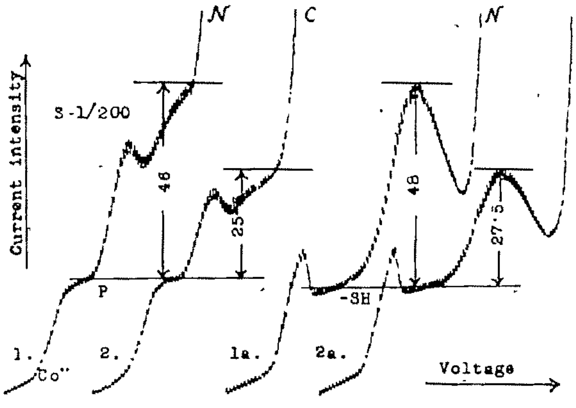

Fig. 1.

CURVE 1, NORMAL SERUM, 'WAVE' P = 46 MM. CURVE 2, CARCINOMATIC SERUM (CANCER UTERI), 'WAVE' P = 25·5 MM. BOTH SERA WERE TREATED WITH PEPSIN AS INDICATED, DILUTION OF SERUM = 1 : 1,250.

CURVE 1a, HYDROLYSATE OF NORMAL SERUM, CYSTINE 'WAVE' = 48 MM. CURVE 2a, HYDROLYSATE OF CARCINOMATIC SERUM, CYSTINE 'WAVE' = 27·5 MM.; DILUTION OF SERUM = 1 : 2,000.

From these experimental facts two questions arise: namely, what is the origin of the difference between carcinomatic and normal serum, and whether disulphidic or sulphydryl or both groups are responsible for the polarographic effect of proteins?

To solve these problems the sera were completely hydrolysed with 5 N hydrochloric acid (1 c.c. of serum boiled with 20 c.c. of 5 N hydrochloric acid for 8 hours and made up to 100 c.c. with water) and the hydrolysates were submitted to polarographic analysis for cystine by my method[3]. In the hydrolysate of the carcinomatic serum there was always found less cystine than in the normal one. The ratio of the cystine concentration agrees with the ratio of the polarographic 'waves' of the denatured or proteolysed serum proteins (see Fig. 1).

These results were controlled by a colorimetric estimation of cystine in the hydrolysates using the Folin-Looney uric acid reagent as modified by Mirsky and Anson[4]. Thus in carcinomatic serum the content of the protein cystine was found to be smaller than in the normal serum.

As to the question whether the group responsible for the polarographic reaction is —S—S— or —SH, polarographic as well as colorimetric tests show that the sulphydryl groups are not present in an appreciable amount, so that the effect must be mainly due to the disulphidic groups.

Details of this research will soon be published elsewhere.

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[2] Mirsky, A. E., and Anson, M. L., *J. Gen. Physiol.*, 19, 427 and 439 (1936).

[3] Brdička, R., *Collection*, 5, 238 (1933).

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Sign of the Magnetic Moment of Free Neutrons

USING a method recently described by us[1], we have now succeeded in determining the sign of the magnetic moment of free neutrons.

The method is based on the fact that the direction of precession of particles in a magnetic field depends on the relative direction of spin and magnetic moment (this is the meaning of the term "sign of the magnetic moment"). The direction of precession can be observed by using bars of magnetized iron as polarizer and analyser[2], which are placed at an angle relative to each other[1, 3].

The experimental arrangement was essentially the same as before[1] except that one of the iron rings was rotated through an angle of 90° with respect to the other, with the neutron beam as axis, making the polarizing and analysing fields perpendicular to each other and to the neutron beam.

A short solenoid was placed between polarizer and analyser, coaxial with the neutron beam. The field in the solenoid (which was found to be fairly homogeneous, on account of the iron below and above) was adjusted so that the neutrons should rotate by 90°, on the average, on passing through the coil. (For calculating this field the magnetic moment of the neutrons was assumed to be 2 N.M.). The neutrons leaving the polarizer in the 'parallel' position arrived at the analyser in the 'parallel' or 'antiparallel' position, depending on the direction of precession, with correspondingly different probabilities of getting through.

The current in the solenoid was reversed at short intervals, and 480,000 counts in all were taken. An unambiguous difference of $(1 \cdot 10 \pm 0 \cdot 29)$ per cent of the total intensity (of which about 50 per cent was due to thermal neutrons) was found on reversing the current. The magnitude of the difference was of the order expected, which shows that the field in the solenoid was correctly chosen.

From the sign of the difference we conclude that the magnetic moment of the free neutron is negative that is, the relative direction of spin and magnetic moment is the same as in the electron. This agrees with expectations based on the magnetic moments of proton and deuteron.

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[1] NATURE, 139, 756 (1937).

[2] Bloch, F., *Phys. Rev.*, 50, 259 (1936).

[3] A somewhat similar method has been proposed by I. I. Rabi, *Phys. Rev.*, 51, 652 (1937). It may be well to point out that the classical concept of precession gives the same result, in our case, as the quantum mechanical calculation

Experimental Test of the Proton-Neutron Exchange Interaction

IT has already been pointed out[1] that, when a proton or neutron of relativistic velocities traverses matter, it travels until it makes a head-on collision with a neutron or proton respectively in the material, transferring nearly its whole energy to this particle, which then travels forward in very nearly the same direction. This process is repeated again, the latter particle transferring nearly its whole energy to a proton if it be a neutron, and vice versa. Let q denote the effective cross-section for either of these processes. We thus get a chain, the proton giving place to a neutron, which then gives place to a proton and so on. This effect is characteristic of an exchange interaction between a proton and a neutron, and would not occur with a non-exchange interaction. As it is important to know the form the proton-neutron interaction takes in the relativistic case, we wish to point out in this note that there is an experiment which could show if the effect mentioned above does or does not exist.

Suppose we have three counters in a vertical plane, d_1 and d_2 being the distances between 1 and 2 and 2 and 3 respectively. Let us suppose that a proton passes through the topmost counter 1 in the right direction to pass through the other counters. It can then be shown easily that the chance of a proton passing through the counter 2 is

$$(\sigma_p + \sigma_n e^{-\sigma q d_1})/\sigma,$$

where σ_p and σ_n are the number of protons and neutrons per c.c. of the substance respectively, and $\sigma \equiv \sigma_p + \sigma_n$. The chance of the counters 1, 2 and 3 being traversed simultaneously by protons is then

$$(\sigma_p + \sigma_n e^{-\sigma q d_1})(\sigma_p + \sigma_n e^{-\sigma q d_2})/\sigma^2,$$

and the chance of protons going through 1 and 3 irrespective of whether a proton or neutron traverses 2 is

$$\{\sigma_p + \sigma_n e^{-\sigma q(d_1 + d_2)}\}/\sigma.$$

The ratio of triple coincidences in 1, 2, 3 to double coincidence between 1 and 3 is therefore

$$R(d_1,d_2) \equiv \frac{(\sigma_p + \sigma_n e^{-\sigma q d_1})(\sigma_p + \sigma_n e^{-\sigma q d_2})}{\sigma\{\sigma_p + \sigma_n e^{-\sigma q(d_1 + d_2)}\}} \qquad (1)$$

If

$$\sigma q d_1 \gg 1, \quad \sigma q d_2 \gg 1, \qquad (2)$$

then the above ratio is $\sigma_p/(\sigma_p + \sigma_n)$, and if either d_1 or d_2 is zero it is unity, as is otherwise obvious. Thus by measuring the ratio of the number of triple to double coincidences between three counters with suitable thicknesses of some heavy material between them, it should be possible to see if the proton-neutron chain mentioned above exists or not.

Dr. Jacobsen and Prof. Clay have independently measured this ratio with d_1 and d_2 corresponding to 10 cm. of lead, and have found that it is unity to within the accuracies of their experiments. If q have the value calculated using the proton-neutron interaction[1] found from considerations of nuclear stability[2], namely, $0\cdot16 \times 10^{-24}$ cm.^{2}, then the condition (2) is satisfied for 10 cm. of lead, and the ratio R should be 0·4 instead of 1. But the above result is not conclusive, since, as we have already pointed out[1], this value of q may easily be in error by a factor of four, as the interaction we have used is not relativistically invariant. We have, however, carried out the above calculation for the scattering both in the system where one of the particles is initially at rest, and in the centre of gravity system, and shown that even in the extreme relativistic case the two cross-sections only differ by a factor four, so that superficially the lack of relativistic invariance of the interaction does not seem to be so serious. In order to get a more definite result, the above experiment should therefore be repeated with at least 50 cm. of lead between each pair of counters.

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[1] Bhabha, H. J., NATURE, 134, 934 (1934).

[2] Wick, G. C., *Z. Phys.*, 84, 799 (1933).

Points from Foregoing Letters

DR. O. ROSENHEIM and Dr. H. King state that they have converted the primary oxidation product of cholesterol, an unsaturated α-glycol, by further mild oxidation into a most reactive substance of the diosphenol type, called diosterol. In its unusual reducing capacity and other properties, diosterol resembles the cortical adrenal hormone. It is suggested that the latter may arise from cholesterol by stepwise oxidation through the α-glycol, thus explaining the position and function of the hitherto unplaced fourth oxygen atom.

Experiments by P. de Fremery and B. Scheygrond show that the enlargement of the uterus, œstrus and luteinization, brought about by injection of gonadotropic substances in immature female rats, can be completely inhibited by simultaneous injection of antigonadotropic rabbit serum. This latter is obtained by repeated injection of a negligibly gonadotropic extract of male urine in a rabbit.

The oxidation of hæmochromogen (a constituent of the blood), accompanying the oxidation of ascorbic acid when the two are brought together, has been investigated by Dr. R. Lemberg, B. Cortis-Jones and Norrie. The authors discuss the mechanism of this reaction, which leads to the formation of verdohæmochromogen (a bile pigment iron compound) and may throw light upon the physiological hæmoglobin breakdown and the formation of bile pigment.

The behaviour of porphyropsin (a dark purple pigment extracted from the retina of freshwater fishes) on exposure to light has been investigated by Dr. G. Wald, by following the light absorption of porphyropsin solutions under various conditions. The author concludes that, under the influence of light, porphyropsin in the retina of the fish goes through a cycle of changes similar to that previously shown to take place in the case of rhodopsin, the corresponding visual purple pigment in mammals, birds and certain marine fishes.

If ethylene oxide and acetaldehyde are heated together at 400° C., they yield ten times more carbon monoxide than when heated separately. This fact, according to Prof. M. W. Travers and C. G. Silcocks, indicates that in the thermal decomposition of ethylene oxide, although only small amounts of acetaldehyde are detected, nevertheless the intramolecular transformation of ethylene oxide into acetaldehyde actually forms the background reaction which precedes the final decomposition.

Recent work has shown that nitric oxide can inhibit the homogeneous decomposition of some organic molecules, presumably by breaking reaction chains. This may be due to the interaction of the nitric oxide with free alkyl radicals. By following the change in the absorption spectrum of the reaction mixture, Dr. H. W. Thompson and M. Meissner find that in the inhibition of the decomposition of dimethyl ether by nitric oxide, ammonia is formed as the nitric oxide disappears. In the decomposition of diethyl ether, the nitric oxide bands are gradually replaced by a continuum and feeble bands indicative of the presence of methylamine. Both these results are understandable in terms of the reaction of nitric oxide with the methyl and ethyl radicals.

Dr. J. Weiss and Dr. D. Porret report the liberation of oxygen by ultra-violet light in solutions of cerium perchlorate without appreciable decomposition of the perchlorate ion. The authors ascribe the reaction to a photochemical process during which a ceric ion is first excited and then gives up an electron to the water molecule, becoming itself reduced to the cerous state. Hydrogen peroxide may be formed as an intermediate product.

Further experiments on his 'polarographic' test for proteins are reported by Dr. R. Brdička. This test, the author claims, is of value in cancer diagnosis, though some acute cases of inflammation and fever give a similar reaction. He ascribes the effect upon the polarographic curve to the disulphidic groups.

By studying the direction of precession of 'polarized' neutrons in a magnetic field, Dr. O. R. Frisch, Dr. H. von Halban and Dr. Jørgen Koch have found that the magnetic moment of free neutrons is negative, that is, the relative direction of spin and magnetic moment is the same as in the electron. This agrees with expectations based on the magnetic moments of proton and deuteron.

H. J. Bhabha points out that the existence of the exchange interaction between protons and neutrons of high velocity (comparable with that of light), predicted on theoretical grounds, could be checked by measuring the ratio of the number of triple to double coincidences between three 'counters' with at least 50 cm. of lead between each pair of 'counters'.

Research Items

Rise and Decline of Populations

The Galton Lecture of Mr. J. M. Keynes at the annual dinner of the Eugenics Society, on some economic consequences of a declining population, is printed in the *Eugenics Review*, 29, No. 1. The enormous increase of capital during the nineteenth century was partly a result of increasing population, although standards of life and the average period of production were also involved. This period was not lengthened by much more than ten per cent during the fifty years before the Great War, while the annual increment in the standard of life has seldom been more than one per cent. Therefore in a stable population, equilibrium conditions of prosperity can only be maintained by causing a smaller proportion of income to be saved, or by so reducing the rate of interest as to make profitable very large changes in technique or in consumption which involve a much larger use of capital in proportion to output. For the maintenance of prosperity and internal peace we must depend on policies of increasing consumption by more equal distribution of incomes and forcing down rates of interest. A rapidly declining population would involve many severe problems, but even in a stationary population we should be more exposed to unemployment of resources. Sir Walter Layton, in his remarks, agreed with Mr. Keynes's general conclusions, but pointed out that a declining population furnished the best conditions for improving their eugenic quality. Mr. H. D. Henderson stated that the chance of increasing the standard of life in a stationary population is likely to be missed through increasing expenditure on armaments, and concluded that the fall of the birth-rate in Western countries had already gone dangerously far.

Fossil Antelopes and Oxen of the Siwalik Hills

Few areas have shed so much light upon the development of Tertiary ungulates as the Siwalik Hills of India, and Guy E. Pilgrim's account of the antelope and oxen remains in the American Museum of Natural History adds much to our already extensive knowledge of that fauna (*Bull. Amer. Mus. Nat. Hist.*, **71**, 729–874; 1937). The results, drawn mainly from the collections made by Dr. Barnum Brown, throw light on many hitherto obscure problems of identity, affinity and taxonomy. This is particularly so in relation to the Boselaphine group, in which six new genera have been described, and the additional material has enabled the author to redefine the family as characterized by horn-core having a sub-triangular cross-section, produced by a strong anterior and weaker posterior keel united by a flat or slightly convex surface, and a third less definite angle. It has also added to our knowledge of the relationships of the living nylghai, and suggests that the developmental centre of the Tragelaphinae was not in Europe, where the fossil forms show a more advanced stage of evolution than the Siwalik fossils, but that they probably migrated thence from a region still undiscovered, probably in or near northern Africa.

A Puzzling Fossil

The fossil remains of a very puzzling organism are described by D. J. Scourfield (*Proc. Roy. Soc.*, B, Feb. 1937) and it is aptly named *Aniktozoon loganense* (αἰνικτός). Twenty-nine specimens, some of which are in an excellent state of preservation, are used as the basis for the description. They come from the Ludlow Beds of Logan Water, Lanarkshire, almost certainly from the same horizon as *Ceratiocaris* and *Pterygotus* and were collected in and around 1904. At first sight, the clear photographs accompanying the paper suggest a crustacean, but, as the author demonstrates, their reference to this group or indeed to any other group of the Arthropoda cannot be supported by detailed examination. Since they were obviously segmented, the only other known possibilities are the Annelida and the Chordata. They do not agree with the former. The suggestion is put forward that they are to be regarded as representing a lowly chordate stock allied to the Tunicata, but unlike any of the existing forms.

Growth-Rate of *Trochus niloticus*

A detailed investigation of the rate of growth of this species in the Andaman Islands has been made by Dr. H. S. Rao (*Rec. Indian Museum*, 38, 473; 1936). It was found from a statistical analysis of many measurements that the rate of growth in the shell bears an inverse relationship to age as determined by the maximum diameter of the shell between certain stages. The monthly rates of growth at each stage, taken with other facts in the life-history, suggest that in the Andaman Islands the full age may exceed ten years, the diameter from the eighth to the eleventh years ranging from 12 to 14 cm. This is a marked difference from the age estimates of *T. niloticus* which have been made on the Queensland coast of Australia, but Dr. Rao, accepting the differences, attributes them to differences in the conditions of growth in the two areas. In the Andamans, the rate of the growth of female individuals exceeds that of males, but here also, as Dr. A. P. Orr found in the waters of the Great Barrier Reef, the seasons in tropical seas do not appear to cause any differential growth.

Polychætous Annelids of Japan

The examination of an extensive collection of polychætous annelids made by Prof. Okada in the neighbourhood of Seto, Japan, has enabled P. Fauvel (*Mem. Coll. Sci. Kyoto*, Sept. 1936) to add a new species, ***Eunice ovalifera***, and to review the Japanese representatives of the group. In all, eighty-two species have been recorded by various workers; the present collection includes seventy of them. As might be expected from the geographical position of the country, its polychæte fauna indicates a mixture of arctic, temperate and tropical forms. In addition to cosmopolitan species, nineteen are peculiar to the Japanese and neighbouring seas, fifteen are boreal or arctic and twenty-six are tropical. It is suggested that the pelagic larval stages of many of them may have been introduced by the great ocean currents reaching the coast. The Kuro-Siwo brings up the warm water from the tropical Pacific to the west coast, and the Oja Siwo comes down from the Arctic Ocean to the north coast.

Cytology of Brassica Hybrids

CROSSES between radishes and cabbages have been made previously in Russia and Japan, and no chromosome pairing was found in the F_1 hybrid meiosis. Dr. R. H. Richharia (*J. Gen.*, 34, No. 1), in a study of the F_1 hybrid between radishes and Brussels sprout, found a maximum of six bivalents, both parents having $2n = 18$ chromosomes. This difference in chromosome pairing may be ascribed to the different varieties used. Brussels sprout, curly kale and radish all showed 9 bivalents regularly in diakinesis, while the cabbage had a ring or chain of 4. The maximum number of secondary associations was five in curly kale and four in the radish. Twenty-one F_1 hybrids were examined at meiosis, and about half were hypotetraploids with frequent trivalent and tetravalent chromosomes, the hybrids showing great variation. Six principal types of chromosomes can be distinguished in *Raphanus sativus* and *Brassica oleracea*, as well as in *B. chinensis*, *B. Rapa* and *B. pekinensis* which have $2n = 10$ chromosomes, and their F_1 hybrids. The last three species show five large and five small bivalents at meiosis, except that in *B. Rapa* the distinction is less marked. In *B. pekinensis* × *B. Rapa* there are occasionally two free univalents, and 'non-disjunction' sometimes takes place. Studies of secondary pairing in these species did not lead definitely to a primary basic number.

Subsidence of East Tokyo

IN some parts of Tokyo, and especially in the districts of Hukagawa and Honzyo on the east side of the River Sumida, recent re-levellings show that there has been a notable sinking of the surface (NATURE, 137, 281; 1936). In the centre of the city, in the Marunouti district, as Prof. N. Miyabe points out (*Bull. Earthq. Res. Inst.*, 15, 102; 1937), many buildings have apparently risen above the ground, one at the rate of nearly 3 in. a year. In both regions, a layer of alluvial soil, 108 ft. thick in the former and 65 ft. in the latter, rests on a hard bed of tertiary rock. A little more than a year ago, two special bench-marks were installed in Hukagawa and Honzyo. They were fixed into the tops of tubes driven down into the tertiary bed. Precise levellings carried out in April and October 1936 showed that the ground-level was lowered 1–2¼ in. with reference to the surface of the tertiary layer. In the Marunouti district, the buildings rest on piles also penetrating the tertiary rocks. Levellings carried out in August 1929 and October 1936 reveal a depression of very nearly the same amount as the apparent uplift of the buildings. Thus, Prof. Miyabe concludes that the subsidence is due, not to any downward warping of the crust, but to the contraction of the surface soil.

Magnetic Properties of Silver Difluoride

THE magnetic properties of silver difluoride, AgF_2, are of interest in connexion with the question of the arrangement of the atomic linkings in this compound. The corresponding oxide, AgO, is practically non-magnetic, and previous determinations have shown that the difluoride has only a very small susceptibility. This result has now been confirmed (E. Gruner and W. Klemm, *Naturwiss.*, 25, 59; 1937); but it has also been found that at low temperatures (– 183°) much higher values of the susceptibility are obtained, the substance becoming weakly ferromagnetic, with a Curie temperature of about – 110°. It is considered that the compound contains Ag.Ag linkings, the spin moments being anti-parallel at ordinary temperatures, becoming, in part, parallel at lower temperatures.

Steam Tables

THE issue of the *Journal of Research of the Bureau of Standards* of April contains a paper of sixty pages by N. S. Osborne, H. F. Stimson and D. C. Ginnings in which their determinations of the properties of water and steam between 100° and 374° C. are described. The work was rendered necessary by the extended use of higher pressures and temperatures in steam engineering, and the results obtained have been co-ordinated by international conferences in order to secure closer agreement in the steam tables embodying recent international research. The method used is to heat electrically a known mass of water and steam in an insulated calorimeter, observing temperature and pressure of the contents and the energy communicated. This is done either with the contents fixed or with withdrawal of liquid or vapour at will. Tables are given of the principal data from each type of experiment, and the final results are embodied in tables of the specific volumes of liquid and vapour in c.c. per gram, the saturation vapour pressure in kilos per sq. cm., the latent heat, the enthalpy (total heat), and the entropy of liquid and of vapour in international steam table calories (4·18605 international joules) per gram and the Clapeyron factor $T\frac{dp}{dT}$ at 5° C. intervals from 100° C. to 365° C. and at smaller intervals to 374·15° C., the critical temperature.

Characteristic Curves for Meteors

THIS is the title of a very interesting paper by Mr. J. G. Porter (*J. Brit. Astro. Ass.*, 47, 6, April 1937), in which he investigates various problems connected with the size, velocity and composition of meteors, and especially the relationship between these and the luminosity. He carries out a very exhaustive analysis, basing his formula on the atmospheric resistance on Davidson's formula (*J. Brit. Astro. Ass.*, November 1913). Mr. Porter finds that there should be a difference of about ten miles in height in the appearance of the fast and slow meteors, that is, those moving with velocities 40 and 10 miles a second, respectively, and the results of the Arizona Expedition largely corroborate this theoretical deduction. Meteors seen at low heights are shown to have lost a considerable fraction of their velocity, and must also be fairly large, generally speaking. It does not follow that they are very bright, because some of them may be of the type of the pyroxene and olivine minerals, possessing high volatility and low luminosity when heated. Mr. Porter hopes to continue his investigation, especially on the question of velocities, from which he may be able to form an opinion on the relative frequency of hyperbolic orbits.

Modern Aristotelianism

By Prof. H. Levy, Imperial College of Science, London

DR. H. DINGLE's plea in NATURE of May 8 for a return to experimental criteria in science, is timely. One may differ from him over the grounds upon which it rests, or over the stress he places on certain points: it is difficult to imagine any genuine disagreement with his main contention.

It must be realized, however, that since the days of Galileo, much has happened in science, not only in the extent of the fields that have been explored, in the nature of the instruments that have been designed to facilitate investigations, but also in our understanding of the relation between the subject matter of science, and those who pursue its study. It is never easy for those who are absorbed in the detailed technique to appreciate the philosophy and the methodology underlying their practice, or even to recognize when and why they are establishing new traditions. To-day we are witnessing such changes, and Dr. Dingle's protest will have been effective if it has the effect of forcing us to examine, in an objective way, the path that is being trodden.

Mathematics is one of the instruments the power of which since the days of Galileo has reached a completely new level. Its success in analysing the relations between empirical data, and in exploring the implications of speculative theories, has tended so to impress the mind, not of the mathematician alone, as to confer on it almost the status of an independent and self-constituted science. It is in directing attention to this dangerous intoxication with symbols that Dr. Dingle's protest is well-founded.

This situation is, however, not to be met merely by a reiteration of the Galilean basis of science, as Dr. Dingle does, or by falling into the error of identifying physics with the whole of science, as Dr. Dingle, following the lead of the mathematician, also does, but demands a positive statement of the place of mathematics and its attendant speculations in the process we call science.

For mathematics is essentially an *instrument* of discovery, and no instrument that has to tell us about the behaviour of the world can function in a vacuum. It works on something, and that something must be extracted from the experience of men in the objective world. Now the trouble begins to show itself in the first instance in the fact that the mathematician can handle ideas and speculations apparently divorced from any empirical background. He starts with *given* assumptions convenient to himself and his mathematical equipment. I say *apparently* with deliberation, because since the mathematical craftsman is primarily interested in the logical coherence of his analysis, he and those others who cannot follow his intricate symbolism, find themselves less and less disposed to examine the origin of the ideas on which he is experimenting with his mathematics. "Mathematics," he would say, "is the formulation of rational relations between any given set of ideas." He does not inquire whence the ideas come, what material circumstances in the world about him have stimulated them, how far they are a direct reflection of the changing situation in the objective world, or how far they are simply a novel combination of such stimulated ideas. As soon as this issue is raised, we can see how futile it is to tilt at the *a priori* principles of the Aristotelians; there are none. What has to be exposed to view is the human experiential basis on which the principles unconsciously rest.

If it is true that the *given* ideas of the mathematician do not come as a miracle out of the void, that they are in some sense 'transformed' observations, then whatever assertions he may make that he can dispense with observations, he is nevertheless pursuing an aspect of inquiry subsumed under the phase—"The formulation of rational relations between 'transformed' sense observations". How close this seems to be to Dr. Dingle's position, judging from his statements, as he judges from those of Prof. Milne, may be seen by comparing this phrase with his own definition of science:

"Science is the formulation of rational relations between sense observations."

Like Sir Arthur Eddington, however, Dr. Dingle is better than his definition, for what he is really pleading for is something slurred over in his definition, the conscious interplay and mutual directiveness between theory and experiment. Every theory and every experiment rests on an interwoven history of both. "Science," one might have expected him to assert, "is the empirical-cum-rational analysis and directing of natural process." Of course, even the speculative cerebrations of mathematicians are natural processes, and in that sense the subject of scientific interest, not to physicists, but to psychologists; or, when a mathematician asserts that by thought alone (whatever that is) the whole of physics can be deduced, of interest to medical psychologists. What we are here concerned with is the results of that cerebration, because they purport to state something about physics.

Two criteria are required in their examination. One will enable us to judge when results are such as to justify incorporation in the expanding body of scientific fact and generalization. That test is a practical one, and in the final analysis must be applied by the experimenter. Even a theory based on so-called *a priori* principles, where it purports to express itself in terms of observables, can have this test applied to it. Where it cannot be so expressed, it does not fall within the ambit of science: it is mathematically experimental speculation. Provided we recognize its nature and do not attempt to dress it up in the outward guise of science, who can assert that the experience so gained is of no value in the pursuit of legitimate science? It is the emergence of this class of inquiry that distinguishes the present epoch in mathematical physics from that of Galileo.

To assert that such studies *may* have a secondary place in suggesting other more directly scientific inquiries does not provide the justification for their indiscriminate pursuit. Some other criterion must be found. ". . . hundreds of pages, and thousands of pounds are being spent . . . by a growing army of 'research' workers . . ." writes Dr. Dingle as evidence of the folly of the new vogue in universes. Here the appeal is certainly not to any criterion directly or indirectly implied in his definition of science, but to a social judgment. He points the finger at something which he conceives, rightly or wrongly, to be anti-social, because it involves wastage on studies not directly scientific. This is a very significant matter. It is importing a consideration that has become more and more prominent in the columns of scientific journals during the past few years. It asserts that the justification for a scientific inquiry is not entirely a narrow scientific one but rests also on its social value. It is an admission of the interconnexion of science with society, that the direction of scientific development, and therefore that the body of theory and practice embraced within science at any given time, is dependent on fundamental social, besides scientific, considerations. That he makes this judgment is itself a fact : hence on his own definition of science he must find a rational place for it within that definition. As it stands there is none. If he objects to the work of the mathematical speculators, he can do so at present only with respect to these phrases that purport to deny the necessity for observation. He cannot object to the expenditure of funds on such investigations, or to publications that are simply mathematical exercises in fictitious model universes.

Just as soon as we face up to this, these various problems begin to fall into a more integrated scheme. We state the position thus :

(1) Science is a social effort to understand, control and fashion Nature in accordance with developing human needs and desires.

(2) The method of science is an ever-growing and ever-deepening integration between experiment and inference, emerging in successive generalizations and successive applications to practice.

(3) Mathematics is an instrument designed to assist in the drawing of inferences from sets of data or of ideas, or what amounts to the same thing, to test such sets for their logical consistencies and inconsistencies. It is in the exposure of the latter that the deficiencies in the original data are made plain. Out of these deficiencies emerges a drive towards further experimentation.

Now when the mathematics under (3) can be regarded as accessory to the inferential processes of (2), and so can be integrated with experimental development, it can be said to have a place in science. This would include that part of pure mathematics that in the widest possible sense can be looked upon directly or indirectly as 'instrument-making'. In no circumstances can (3) ever replace (2).

To decide that a particular series of investigations ought to be encouraged, and, in particular, that it ought to receive the blessing of dominant scientific groups—and this is ultimately the question raised by Dr. Dingle—equally implies deciding to discourage other investigations, since the income to science is limited. Such a decision can emerge only from a thoroughly clear conception of what is implied in (1). It involves planning science pure and applied in its social context, and not following it indiscriminately for intellectual, financial or æsthetic interest ; we are very far from that at the present moment, as the leader columns of NATURE amply testify. Dr. Dingle is therefore tilting at one of the irrational features of social and scientific life. The fact that such irrationalism manifests itself in bold assertions of the type Dr. Dingle rightly deplores, that (3) can replace (2), is in such circumstances a natural consequence of the persistent refusal of scientific men to devote as much careful thought to science as a movement as they are prepared to give to their specialized fields.

Royal Observatory, Greenwich Annual Visitation

THE annual visitation of the Royal Observatory, Greenwich, by the Board of Visitors took place on June 5.

The report of the Astronomer Royal includes for the first time an account of the work of the Nautical Almanac Office, which has been made a branch of the Observatory, with Mr. D. H. Sadler as a chief assistant and superintendent of the Office. It is of interest to recall that the *Nautical Almanac* originated with Maskelyne, the first volume appearing in 1765, the year following his appointment as Astronomer Royal, and that the almanacs for fifty years were produced under his direction.

The Nautical Almanac Office has recently undertaken the compilation of an *Air Almanac*, specially adapted to the requirements of aerial navigation. The first issue will cover the last three months of the present year. The *Air Almanac* will give the air navigator the astronomical data in a convenient form ; but the present methods for the subsequent computation are not suitable for conditions in the air. Extensive altitude and azimuth tables will be computed in the Office, which will give the solution of the spherical triangle directly.

The astronomical observations at Greenwich during the past year suffered inevitably from the poor observing conditions, the year having been one of the most cloudy on record. 6,573 transit observations were obtained, including 107 observations of the sun and 86 observations of the moon. The observations of the moon continue to show a decrease in the correction required by the longitude according to Brown's tables. These tables, however, include Newcomb's great empirical term and, when comparison is made with pure gravitational theory, the moon shows an increasing departure from its computed place. This departure is produced by variations in the rate of rotation of the earth. The accumulated effect of such variations in a year may at times amount to one second. The best astronomical clocks are scarcely sufficiently uniform in rate to detect such an error. It is possible that a clock of the vibrating quartz crystal type would have the desired accuracy. Such a clock is under construction for the Observatory at the National Physical Laboratory and should be of material help in improving still further the accuracy of the time signals sent out from the Observatory, which are necessarily based on predicted clock errors.

The Observatory controls, by means of hourly signals, the Post Office Talking Clock, a service that was inaugurated by the Astronomer Royal on July 24. The calls on this clock are at the rate of ten million a year. It is intended to install similar clocks in other large centres.

The observations made with the Cookson floating telescope on a uniform programme for the past twenty-five years are under discussion. These observations have shown that the mean position of the Pole has not varied, during this period, by more than two or three feet.

The 28-inch refractor is being used for the general re-measurement of all double stars in the northern hemisphere, within the range of the telescope, that show appreciable motion in a decade. 692 observations on 238 double stars were secured. A comparison image micrometer has been constructed to facilitate and improve the accuracy of the measurement of close pairs. The filar micrometer will continue to be used for the wider pairs.

The projection method of measuring photographs has been applied to the micrometer used for the measurement of the stellar parallax plates. The star image and the micrometer wire system are projected on a screen, which is adjusted to the measurer's most comfortable reading distance, and both eyes are used, so avoiding eye fatigue.

Sunspot activity has increased greatly during the year. There were about twenty-five groups the maximum area of which exceeded 500 millionths of the sun's hemisphere. An intense magnetic disturbance, the largest for ten years, was associated with a large spot, the meridian passage of which occurred on April 24. The study of bright eruptions on the sun has been continued. These are becoming much more frequent with increasing solar activity; 72 were observed during the year. A close relationship between these eruptions and sudden fadings of short-wave radio transmissions has been established. The spectrohelioscope is being used also for measures of radial velocities, mostly in connexion with dark markings associated with sunspots, and of the maximum intensities of prominences and of bright and dark flocculi.

Magnetic observations were made at Abinger throughout the year. The mean values of the magnetic elements for the year 1936 were as follows:

Declination . . .	W. 11° 20·0′
Inclination . . .	66° 41·8′
Horizontal intensity .	0·18524 gauss
Vertical ,, .	0·43007 ,,

Preliminary investigations in connexion with the new reversible transit circle have occupied much time. The figuring of the pivots was completed, the maximum departure of each pivot from the circular form being about one-twelfth of a micron. The errors of the one-degree divisions on the 24-inch fixed glass circle have been determined; these show a range of only 0·4″. Observations with the transit micrometer revealed some anomalies that required extensive investigation, and that necessitated the return of the micrometer to the makers for correction.

The slit spectrograph for use with the 36-inch reflector has been completed. It has optical parts made of ultra-violet crown and flint glass, combined with quartz, being intended specially for work in the ultra-violet region. It can be used with a dispersion of either one or three prisms.

During the year, Mr. W. Bowyer, who had been in charge of the Time Department, retired after forty-four years' service and Mr. D. J. R. Edney, secretary, retired after nearly forty-five years' service.

The Astronomer Royal concludes his report with a reference to the difficulties connected with the installation of mercury vapour discharge lamps for lighting certain streets in the vicinity of the Observatory. Representations have been made to the Greenwich and Lewisham Borough Councils of the probable effects of the extension of such lighting along the roads across Blackheath. The two Borough Councils have expressed their desire to avoid interference with the work of the Observatory, and extensions of this system of lighting have been held in abeyance, so that possible alternatives could be thoroughly investigated.

Rothamsted and Agriculture

ANNUAL INSPECTION OF THE ROTHAMSTED PLOTS

A LARGE and representative gathering met at Rothamsted on June 4 for the annual inspection of the field plots and the laboratories. The Right Hon. W. S. Morrison, Minister of Agriculture, was present. Prof. H. E. Armstrong, recently elected chairman of the Lawes Agricultural Trust Committee, was unfortunately unable to attend owing to ill-health, but sent the following message:

"My connexion with Rothamsted goes back to 1870, when I first learnt to know Sir John Lawes and Dr. Gilbert. I am the only member of the original Trust Committee, established in 1898. I claim to have been instrumental in bringing both Sir Daniel Hall and Sir John Russell away from Wye here. I have therefore accepted the Chairmanship of the Trust Committee with singular satisfaction, though I know full well that it is now beyond me to exercise much constructive control.

"We are at the close of our first critical period. We have acquired the Trust and purchased our release from Sir John Lawes' conditions. We owe this advance to our present Director: he has carried out a task of greatest difficulty, with conspicuous success, for which I, as Chairman, would thank him on behalf of my colleagues and the friends of agriculture in general.

"At first the work of the Trust was confined to the experimental fields, laid down by Sir John Lawes and Dr. Gilbert—no funds were available for other work. Sir John Russell, with extraordinary acumen, by his pertinaceous appeals, has secured funds enabling us to extend the ambit of our inquiries : by his genius we have acquired the estate and so extinguished our obligation. According to the Trust Deed, the Committee has the sole management, superintendence and direction of the Trust and of the investigations and experiments to be carried on. Authority rests with the Committee. This is not sufficiently recognized.

"We shall need now to frame a constitution to govern the future, by no means an easy task. Studying the work done during all but seventy years, I have long formed the very definite opinion that the 'living soul' does not enter sufficiently into our activities. We need to force our workers more out into the field.

"Sir John Lawes began his experiments in prehistoric times, in a controversy with Liebig over the need of wheat for nitrogen beyond that derived from natural sources. He was thereby led to initiate the systematic trials embodied in the plots, now known to all the world, using various mineral salts in conjunction with either ammonia or nitrates. Lawes did not consider that much more would be learnt from the crops, apart from the periodic effect of climatic variations. He thought, however, that in course of time the soil might be affected. It is to be feared that he inaugurated a policy which, if persevered in, may be ruinous to the soil.

"Lawes provided only for the continuation of the plot experiments. When the Development Commission divided agricultural inquiry into sections, it assigned *Soil* to Rothamsted. There were no funds for the work but the difficulty was overcome by the munificence of the Goldsmiths' Company. It is most unfortunate that our wings were thus clipped to the soil. The agricultural artist cannot work in a single medium—the policy of the Commissioners was a wrong one, wherever applied—equally at Aberdeen and Cambridge. As a consequence we have been far too much confined to academic laboratory work—animal and plant have scarcely been in the picture.

"Rothamsted policy in future must be to make food production and nutritional values—A.P.H.'s benenutrition—the main study. No higher work can be undertaken. A great and hopeful future is before farming, if only it be properly led. Special care must be given to training men for its service. To this end, the teaching of chemistry and physiology in general must be made effective in school and university. Training must be given in the use of eyes and especially in the exercise of scientific thought—of thought based upon knowledge.

"Agriculture has a sufficient task before it. The work done by Sir John Lawes is a great one—who shall say what his influence has been in introducing systematic inquiry into farming ? Thus far, however, he has taught us mainly what not to do—the course usually followed in the most fruitful inquiries but not to be long maintained."

In the absence of Prof. Armstrong, Sir Bernard Greenwell presided. Mr. Morrison, speaking of Rothamsted Experimental Station, said that it is a remarkable example of State aid and private enterprise, and that the suspicion with which research used to be regarded by the practical man has largely passed away. Mr. Morrison then reviewed some of the broad considerations which have guided him in developing his recent agricultural policy. Soil fertility is the most fundamental aspect of the agricultural problem. With a fertile soil, production can be adapted to changing circumstances and emergencies, whereas a depleted soil is unequal to the demands made upon it. For this reason, he has taken steps to encourage measures of soil improvement, and in the technical matters arising out of his proposals for increasing the use of lime and basic slag, he has not hesitated to call upon the special knowledge that Rothamsted can provide. He reminded his audience that in addition to the material basis of farming, the soil and the livestock upon it, there must also be knowledge.

Sir John Russell, who followed, took up this theme and showed how the object of the work at Rothamsted has always been this search for information. Some of the investigations undertaken seemed at first to be remote from practice, and indeed appeared to have no immediate application. Sir John proceeded to quote many instances in which such investigations have turned out to be of the greatest practical importance and usefulness. He mentioned some of the recent Rothamsted work on lime and basic slag that will be of special service in advisory work arising out of the new proposals. In spite of the difficult six months just passed, Broadbalk, now in its ninety-fifth year, looks surprisingly well, and its interest has been enhanced, rather than diminished, by the fallowing system adopted in recent years. The visitors also inspected the modern rotation experiments on present-day problems in soil fertility.

The proceedings were favoured by ideal weather conditions.

EMPIRE AGRICULTURAL OFFICERS

On June 3, the annual gathering of agricultural officers on leave from various parts of the Empire took place at Rothamsted at the invitation of the Imperial Bureau of Soil Science, when some eighty visitors representing seventeen Empire countries were present. This function not only enables members of the overseas agricultural services to make contact with the staff of the Soil Bureau and Rothamsted workers, but also affords a valued opportunity for meeting each other. In his speech from the chair, Lord Bledisloe outlined the development of the Soil Bureau during the eight years of its existence. He mentioned that the year's output of scientific papers in soil science now amounts to the astonishing figure of about 4,000, written in twenty different languages. The task successfully undertaken by the Bureau is to sort out this great mass of literature and make available to workers in any part of the Empire the latest information from all countries relating to soils, crops and manures. The Technical Communications published by the Bureau are in increasing demand, and several of them have attained the status of standard and authoritive works. Lord Bledisloe, speaking with special knowledge of agricultural conditions in several Dominions and his own close acquaintance with agricultural research, expressed his conviction that money spent in the investigation of farming problems is an investment that will give returns out of all proportion to the original outlay.

The visitors spent the morning examining the plots on the Rothamsted farm and the afternoon was devoted to a tour round the laboratories.

Science News a Century Ago

Wheatstone and Cooke's Electric Telegraph

ON June 13, 1837, Wheatstone and Cooke took out their first patent for "giving signals and sounding alarms at distant places by means of electric currents". Among the instruments included in this patent were those with five needles and two needles. An experimental line was laid down between Euston and Camden Town in 1837, but the first actual working telegraph was that joining Paddington and West Drayton, a distance of 13 miles, erected in 1838–39. Examples of these early telegraphs are preserved in the Science Museum.

J. D. Forbes and von Buch

IN the journal of his travels on the Continent in the summer of 1837, J. D. Forbes in his notes on the six weeks he spent at Bonn wrote under the date June 15: "Finding Von Buch here, I left my letter from Professor Jameson for him, and in the course of an hour he called. I was instantly charmed with the kindness and simplicity of his manner; and as I could see at once that his character for singularity was not one which I had any reason to fear, we were immediately excellent friends".

The next day the two met again, and had conversation on Forbes's views on the Pyrenean springs and von Buch's paper on craters of elevation. "As to the history of the elevation theory," wrote Forbes, "he states that he first pointed out four elevations belonging to different epochs—all of which are well seen in Grimm's map of Germany—chiefly by tracing the river courses. The mountains about the Elbe form one system, the Taunus mountains another, the Schwartz-Wald a third, and the Alps a fourth; . . . pointing out, as evidence of the comparatively recent elevation of the latter, the inclination of the tertiary strata. He gives Elie de Beaumont the credit of finding exact criteria for determining epochs of elevation, but attached little probability to the theory of parallelism on a large scale, considering the systems of chains rather overdone. . . ."

On the afternoon of June 16, Forbes observed the magnetic dip at Poppelsdorf and afterwards called on Prof. Gustav Bischoff "who showed me the sheets of his work on the temperature of the earth. . . . He has also made experiments on the cooling of spheres of melted basalt, having a diameter of twenty-seven inches, and others of nine inches. . . . Von Buch came in as we were examining these".

"Bischoff also took a piece of basalt, split in two, and tied together with twine . . . fixed it in the axis of a cylindrical mould, and poured molten iron round it. This latter in cooling, (according to him) expanded and squeezed the basalt. Certainly, many dykes of basalt in iron appeared, very prettily, but I doubt the squeezing, especially from the large cavities left in the iron, a fact which was also noticed by Von Buch: whether there would be squeezing or not, would be somewhat difficult to predict. . . ."

Captain George Back's Expedition

ON June 15, 1837, a general meeting was held of the subscribers to the fund raised for sending Captain Back in search of Captain John Ross. The meeting was held in the rooms of the Royal Geographical Society in Regent Street, Admiral Sir George Cockburn being in the chair. The total amount subscribed had been £6,578 19*s.* 10*d.* and after paying all expenses there remained a balance of £619 4*s.* 6*d.* The meeting agreed with the suggestions put forward by the committee that three pieces of presentation plate should be given to Captain Back, Captain James Clark Ross, and Captain Maconochie, the last of whom had organized the expedition, and that £300 should be given to the Sailors' Home, Wells Street. The Hudson Bay Company had waived the whole of its claim for the amount due for supplies provided for the expedition in North America.

Dalton on the Constitution of the Atmosphere

BEFORE adjourning for the long vacation, the Royal Society met on June 15 to hear the reading of several papers, among which was one by Dalton entitled "Sequel to an Essay on the Constitution of the Atmosphere published in the Philosophical Transactions for 1836; with some account of the Sulphurets of Lime". An abstract of the paper said: "The author communicates in this paper an account of the investigations on the constitution of the atmosphere, which have engaged his attention during a long period of years. He enters into an examination of the comparative advantages of the three methods which are most in use for analysing common air, namely, firing it with hydrogen in Volta's endiometer, or abstracting the oxygen by means of nitrous gas and quadrisulphuret of lime; and details the precautions to be taken in the employment of each of these methods, and the degree of accuracy to be expected from the results under different circumstances. He then relates numerous experiments made on air obtained from great heights, from which he is led to the conclusion that the proportion of oxygen to azote in the atmosphere on the surface of the earth is not precisely the same at all places and times. . . ."

National Board of Health

AN editorial in the *British Annals of Medicine* of June 16, 1837, contains the following suggestion: "The necessity for the establishment of a Board of Public Health is forcibly pointed out by the fact that the mortality during the last 10 years—years of peace too—has been progressively increasing in Sweden, Prussia, France and England. This is proved by authentic documents. Are medical men aware of this fact? Not generally, we believe, because no public board exists to bring the conviction home to their minds. Yet—amidst all the splendid discoveries of the century, the accession to our knowledge of disease and the new remedies which have sprung into existence—people die faster than they did 10 years ago. A vast opposing tendency yet to be investigated, carries us against the full tide of improvement. . . . So soon as public attention can be brought to bear on the question, a Board of Health will, we do not doubt, be established. As Dr. Mohry has remarked, the apathy of the College of Physicians, and of the persons accidentally at the head of the profession, has alone retarded the establishment in this country of something corresponding to the *Conseils de Salubrité*, and *Sanitatsbehörde* in France and Germany. . . . There would be three principal functions of the new institution; to publish a report of the state of public health every year; to provide or point out measures for its amelioration; and to control the medical profession. . . . The Annual Sanitary Report, if properly executed, would be an invaluable contribution to science."

Societies and Academies

Dublin

Royal Irish Academy, March 16.

J. J. Dowling and T. G. Bullen: Precision measurements with a radial deflection oscillograph. An extra pair of concentric cylindrical electrodes are fitted between the XY deflector plates and the screen of a gas focused cathode ray oscillograph. Employing a double frequency circular time-base locked to the signal frequency a so-called Radioid curve (resembling a Limaçon) is obtained, and the position of the node around the time base circle serves to measure phase or frequency differences in high-frequency circuits. Another application is as a 'time-comparator', and comparisons of the periods of a pair of two-seconds pendulums to within five parts in a million are easily obtained while the pendulums are executing twenty swings. An improved design of tube is described and further work promised.

Paris

Academy of Sciences, April 26 (*C.R.*, 204, 1225–1284).

Samuel Eilenberg: Slight enlacement.

Shiing-shen Chern: The geometry of a differential equation of the third order.

Nikola Obrechkoff: The zeros of some classes of polynomials.

Pierre Chevenard, Louis Huguenin, Xavier Waché and Albert Villachon: New alloys of the elinvar type susceptible of structural hardening. Balance springs of elinvar, although giving excellent thermal compensation, are much softer than ordinary steel springs. The elinvar alloy can be modified by the addition of titanium. The modified alloy, while retaining the thermal advantages of elinvar, has an elastic limit approaching that of carbon steel.

Mlle. Jacqueline Hadamard: The dielectric constants of cyclohexane and benzene. The results given, for which an accuracy of 0·1 per cent is claimed, are compared with those of earlier workers.

Georges Nadjakoff: The nature and origin of the large ions of the atmosphere. The author's observations are in agreement with the view suggested previously by other workers, that there is a close connexion between the number of large ions and the smoke of towns.

J. J. Placinteanu: The wave function of the photon.

Marcel Laporte: The production of white light by the electrical luminescence of xenon.

Jules Farineau: An attempt at photometry in the field of the soft X-rays; application to the study of the free electrons of metals.

Georges Mano: The relation between the kinetic energy and path of the protons. The case of artificial transformations.

Roger Chatelet: A thermo-chemical application of thermal analysis to the formation of the eutectoids of the binary alloys.

Clément Courty: The diamagnetism of iodine solutions. An attempt to trace a connexion between the colour of iodine solutions in different solvents and their magnetic properties.

Ernest Toporescu: The action of sulphur on silver.

Albert Portevin, Georges Chaudron and Léon Moreau: Contribution to the study of the role of gases in metals. Study of the variations in hardness, conductivity and crystalline parameter after removing the gases at the ordinary temperature, after annealing and after charging with hydrogen by electrolysis. Data are given for iron and aluminium.

Hubert Forestier and Richard Lille: The variation of catalytic activity of ferromagnetic oxides at the Curie point. The experiments cited establish a clear relation between the magnetic transformation point and the catalytic properties of ferromagnetic oxides.

Georges Denigès: Reactions for the identification of tellurium of microchemical order.

Paul Renaud and Georges Costeanu: Anomalies in the action of steam or of ammonia on sodium or hæmatoxylin.

Maxence Meyer: The formation of hydrocarbons in the thermal decomposition of the α-ethoxyacids.

Panos Grammataticakis: The action of mixed organomagnesium compounds on the phenylhydrazones of the symmetrical alkylphenylhydrazines. A new method of preparation of the symmetrical alkylphenylhydrazines.

Paul Fleury and Mlle. Suzanne Boisson: The action of periodic acid on lactic and pyruvic acids. In the oxidation of lactic acid by periodic acid, two primary products are aldehyde and methyl alcohol.

Jacques Duclaux: The transparency of the air in the arctic regions.

Paul Becquerel: The death of the plant cell by freezing in liquid nitrogen at −190° C.

Marcel Mascré and René Paris: Scoparine (scaparoside) from *Sarothamnus scoparius*.

Auguste Chevalier and Pierre Viguier: The double origin of cultivated rice and the West African centre of rice dispersion.

Jean Renaud: A *Saccharomyces* presenting curious anomalies in its sexuality due to a dikaryotic state of its zygospores.

Stefan Nicolau and Mme. Léonie Kopciowska: Data on the coloration and morphology of some viruses in animal tissue.

Alexandre Besredka and Ludwik Gross: The immunization of the fowl against sarcoma by the intracutaneous method.

Paul Valade: The cancer-forming activity of methylcholanthrene.

Amsterdam

Royal Academy (*Proc.*, 40, No. 4; 1937).

R. Weitzenbock: Remarks on trivectors.

F. M. Jaeger and L. Bijkerk: Investigations on the complex salts of the racemic and optically active cyclohexanediamines with trivalent cobalt and rhodium (4). Crystallographic properties of the optically active tri-cyclohexanediamine cobalt salts and on ethylenediamine-cyclohexanediamine cobaltic salts of this series.

J. le Heux and A. de Kleyn: Investigations on the isolated eye muscles of the rabbit during the positional nystagmus in acute alcohol poisoning.

T. L. de Bruin, J. N. Lier and H. J. van de Vliet: The Zeeman effect of doubly ionized cerium, Ce III.

T. L. de Bruin: New terms in the spark spectra of argon, A II and A III.

J. Popken: An arithmetical property of certain integral functions (3).

C. Visser: Certain infinite sequences.

N. H. Swellengrebel, A. de Buck and H. Kraan: Further investigations on 'healthy' human carriers of *Plasmodium vivax* in North Holland.

Capetown

Royal Society of South Africa, April 21.

Archæology of the Oakhurst Shelter, George. (1) A. J. H. Goodwin: Course of the excavation. (2) A. J. H. Goodwin: Disposition of skeletal material. (3) M. R. Drennan: Skeletal material. (4) J. F. Schofield: The pottery.

P. W. Laidler: An unusual grooved stone.

Geneva

Society of Physics and Natural History of Geneva,

March 4.

R. Wavre and G. Bilger: Some polygons of similar attraction. The authors establish that a homogeneous regular polygon creates at every point external to the plane the same single layer logarithmic potential as the radii of the circumscribed circle touching the angular points.

March 18.

E. C. G. Stueckelberg: (1) The analogy between the retarded potential of quantum physics and classical physics. A Lagrangian function is established by a system of *n* particles which react with each other. This function is invariant, but has the defect of containing higher potentials. However, the interaction terms can be expressed in quantum physics, where they give the necessary relations. (2) The establishment of the formula of retarded potential in quantum physics. By means of electrodynamics with multiple time quanta, the interaction terms established in the previous communication are here established rigorously to the second approximation in *e*.

E. Cherbuliez and J. Jeannerat: Researches on casein. The authors have improved the method of separation of casein into various fractions. They show that one of these fractions, δ, is identical with a protein body, proteose, isolated by Hammarsten from the products of the action of rennet on casein. Hence proteose appears to be an original constituent of the milk and not a cleavage product due to the action of rennet on casein.

F. Chodat: The enzyme decoloration of the petals of the poppy.

E. Briner and E. Perrottet: (1) The problem of the removal of ozone from air and from oxygen. The properties of air and oxygen free from ozone. The authors describe the method employed for removing ozone from ordinary air and ordinary oxygen. They point out the differences in oxidizing power of air and of oxygen free from ozone. (2) A method of analysing very dilute ozone: the determination of the ozone concentration in the air of Geneva. The application of the method described at the meeting of February 4, 1937, by the same authors has given for the concentration of ozone in the air of Geneva the value 7×10^{-8} with an error of $\pm 2 \times 10^{-8}$.

April 29.

F. Chodat and R. Cortesi: Study of buffer action in culture fluids. The authors have observed fluctuations in buffer action in the culture of *B. mycoides*; a minimum is reached at the end of the first week, as soon as the gelatine medium is liquefied.

P. Rossier: A simplification in the calculation of the magnitude of a star, relating to a receiver with two sensibility maxima. The author replaces the usual formula by the simpler one of Stirling, some factors of which can be neglected in certain cases. This leads to a marked simplification in the calculations.

R. Sulzer: The comparative study of the attitude of an animal deprived of a labyrinth and the attitude of a normal animal standing on a slope. The author studies the disturbances of equilibrium produced in the guinea pig by the unilateral suppression of the labyrinth.

G. Tiercy and Ch. Golaz: The law of the variation with altitude of wind velocity. The note gives three numerical tables established with the view of controlling the theory by observation.

Melbourne

Royal Society of Victoria, April 8.

Elizabeth A. Ripper: (1) Some Stromatoporoids from Griffith's Quarry, Loyola, Victoria. This locality has yielded four species: *Clathrodictyon regulare* (von Rosen). *C.* aff. *chapmani* Ripper, *Stromatopora typica* von Rosen, and *S. bücheliensis* (Bargatsky), as well as a *Stromatoporella* not here described. This fauna has little in common with that of the Yeringian limestone at Liludale, and the abundance of *C. regulare* and *S. typica*, two Wenlock species, suggests that the limestone should be placed on a lower horizon than that of Lilydale, which contains a fauna with Devonian affinities. (2) The Stromatoporoids of the Buchan District, Victoria. Fourteen species and varieties are described, of which the following are new: *Actinostroma stellulatum* var. *distans*, var. nov., *A. contortum*, sp. nov., *Clathrodictyon convictum* var. *delicatula*, var. nov., *Hermatostroma episcopale* var. *buchanensis*, var. nov. The assemblages have, in the main, definite Devonian affinities, though typical Wenlock species, for example *Clathrodictyon regulare* (von Rosen), persist and make up a small proportion of the fauna.

G. Baker: Orthite in some Victorian granitic rocks. The study of the distribution of orthite in some granites and associated xenolithic rocks in Victoria indicates that orthite has a contamination mode of origin in most Victorian examples, and a pyrogenetic mode of origin in a few cases.

F. Chapman: Cherty Limestone with *Planorbis hardmani* Wade from the Mt. Elder Range, Kimberley District, W.A. The cherts were originally laid down in early Pleistocene times in shallow lakes on a peneplain, and are now perched on hills nearly 1,000 feet above sea-level. The Mollusca of the lake fauna comprise *Planorbis hardmani*, *P.* aff. *essingtonensis*, and a probable new species of *Bullinus*. Other indigenous organisms of this lake deposit are: calcareous algæ allied to *Cladophora* and *Charophytes*, freshwater sponge-spicules, Ostracoda and probable insect remains. There is also evidence that minute Foraminifera had been carried into this lake deposit by wind agency from the coast-line, the nearest point to which now lies about 160 miles to the north.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, June 15

Eugenics Society, at 5.15—(at the Linnean Society, Burlington House, W.1).—Prof. W. G. Miller: "Veterinary Eugenics".*

Wednesday, June 16

Warburg Institute, at 5.30.—Dr. Otto Brendel: "Roman Emperor Worship" (succeeding lectures on June 23 and 30).*

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Woman Indexer at the Bureau of Chemical Abstracts, 46 Finsbury Square, E.C.2—The Secretary (June 15).

Teacher of Science and Teacher of Engineering in the Luton Technical College—The Director of Education, Shire Hall, Bedford (June 15).

Two District Forest Officers—The Secretary, Forestry Commissioner, 9 Savile Row, W.1 (June 16).

Assistant Lecturer in Mathematics in the University of Manchester—The Registrar (June 17).

Four University Demonstrators in Anatomy and One University Demonstrator in Physiology in the University of Cambridge—Dr. F. J. W. Roughton, Physiology Laboratory, Cambridge (June 18).

Curator at the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (June 21).

Lecturer in Mechanical Engineering in the Municipal Technical College, Hull—The Director of Education, Education Offices, Hull (June 21).

Lecturer in Physiology and Zoology in the Sunderland Technical College—The Director of Education, Education Offices, 15 John Street, Sunderland (June 22).

Assistant in Agricultural Botany in the Edinburgh and East of Scotland College of Agriculture—The Secretary (June 23).

Biochemist in the Royal Victoria Infirmary, Newcastle-upon-Tyne—Dr. Ungley (June 27).

Director of Research to the British Rubber Research Board—R.G.A., 19 Fenchurch Street, E.C.3 (June 30).

Official Publications Received

Great Britain and Ireland

Armstrong College: Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending July 31st, 1936. (Third Series, No. 4.) Pp. 52+10 plates. (Cullercoats: Dove Marine Laboratory.) 5*s*. [105

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 1, No. 1: A Study of the Vascular Supply to the Carpels in the Follicle-bearing Ranunculaceæ. By Dr. Mabel S. Fraser. Pp. 56. 7*s*. Vol. 59, Part 1, No. 3: Perthshire Tectonics; Schiehallion to Glen Lyon. By Prof. E. B. Bailey and Dr. W. J. McCallien. Pp. 79–118+2 plates. 6*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [135

Amgueddfa Genedlaethol Cymru: National Museum of Wales. The Fisheries of Wales: Handbook to a Temporary Exhibition, May to October 1937. By Colin Matheson. Pp. 16. (Cardiff: National Museum of Wales.) 2*d*. [135

Association of Special Libraries and Information Bureaux. Select List of Standard British Scientific and Technical Books. Compiled at the request of the British Council. Pp. 35. (London: Association of Special Libraries and Information Bureaux.) 2*s*. to "Book-List" subscribers; 2*s*. 6*d*. to others. [145

The Journal of the Royal Agricultural Society of England including the Farmers' Guide to Agricultural Research. Vol. 97. Pp. 498+cxlviii+12+22 plates. (London: John Murray.) 15*s*. (145

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1936. (Twenty-second Report.) Pp. viii+128+2 plates. (London: H.M. Stationery Office.) 6*s*. net. [185

The British South Africa Company. Publication No. 5: Mazoe Citrus Experimental Station Report for the Year ending 31 December 1935. Pp. xii+74. (London: British South Africa Co.; Mazoe: Citrus Experimental Station.) [185

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1935. Part 2. Pp. vi+129+7 plates. (London: H.M. Stationery Office.) 3*s*. net. [185

University College, Cork. Agricultural Bulletin No. 4: Oils from Irish Grown Plants. Preliminary Report by Prof. Joseph Reilly and Denis F. Kelly. Pp. v+92+6 plates. (Dublin and Cork: Educational Company of Ireland; London: Longmans, Green and Co., Ltd.) 2*s*. 6*d*. [195

Proceedings of the Royal Society of Edinburgh, Session 1936–1937. Vol. 57, Part 2, No. 8: On the Ciliary Currents on the Gills of some *Tellinacea* (Lamellibranchiata). By Alastair Graham. Pp. 128–134. 6*d*. Vol. 57, Part 2, No. 9: The Gravitational Field of a Distribution of Particles Rotating about an Axis of Symmetry. By W. J. van Stockum. Pp. 135–154. 1*s*. 9*d*. Vol. 57, Part 2, No. 10: The Revised Complete System of a Quadratic Complex. By Prof. H. W. Turnbull. Pp. 155–162. 9*d*. Vol. 57, Part 2, No. 11: The Time Lag of the Vacuum Photo-cell. By Dr. R. A. Houstoun. Pp. 163–171. 9*d*. Vol. 57, Part 2, No. 12: Studies in Practical Mathematics. 1. The Evaluation, with Applications, of a Certain Triple Product Matrix. By Dr. A. C. Aitken. Pp. 172–181. 1*s*. Vol. 57, Part 2, No. 13: Ions and Isotopes. By Prof. James Kendall. Pp. 182–193. 1*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [205

Seventy-third Annual Report on Alkali etc. Works. Proceedings during the Year 1936. By the Chief Inspectors. Pp. ii+51. (London: H.M. Stationery Office.) 1*s*. net. [215

Other Countries

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 89. African and Malagasy Blattidæ (Orthoptera), Part 3. By James A. G. Rehn. Pp. 17–123+plates 8–11. (Philadelphia: Academy of Natural Sciences.) [185

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 21, Memoir No. 4: Fossil Algæ from the Uppermost Cretaceous Beds (The Niniyur Group) of the Trichinopoly District, S. India. By L. Arama Rao and Dr. Julius Pia. Pp. v+49+6 plates. (Calcutta: Geological Survey of India.) 4.10 rupees; 7*s*. 9*d*. [185

Organisation météorologique internationale. Commission regionale 2: Preliminary Report of the Proceedings of the First Conference in Hong Kong, January 13th–21st, 1937. Pp. 105. (Hong Kong: Printed at Victoria Gaol.) [185

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 147: Vibration Phenomena in Ternary Wing Flutter. By Katsutada Sezawa, Satosi Kubo and Hirosi Miyazaki. Pp. 129–162. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 45 sen. [185

Education, India. Education in India in 1934–35. Pp. vii+137. (Delhi: Manager of Publications.) 2 rupees; 3*s*. 6*d*. [185

Proceedings of the Animal Husbandry Research Workers' Conference held at New Delhi from the 17th to the 19th February 1936, with copies of Papers presented by the Delegates and a resumé of Discussions thereon. Pp. iii+112. (New Delhi: Government of India Press.) [185

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 36: Spinning Tests on Mixtures of Stable Fibres and Indian Cottons. By Dr. Nazir Ahmad. Pp. ii+17. (Bombay: Indian Central Cotton Committee.) 8 annas. [185

Publications of the Dominion Observatory, Ottawa. Bibliography of Seismology. Vol. 12, No. 12 (Items 3267–3370): October, November, December, 1936. By Ernest A. Hodgson. Pp. 241–266. (Ottawa: King's Printer.) 25 cents. [185

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 5: Antiseptic and other Treatments in the Storage of Trinidad Citrus Fruits. By C. W. Wardlaw and E. R. Leonard. With an Appendix: Mycological Notes on Citrus Wastage, by R. E. D. Baker. Pp. 27+11 plates. 2*s*. 6*d*. net. Memoir No. 6: Storage Investigations with Trinidad Citrus Fruits, 1935–36. By E. R. Leonard and C. W. Wardlaw. Pp. 28+8 plates. 2*s*. 6*d*. net. (Trinidad: Imperial College of Tropical Agriculture.) [185

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, Nr 78 (Historical Notes and Papers, Nr. 4): On Greek Cosmogony and Astronomy. By Knut Lundmark. Pp. 36. Ser. 2, Nr. 82 (Historical Notes and Papers, No. 6): Statistical Notes on the Astronomers of Antiquity. By Per Collinder. Pp. 13. Ser. 2, Nr. 83 (Historical Notes and Papers, Nr. 7): Quelques essais d'identification de constellations sur les rochers sculptés en Ostrogothie. Par Bjorn Svenonius. Pp. 16. Ser. 2, Nr. 85 (Historical Notes and Papers, Nr. 9): Quelques aspects de l'identification de constellations sur les rochers sculptés par rapport à l'histoire des religions. Par Åke Ohlmarks. Pp. 6. (Lund: Astronomiska Observatorium.) [185

Havsforskningsinstitutets Skrift. No. 102: Översikt av isarna vintern 1934–35. Av Risto Jurva. Pp. 64. No. 106: Strom- und Windbeobachtungen an den Feuerschiffen in den Jahren 1934 und 1935. Von E. Palmén. Pp. 57. No. 107: Havsforskningsinstitutets Verksamhet År 1935. Av Gunnar Granqvist. Pp. 18. No. 108: Översikt av isarna vintern 1935–1936. Av Gunnar Granqvist. Pp. 47. No. 109: Regular Observations of Temperature and Salinity in the Seas around Finland, July 1935–June 1936. By Gunnar Granqvist. Pp. 43. No. 110: The Thalassological Cruise, Sept.-Oct. 1936. By E. Palmén and E. Laurila. Pp. 14+v. No. 111: Havsforskningsinstitutets Verksamhet under År 1936. Av Gunnar Granqvist. Pp. 16. (Helsinki: Havsforskningsinstitutet.) [195

Bericht über das Geobotanische Forschungsinstitut Rübel in Zürich für das Jahr 1936. Von E. Rübel. Pp. 127. (Zürich: Geobotanische Forschungsinstitut Rübel.) [215

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 11, No. 14: Observations of Tidal Motions of the Earth's Crust made at the Geophysical Institute, Bergen. By J. Egedal and J. E. Fjeldstad. Pp. 30. (Oslo: Grøndahl and Søns Boktrykkeri.) 3.00 kr. [215

Transactions of the Academy of Science of Saint Louis. Vol. 29, No. 2: Atrypæ of the Central Missouri Devonian. By D. K. Greger. Pp. 39–54. 25 cents. Vol. 29, No. 3: Outline of a Theory of Functions of an Abstract Variable. By Solomon Bilinsky. Pp. 55–86. (St. Louis, Mo.: Washington University.) [215

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No. 3529 SATURDAY, JUNE 19, 1937 Vol. 139

Foot-and-Mouth Disease*

THE Foot-and-Mouth Disease Research Committee of the Ministry of Agriculture and Fisheries was first appointed in 1924, and although it has not succeeded in discovering any method of prevention, and the policy of slaughtering all infected and contact animals still continues, it has found out a good deal about the virus and its reaction with the body. The present, fifth, progress report covers the work done in the last five years, mainly at the experimental station at Pirbright and also at the Lister Institute, and the National Institute of Medical Research at Hampstead.

The size of the virus has been more accurately determined by means of Elford's graded filter membranes. It is held up by all membranes with an average pore diameter of 25 mμ or less, whence the diameter of the virus particles is about 8–12 mμ, compared with a molecule of oxyhæmoglobin with a diameter of about 4 mμ. It is indeed about the smallest pathogenic virus known, and is actually smaller than some protein molecules such as hæmocyanin or those recently described by Stanley as causing tumours. Size measurements have also been useful in distinguishing the virus from the much larger agent which causes vesicular stomatitis in horses and cattle, a disease which has similar clinical symptoms. Attempts to cultivate the virus *in vitro* in the presence of guinea pig or calf tissue have been only very moderately successful, and, unlike many viruses, it will not grow at all in the developing egg of the fowl or duck.

One of the most obvious objects which the Committee must have had in view from the beginning is some sort of protective inoculation such as has been used so successfully for cattle plague. An attack of the disease confers an extremely solid resistance on a cow; but, as has been known for some time, there are several strains or sub-species of virus, and the recovered animal, unfortunately, is resistant only to that strain which caused its illness; it has, for example, been shown that an animal may be given three successive attacks by using three different strains, and it also follows that a cow which has survived a natural attack is by no means secure against picking up the disease again from another strain of virus. These embarrassing features are now known to be worse than was supposed, and recent work has shown a greater multiplicity of identifiable strains as well as the existence of a number which have uncertain characters; types hitherto unknown have appeared in Great Britain. Particularly inconvenient is the variation of infectivity for guinea pigs, since these are the standard animals used in testing for the presence of virus. Indeed, the prospect of finding an effective and practical method of immunization does not seem at all good.

A very interesting section of the report deals with the influence of diet on susceptibility, and it may surprise some of those who attribute so many ills to undernutrition to learn that well-fed, rapidly growing rats could be infected with a much smaller dose and took the disease much more severely than those which were fed on a meagre (but far from a starvation) diet. The animals which showed no symptoms after inoculation were in some instances found to be immune on subsequent testing after feeding up, showing that they had really been infected without any obvious illness; others, however, were susceptible, and in them presumably no infection at all had occurred.

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* Ministry of Agriculture and Fisheries. Fifth Progress Report of the Foot-and-Mouth Disease Research Committee. Pp. 386+26 plates. (London: H.M. Stationery Office, 1937.) (7*s.* net.)

Good feeding, especially with such eclectic foods as liver and carrot, produces a high degree of susceptibility in a few days, and it takes a long time for the effect to wear off after the animals return to a more ordinary diet. Similar results were obtained with guinea pigs and hedgehogs, and they are no doubt analogous to the old observation of Arkwright that the inflammatory reactions following certain irritating stimuli are much diminished in underfed animals. It may well be that foot and-mouth disease was little obvious and did little harm among the scrawny cattle of past times in England, and it is just possible that some sort of vaccination with live virus might be a practical procedure if it was combined with deliberate underfeeding.

The major unsolved problem of the disease is, however, where the infection comes from and how it is spread. In the great majority of outbreaks, no perceptible source of infection can be identified, though for some time past they have been thoroughly examined by people fully alert to the various possibilities. With rare exceptions, each outbreak seems to be a thing of itself, and they are scattered about England in an apparently haphazard manner. Movements of cattle are, of course, continuously going on, and it has been suggested that some of them may be carriers of the virus without showing any signs of illness; the inquiries of the Committee do not, however, lend any support to this idea; nor do they favour the speculation that infection is brought from the Continent by birds, which are beyond the control of the most rigorous Ministry. With the dimming of what used to be the sharp boundary between live and dead, it is theoretically possible that the virus is frequently arising *de novo*, generated in cattle or pigs by some unknown influence. The great and apparently increasing variability of the virus is compatible with this idea, though it would be more orthodox to regard it merely as evidence that all the English outbreaks cannot have a common origin, or that the different sub-species of virus are not very permanent.

Spontaneous generation must, however, be the last resort of baffled epidemiologists, and the facts more reasonably suggest that infection is present in some common wild animal, very likely in a form which does not often cause any conspicuous mortality, as is often the case where an uncontrolled infection and its host come into some sort of permanent balance out of which, for reasons unknown, epidemics may arise. Of this line of thought the Committee has made a reconnaissance, partly by laboratory experiments, partly by trapping animals around the Pirbright Station, and partly by surveys of infected localities by Elton and his colleagues from Oxford. But it has all been on such a slight scale that it can scarcely be called an exploration, and much more work needs doing in the field, where it is none too easy under the conditions of isolation and disinfection which are imposed on infected farms.

Several animals and some birds are capable of being slightly infected by artificial inoculation, but the results are irregular and seem to be of no particular importance. The short-tailed field-vole (at any rate the northern form) is freely susceptible and the infection can be carried on in the laboratory from one animal to another by inoculation; it will not, however, spread from an infected to a healthy animal by contact any more than it will in guinea pigs, which implies that voles cannot be important in Nature from the point of view of infection.

The greatest suspicion attaches to the hedgehog, which by tradition is in the habit of sucking cows' teats and drinking the milk. This may or may not be true—the direct evidence for it is thin—and it may well mean nothing more than that it had been observed that close association between hedgehogs and cows was apt to result in a smaller yield of milk—an obvious symptom of foot-and-mouth disease. Whether they were confusing fact with interpretation or not, our ancestors certainly had such a dislike of the hedgehog as a harmful animal that, as Charles Oldham has shown, churchwardens in the eighteenth century would pay as much (fourpence) for an urchin as for a polecat. These bits of history make a rational tale if we suppose, with G. C. Damant, that the hedgehog is the natural reservoir of the disease. The Committee has shown that it is indeed very susceptible, and takes the disease severely: it is also the only wild animal known in which infection spreads from diseased to healthy animals by contact, and the virus has been demonstrated in the expired air. Moreover, in the small surveys which have been made, a single live hedgehog caught in the neighbourhood of an outbreak near Bristol was found to be infected, although it had no naked-eye signs of disease. At Pirbright a cow was infected by stall contact with a diseased hedgehog, and a hedgehog was infected by contact with a diseased cow. The case against the hedgehog seems strong enough to justify much more extensive and intensive field work.

Science and John Donne

John Donne and the New Philosophy
By Prof. Charles Monroe Coffin. Pp. ix+311. (New York: Columbia University Press; London: Oxford University Press, 1937.) 17*s.* 6*d.* net.

THE author explains in his preface that, while this book was undertaken as an "academic exercise", it fulfils a long-standing desire dating from a time many years earlier when he fell under the spell of Donne's poetry and noticed that none of the numerous and worthy studies of his life and works which have appeared in recent years seemed to touch more than lightly on the subject of his response to the new philosophy; whereas he (the author) conceived the idea that in Donne's familiarity with the "new science" there might be found an explanation of the compelling interest he has had for the late nineteenth and the twentieth centuries. He wished, therefore, by this study to provide a necessary supplement to such books as "The Life and Letters of John Donne", by Edmund Gosse (1899), and the prefaces, introductions and notes to the editions of his poems by Charles E. Norton (1895), E. K. Chambers (1896), and Prof. Herbert J. C. Grierson (1912), as well as "A Study of the Prose Works of John Donne" by Mrs. Evelyn M. Simpson (1924). Professor Grierson had already remarked that "No other poet of the seventeenth century known to me shows the same sensitiveness to the consequences of the new discoveries of traveller, astronomer, physiologist and physician as Donne"; and Mrs. Simpson clearly saw that, as a result of the influence upon Donne of the beginnings of modern science, "the break up of a whole system of thought is reflected in his pages".

Donne was brought up as a Catholic, and was first educated abroad by the Jesuits, who were governed by the Ptolemaic-Aristotelian system as brought by St. Thomas Aquinas into harmony with Christian doctrine. While his instruction by the Jesuits stimulated his interest in many branches of learning, Donne's independent and even heretical spirit chafed under their authoritarian régime. In 1584 he entered Hart Hall, at Oxford, "that refuge for adherents of the old religion", which again meant a curriculum of study scarcely less medieval than that followed by his Jesuit instructors. In 1586, or soon after, he is said to have gone to Cambridge, where the Reformation had taken stronger hold, and the contest was then not so much between Catholic and Protestant as between the National Church and the dissenters. Moreover, rebellion against the medieval scholasticism had been encouraged there by Francis Bacon's denunciation of the too dominant influence of Aristotle at the University, and more specifically by the publication by the Cambridge University Press of an edition of the "Dialecta" of Peter Ramus (Pierre de La Ramée) challenging the whole of Aristotle's logic.

Cambridge had also produced before Donne's time the first champions of the new science of the Renaissance. Among these were Robert Recorde, the author of "The Grounde of Artes", and John Dee, who were both adherents of Copernicus, as well as Thomas Digges (son of the mathematician Leonard Digges), who had (before 1576) made the first English translation of Copernicus and had prepared a map of the heavens according to the new system. Henry Briggs, later Savilian professor of geometry at Oxford, was made fellow of St. John's College in 1588 and was still at Cambridge while Donne was at the University

Donne belonged, however, to no school and was a disciple of no system; he was greedy of learning and experience of all sorts, regardless of consequences; he speaks himself of his "hydroptique immoderate desire of humane learning." He was most deeply impressed by two things: (1) the refutation of Aristotle's dictum about astronomy (that the heavens are unalterable because in so many ages nothing had been observed to have been altered, "De caelo", i. 3), by the discovery of new stars, and (2) the deposition of the earth from its place in the centre. On the second point we know that Donne was familiar with the Copernican hypothesis before (in 1611) he brought out "Ignatius his Conclave", which not only introduces Copernicus as one of the characters but also mentions Kepler and Galileo, and shows that Donne was versed in the earlier history of the subject and the parts in it attributed to Ecphantus, Heraclides and Aristarchus of Samos. Allusions in the poems are illustrated by the lines in "The First Anniversary" (1610-11), "The sun is lost and th' earth, and no man's wit Can well direct him where to find it", where by "lost" applied to the sun he means lost in the sense of a beneficent satellite as it were. (Incidentally, it is worth noting that Robert Burton, a contemporary of Donne, wrote in "The Anatomy of Melancholy": "Copernicus, Atlas his successor, is of opinion the earth is a planet, moves and shines to others as the moon doth to us. Digges, Gilbert, Keplerus, Origanus, and others defend this hypothesis of his in sober sadness, and that the moon is inhabited: if it be so that the earth is a moon, then are we also giddy, vertiginous and lunatic within this sub-lunary maze".)

As regards new stars, Donne shows by a marginal note to "Biathanatos" one source of his information, Kepler's "De stella nova" (1606) containing an account of his discovery in 1604 of a brilliant new star in the constellation of Serpentarius. He was acquainted too with Galileo's "Sidereus Nuncius" (1610), the full title of which is, in translation, as follows: "The Astronomical Messenger, containing and setting forth Observations lately made with the aid of a newly invented Telescope respecting the Moon's Surface, the Milky Way, Nebulous Stars, an innumerable multitude of Fixed Stars, also respecting Four Planets never before seen which have been named the Cosmian Stars". The planets mentioned were the four satellites of Jupiter, discovered by Galileo, and are plainly alluded to in "The First Anniversary", "And freely men confesse that this world's spent when in the Planets and the Firmament they seeke so many new . . ." One more quotation from "The First Anniversary" may be permitted, "And now Philosophy calls all in doubt, The Element of fire is quite put out". Cardan had denied the existence of the element of fire ("De subtilitate", which Donne had mentioned in "Biathanatos"), but it was more probably from Kepler ("Dioptrice") that he learnt of the "confutation" of fire by Tycho Brahe and Pena, and by Kepler himself

The book contains fifteen chapters, of which the following may be mentioned: Poetry and Science (i), The Old Order (iii), The Rise of the new Philosophy (v), The Moving of the Center (vi), The New Heavens (vii), "Figures of Space (ix), The Text Saves Us (xi), in which the editor shows the scholarly habits of Donne, how he searched for ultimate sources, compared texts to test their relative validity, acknowledged his obligations to those who had supplied him with information, and even indulged in footnotes.

Enthusiasts for Donne will find the book a mine of detailed and accurate information about his works and thought; while all who are interested in the history of astronomy will, in the text and the elaborate notes, find many particulars about the original works of Copernicus, Kepler and Galileo, as well as many facts in the history of astronomy (especially that of the Greek pioneers).

Morphogenetic Factors of Bone

Bones:
a Study of the Development and Structure of the Vertebrate Skeleton. By Dr. P. D. F. Murray. Pp. x+203+8 plates. (Cambridge: At the University Press, 1936.) 8*s.* 6*d.* net.

THE study of the factors which determine the growth and form of an organism is the special province of the morphologist. Hitherto this has been mainly pursued by the investigation of the biological history of the organism or structure, and indeed morphology has become more or less synonymous with the historical approach. The other common factor, the influence of function upon structure, has of course been implicit in all sorts of biological studies. Beyond these historical or functional investigations of the determinants of form, there is still the experimental approach to the question of the relation between the structure made visible by anatomical methods and the morphogenetic factors that have brought the structure to the state which has actually been achieved.

It is the especial merit of the Strangeways Laboratory at Cambridge, over which Dr. H. B. Fell presides, that it has become one of the most distinguished places in the scientific world for the prosecution of morphogenetic studies. Here the technical methods, tissue cultivation *in vitro*, tissue grafting, the growth of large explants under a variety of conditions, embryological experimentation, the registration of results by the Canti cinema method and so on have been used abundantly, and, in the process, made more efficient and applicable on a wider scale. Dr. Fell and the Strangeways Laboratory have placed British anatomists deeply in their debt.

The present volume relates the work done there by Dr. Murray and his colleagues as it bears upon the anatomical problems presented by bone. The author has set himself the task of presenting the knowledge available which throws light on the factors determining the position of bone. For example, in the membranous skull of the embryo it may be inquired why the sutural margins run where they do. As a matter of experimental observation, the position of the bone and the limiting sutural lines seem inherent in the cells of the dura mater, for when bone including the sutural line is removed and the dura is left intact, both the bone and the sutural line in its normal position are regenerated. Next the author discusses the differentiation of the architectural structure of developing and adult bone. It has become almost traditional in anatomical schools to regard this as a precise orthogonal pattern precipitated as it were along the lines of tension and compression. The matter is not nearly so simple, and much further investigation is necessary upon this problem.

The fixing of the form of the bone is perhaps an issue upon which the most spectacular experiments have been performed by Dr. Fell and her colleagues. The growth of a recognizable femur outside the body beginning from its primordial mesenchymatous stage was a great achievement and also prepared one to believe in the potency of the factors inherent in the primordial cells. In later life, however, extrinsic factors have more say in influencing shape than in these earliest stages. Finally, of course, there is the problem of how increase in size is attained with the preservation of the characteristic form of the bone. This problem in bone growth has been long investigated, and Dr. Murray mentions that it is germane to his theme. He omits it, however, from his book in order that he may write more particularly upon the experimental aspect of the other two problems mentioned. The problems raised cover all the bones of the skeleton, and a special chapter is given to cartilage.

Those who study the morphogenetic factors cannot help being impressed by the inherent formative properties of the cells themselves. It is difficult to refrain from endowing them with potentialities that make further scientific investigation impossible. The cure for this seems to be more experiments, for some of the supposed facts which have been the starting point of theories outside the realm of science have been shown later to depend on interpretations which further investigation has proved to be erroneous. Dr. Murray has refrained from any such speculation, and has given us a straightforward account of the problems, the experiments and the results obtained. In thanking the author one may append a remark upon his concluding sentence. The author modestly suggests that his book at least has the merit of raising more problems than it solves; the commentator may justly add that it has the merit of raising them in a form that at least makes solution seem not impossible.

Infectious Exanthemata

The History of the Acute Exanthemata: the Fitzpatrick Lectures for 1935 and 1936, delivered before the Royal College of Physicians of London. By Dr. J. D. Rolleston. Pp. ix + 114 + 10 plates. (London: William Heinemann (Medical Books), Ltd., 1937.) 7*s*. 6*d*. net.

THIS small volume contains the Fitzpatrick Lectures for 1935 and 1936. It is concerned with the history of smallpox, chicken-pox, scarlet fever, measles and German measles.

The study of the history of *diseases* presents special difficulties, and in the case of the infectious exanthemata these difficulties are accentuated by the fact that "it is now generally agreed among medical historians that the acute exanthemata were not distinguished from one another until a comparatively late period of their history". This point is exemplified in many passages. "In spite of the teaching of Heberden, Cullen, Willan, and others, there were not lacking during the nineteenth century writers, including some of high distinction, who maintained the identity of smallpox and chicken-pox". "Richard Morton held the view that scarlet fever was exactly the same as measles." The problems which confront the medical historian are much increased by such diagnostic confusion.

Even more perplexing is the nomenclature. Both German measles and chicken-pox received a multitude of names, out of all proportion to their real significance. Chicken-pox, first described by Ingrassias in 1552 under the name of crystalli, has been rechristened forty times; whilst German measles has at least a dozen names. The author negotiates all such obstacles with a confidence which can only come from practical experience and a wide knowledge of the literature of each disease. He goes further, and makes his subject one of profound interest to the reader.

The importance of medical history as a guide to modern practice is apt to be overlooked. Here, the reader finds no excuse for such neglect. Many a modern 'discovery' has its roots in the distant past. Athanasius Kircher (1601–1680) examined the pus of smallpox lesions, and attributed the disease to the action of micro-organisms. Boerhaave (1668–1773) maintained that smallpox was a specific disease spread by contagion. In the middle of the eighteenth century, Francis Home (1719–1813) anticipated the modern prophylactic use of convalescent serum in measles, by using infective blood as an application to the scarified skin.

History also emphasizes the danger of introducing the acute exanthemata to a virgin soil. One of the earliest examples of this kind is the Amazon measles epidemic of 1749, when 30,000 natives died of this disease. In 1846 a somewhat similar fate befell the Faroe Islands, and in 1875 Fiji, when nearly a quarter of the population died of measles. The lesson was brought home to Great Britain in 1914–15, when a Highland Division in training at Bedford had 529 cases with 65 deaths.

Another example of the value of history in actual practice is found in the variability of virulence in epidemics. One example out of the many provided will serve as an illustration. It refers to the experience of Bretonneau at Tours with regard to scarlet fever. During the period 1799–1822, he never saw a single death from this disease, which he always found a very mild complaint. In 1824 an epidemic occurred which proved so deadly and refractory to treatment that he came to regard scarlet fever as formidable a disease as plague.

The value of the work is enhanced by a generous list of references, also a series of portraits of those who have contributed to our knowledge on the acute exanthemata. A book which may be recommended to all who are interested in the history of medicine.

S. H. D.

Fundamental Electrical Measurements

Electrical Measurements:
Precise Comparisons of Standards and Absolute Determinations of the Units. By Dr. Harvey L. Curtis. (International Series in Physics.) Pp. xiv + 302. (New York and London: McGraw-Hill Book Co. Inc., 1937.) 24*s*.

THERE can be but few physicists better entitled than Dr. H. L. Curtis to write on fundamental electrical measurements. As an associate of Rosa, Dr. Curtis has witnessed the development of high-precision work on electric units at the National Bureau of Standards, Washington, and since then he has never ceased to improve existing methods, and to devise new methods in an effort—and a successful one—to increase the accuracy of determination of electric units.

The first quarter of the book under notice treats of units and standards generally. The descriptions of the most modern types of manganin wire resistance standards and of cadmium standard cells are particularly useful, as are also the details of the methods by which national laboratories maintain their units of resistance and of electromotive force.

The comparison of standards is dealt with next. In this section, as elsewhere, instead of outlining all the accurate methods available, the author selects one or two methods, possibly those with which he is most familiar, and describes them in detail. Among the measurements involving two or more electrical quantities, the determination of capacitance by the Maxwell bridge, in terms of resistance and time, receives very good treatment.

The second half of the work is devoted to calculation and design of inductance, and absolute measurement of resistance and current. It is no simple matter to deal with the computation of self and mutual inductance in a few pages, but Dr. Curtis has performed his task remarkably well; rightly starting from first principles, he introduces the reader without difficulty to the complicated formulæ which represent the solution of practical problems. The next chapter, nominally concerned with design of standards of inductance, is devoted mainly to a description of a particular method of winding a solenoid on a cylindrical former. In this chapter and elsewhere in the course of the work, the author embarks on the risky venture of suggesting, and even describing in detail, methods of procedure which have never been subjected to serious test. In this case, the suggestion refers to the construction of a mutual inductor from two solenoids.

Absolute measurement of resistance comes next. A survey of old and new methods is followed by very complete descriptions of the Lorenz method and of the self-inductance bridge method. In the same way the absolute measurement of current is illustrated by detailed descriptions of the Rayleigh balance, for the improvement of which Dr. Curtis is himself largely responsible, and of the Ayrton-Jones balance of the National Physical Laboratory.

The comparative definitions of units in the electrostatic and electromagnetic systems, given in the second chapter, could easily have been avoided by the use of the M.K.S. system of units recommended by the International Electrotechnical Commission. Automatically, the last chapter would then have received a simpler title, and it is possible that with ideas clarified by a more logical choice of starting-point, Dr. Curtis would not have written (top of p. 219): "the variability of the earth's magnetic field prevents its accurate measurement *in c.g.s. units*".

Printing and diagrams are excellent.

British Trees and Shrubs, including those commonly planted:

a Systematic Introduction to our Conifers and Woody Dicotyledons. By H. Gilbert-Carter. Pp. xv+291. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 12*s.* 6*d.* net.

Dr. Gilbert-Carter's aim in writing this sequel to his earlier "Catkin-Bearing Plants" is threefold: to enable students to identify our native woody plants, and many commonly cultivated ones; to illustrate Engler's system of classification and to show, by giving the derivations of all the Latin names used, that botanical nomenclature is a human subject with its roots in the past.

The descriptive treatment of the various groups is, on the whole, excellent, though some of the specific descriptions are too brief for certain identification. Under many genera and species valuable notes are given on distribution, ecological preferences, medicinal and culinary virtues, cultivation and general biology. Readers will very rarely have to rest content with the name of any specimen they identify; some illuminating sidelight is nearly always thrown on one or other aspect of the species concerned.

In his preface, and under many of the classes, groups, orders and families, the author discusses briefly the theory and application of Engler's system of classification. He is sceptical, as was Engler, of the possibility of making phylogenetic speculation the basis of natural classification, and uses throughout the noncommittal term 'affinity' when discussing relationship. Dr. Gilbert-Carter's remarks are a welcome contribution to a subject on which many taxonomists are by no means clear.

The footnotes giving the derivation and pronunciation of Latin names will be appreciated by all who value the historical approach, and are not content merely to repeat, parrot-like, the names that they are taught. The few inaccuracies that have crept into these admirable notes will doubtless be corrected in a future edition.
J. S. L. G.

Hardy Californians

By Lester Rowntree. Pp. xv+255+64 plates. (New York: The Macmillan Co., 1936.) 18*s.* net.

The title of this book may call up visions of the "Old Timers" or "Redskins" of the novelist or of Hollywood, but in fact it deals principally with the hundreds of little-known, but none the less interesting and beautiful flowers of the amazing western State, California.

Mrs. Lester Rowntree takes us with her in her travels from what she calls the "Top of the World", altitudes of 9,000–14,000 ft., down to "Death Valley" 276 ft. below sea-level, and from the heat and glare of the Colorado Desert to the dense shade and humidity of the Redwood Forest; a revelation of the wide range of geographical conditions existing in that State. To the Nature lover or gardener, the book is as thrilling as any Western romance, for it is an introduction on an intimate and personal footing to the "plant personalities" she loves and describes so well.

The wealth of detail given on soils and situations, possible requirements in cultivation, etc., is of course intended to assist the gardener, but it is none the less interesting to the botanically minded, and particularly to the student of ecology. To some of the genera with which we in Britain have a nodding acquaintance, for example, *Penstemon*, *Lupinus* and *Viola*, the author devotes whole chapters, and one chapter is reserved for the wonderful and varied range of bulbous plants for which the West is famed. How many of the plants enumerated will prove hardy in Great Britain is an open question, for the book is written primarily for American gardeners and climatic conditions. A fair proportion will undoubtedly find congenial homes in Great Britain, for where else will they receive such hospitality or obtain climatic conditions so varied ?
G. W. Robinson.

Electrical Engineers' Handbook

(Vols. 4 and 5 of Wiley Engineering Handbook Series.) 4: Electric Power. Prepared by a Staff of Specialists under the Editorship of Dr. Harold Pender, William A. Del Mar, Knox McIlwain. Third edition rewritten. Pp. xiv+1268+37. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 30*s.* net.

Electrical engineers' handbooks have become both bulky and inconvenient, and contain much duplicated matter owing to the rapid development of the various branches of engineering. In this series it has been decided to publish the fundamental material which forms the basis of all engineering in a separate volume, and the existing handbooks as they are revised are being issued in several volumes containing material closely connected with the specialized branch considered. The entire new series of handbooks will give much more complete information on all topics of interest to engineers.

The latest developments of filament and discharge lamps, methods of air-conditioning, and ventilation fans are all described and the physical constants of building materials including their thermal conductivities are discussed. To the practical engineer, this book will be useful for reference. The latest information about electric power has been included.

The Cactus Eaters

By Julian A. Weston. Pp. 240+16 plates. (London: H. F. and G. Witherby, Ltd., 1937.) 10*s.* 6*d.* net.

In "The Cactus Eaters" the author records the results of a stay of four months on the Goajira Peninsula on the southern shore of the Caribbean Sea and a boundary area between Colombia and Venezuela. His purpose was to observe the customs and culture of the Goajiro Indians. Although a stock-raising people, it is evident that in level of culture they have advanced little beyond the hunting stage, and the author discusses the interesting question of the nature of their subsistence in pre-Conquest days, as their stock must have been derived from the Spaniard. In view of environmental conditions and cultural indications, it is suggested that they may have been a people of a fishing culture.

A Taxonomic Problem

By J. S. L. Gilmour

AMONG present-day biologists there is widespread interest in, and considerable disagreement on, the proper relationship between taxonomy[*] and other branches of their science, especially genetics, cytology and ecology. Should the data provided by these branches be incorporated into the existing taxonomic categories, or should new categories be created to meet their needs ?

In discussing these questions, I believe that the purpose and general principles underlying the process of classification have been unduly neglected and that a consideration of these would help materially to clarify the issues involved. A full discussion of these principles may be found in the standard works on logic and scientific method[†], and only those points most relevant to the present problem will be dealt with here.

In its simplest terms, classification consists in grouping individual objects (and, ultimately, sense data, expressed as qualities and relations) into classes, so that all the individuals in one class have certain attributes in common. The use of such general names as book, piano, mountain, etc., involves a process of classification no less than the formation of such classes as mammals or flowering plants. Viewed thus, classification is seen to be a necessary stage in the inductive process by which the human mind obtains an ordered knowledge of the universe. Ritchie (*op. cit.*, p. 79) has expressed this concept of classification as follows : ". . . our general knowledge of the external world as expressed by laws of nature is a product of the interaction of two processes, selection from and classification of what is experienced and the discovery of laws relating to the classes".

Any given collection of objects can, of course, be classified in a great number of different ways, depending on the particular attributes chosen as a basis for classification. Thus mankind can be classified on a basis of nationality into Frenchmen, Germans, etc. ; on a basis of occupation into lawyers, doctors, etc. ; on a basis of physical characters into the various so-called 'races', and so on. Further, the choice of particular attributes depends on the *purpose* in view in making the classification. Thus if we wish to investigate the distribution of professions among the inhabitants of different countries, we employ classifications based on the attributes of occupation and nationality, and, from an examination of the resulting classes, we formulate laws relating them, such as, for example, that there is a greater proportion of clergymen in England than in the U.S.S.R.

These considerations apply also to biological classification in general. Fundamentally, the purpose of biological classification is the acquisition of ordered knowledge regarding living things, and logically any grouping of plants and animals should be considered a taxonomic process. Such groups as hydrophytes, succulents, hemicryptophytes, ruderals and alpines are, in this sense, 'taxonomic' groups, no less than the families, genera, species, etc., of 'traditional' systematic botany. Why is it, then, that the term taxonomy is usually confined to this latter grouping ? Why are Ranunculaceæ, but not annuals, considered a taxonomic group ? The answer to this question involves a consideration of the difference between a natural and an artificial system of classification.

The term 'natural classification' is a general one, the significance of which is not confined to the grouping of living things. It is usually stated in logic that a system of classification is the more natural the more propositions there are that can be made regarding its constituent classes. For example, a classification of mankind on a basis of nationality is more natural than one based on the initial letter of surnames, because more propositions can be made regarding an Englishman (for example, that he probably speaks English, knows "God Save the King", has a white skin, etc.) than about a man whose name begins with E. Thus a natural classification is one founded on attributes which have a number of other attributes correlated with them, while in an artificial classification such correlation is reduced to a minimum. From the point of view of function, a natural classification can be used for a great variety of purposes, while an artificial one serves only the limited purpose for which it was constructed.

The difference between them can be expressed in another way. The greater number of propositions that can be made regarding an Englishman depends on the fact that nationality (the basis of the classification) is an attribute connected with a very important factor in human life (namely, the habit of living in territorial groups to which we become emotionally attached), while the initial letter of surnames is not. This point is made clearer if we imagine that a dictator has decided to execute forthwith all those whose names begin with E. This attribute would then become connected with another important factor in human life (namely, the power of a dictator) and immediately the hitherto artificial group of E's would become, at any rate temporarily, a natural one, about which many propositions could be made (for example, that they would soon be dead, were probably frightened, were probably making their wills, etc.). From this rather trivial example, the proposition emerges that a natural classification is one which is based on attributes connected with a factor that has an important influence on the objects being classified: the more important the factor the more natural the classification becomes.

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[*] "Taxonomy" is here understood in its ordinary dictionary definition of "the principles and practice of the classification of living things". The discussion concerns taxonomy in general, though I have had chiefly in mind the higher plants. I am grateful for certain suggestions made by those who have been kind enough to read through the paper.

[†] See especially : "Logic" by J. S. Mill (1843) ; "Logic" by A. Bain (1878) ; "The Principles of Science", by W. S. Jevons (1883) ; "Logic", by Carveth Read (1898) ; "The English Utilitarians", by L. Stephen, Vol. III (1900, esp. pp. 124–131) ; "The Use of Words in Reasoning", by A. Sidgwick (1901) ; "Inductive Logic", by T. Fowler (1904) ; "Formal Logic", by F. C. S. Schiller (1912) ; "A New Logic", by C. Mercier (1912) ; "The Philosophy of Biology', by J. Johnstone (1914) ; "Scientific Method", by A. D. Ritchie (1923) ; "Biological Principles", by J. H. Woodger (1929) ; "Modern Introduction to Logic", by L. S. Stebbing (1930).

The difference between the two is therefore one of degree only. Indeed, it is impossible to construct a classification that is not to some extent natural. As pointed out by Jevons (*op. cit.*, p. 680), even in so artificial a class as those whose names begin with E, there will probably be an abnormally high proportion of Welshman owing to the presence of a large number of Evanses.

If there is one factor influencing a particular collection of objects which is more powerful than any other, then a classification based on attributes connected with that factor will be more natural than any other. For example, in classifying a number of motor-cars which were manufactured during the last forty years, the most natural classification would be a division based on attributes connected with the period of manufacture, because that is the most important factor determining the attributes of the cars. If, however, there are several factors of nearly equal importance influencing a group of objects, then a number of equally natural classifications is possible. This is the case in the classification of mankind, where, for example, it is difficult to say whether a basis of nationality or annual income gives a more natural classification.

If these conclusions are applied to biological classification as a whole, the reason for the unique position held by traditional taxonomy begins to emerge.

Owing to the method of reproduction and evolution of living things, involving the inheritance of parental characteristics, and to the pre-eminent influence that these factors exert on the attributes of plants and animals, the possibility exists of constructing a series of classifications which are more natural than any others, namely, those based on inherited characters. It is by a constant search for the most natural among these classifications that the present vast structure of traditional taxonomy has been gradually built up. We may say, then, that the unique position held by traditional taxonomy, marking it off from other arrangement of living things, is primarily due to the possibility of constructing a set of peculiarly natural classifications of living things based on inherited attributes.

On this view, a natural classification in biology is a particular example of natural classification in general and not a phenomenon peculiar to living things; further, a natural classification differs in degree only from other biological classifications. This is in contrast to the concept, widely (though not universally) accepted in post-Darwinian times, of a natural classification as being based on *actual phylogenetic relationship* and thus differing fundamentally from artificial classifications. This view involves the assumption that there exists a criterion of degree of phylogenetic relationship, apart from degree of similarity of attributes, and either that such a criterion should be used in constructing a natural classification, or that degree of similarity of attributes is an invariable indication of such relationship and can therefore be used as a basis for a natural classification.

Now, this criterion of phylogenetic relationship must presumably be the same that leads us to say that two brothers are more nearly related than two cousins—namely, the degree of remoteness of a common ancestor. But in order to judge degree of relationship on this criterion, a knowledge of the genealogy of every *individual* in any group under consideration is essential, and such knowledge, except occasionally in man and in certain domesticated animals and plants, is clearly unobtainable.

Can we, then, fall back on the second alternative and accept degree of similarity of attributes as an invariable indication of degree of relationship? That such similarity is frequently an indication of relationship is true, but that it is an invariable indication certainly cannot be maintained. For example, two individuals related as cousins may have identical genotypic constitutions, while two sibs may be strikingly different and, further, parallel mutations may occur in two individuals only distantly related phylogenetically but of similar genotypic constitution.

If, then, the criterion of degree of relationship applicable to *individuals* cannot be applied in practice to *groups*, and, further, if similarity of attributes cannot be regarded as a certain indication of such relationship, then it would seem that the view that a natural classification differs fundamentally from artificial classifications in that it represents phylogenetic relationship cannot be substantiated. A natural classification should rather be regarded, first and foremost, as that arrangement of living things which enables the greatest number of inductive statements to be made regarding its constituent groups, and which is therefore the most generally useful classification for the investigation of living things. Whether or not such a classification does in fact group together individuals who are phylogenetically related is a secondary question which must be answered for any particular case on its merits.

For special purposes, however, additional classifications are essential. As emphasized above, classification is a stage in inductive investigation, and in so far as it is desired to discover laws relating certain attributes of living things, such attributes must be embodied in distinct classifications of greater or less complexity. The need for such additional classifications is obvious when the attributes concerned give an arrangement conspicuously less natural than that of traditional taxonomy, for example, a classification into trees, shrubs, herbs, etc., or on medicinal properties. But when the classification is only slightly less natural than the most natural possible, then its validity becomes obscured and confusion arises between it and traditional taxonomy. Such is the case with many of the attributes that have been investigated during the last thirty or forty years under the headings genetics, cytology, physiology and ecology. For example, a traditional taxonomist may divide a genus into a certain number of species on morphological characters, the result being a good natural grouping. A cytologist may then investigate the same genus and find that, say, sterility barriers in some cases cut right across the taxonomist's groups. If the sterility classification is the less natural of the two, that is, if its groups show a smaller correlation of attributes, it should not, as is sometimes suggested, be dismissed as 'taxonomically useless'; but should be retained as a distinct classification for the purpose of establishing the relationship between sterility and other attributes.

This principle of 'multiple classification' is fundamental to the proper functioning of taxonomy as an instrument for the inductive investigation of living things. How can it be most satisfactorily applied in the present position of biological taxonomy? A few tentative suggestions may be put forward.

The categories and nomenclature of traditional taxonomy should be confined to the most natural classification possible in the existing state of knowledge of any particular group, on whatever attributes it may be based, and such a classification would be the most generally useful for a great variety of purposes, both scientific and non-scientific.

Any exact definitions of the categories within this classification are, in my opinion, an impossibility. The categories, genus, species, etc., are of the same nature as such categories as herd or heap, individual *characters* taking the place of individual animals or stones. A well-known trick in logic known as the 'sorites' illustrates this point. The question is put "Does one stone form a heap?" If the respondent answer "No", it is asked, "Do two stones form a heap?" and so on. Great difficulty is found in deciding when the addition of one stone constitutes a heap. The answer would vary from person to person and also according to the shape and size of the stones. Similarly, in a natural classification, the definition of the categories must vary somewhat according to the mentality of individual biologists and the nature of the material being classified.

If the traditional taxonomy is defined in this way, what should be the aim and methods of the additional classifications necessary for special investigations? Unlike the classification of traditional taxonomy, they should be based on the same attributes throughout, and their categories should have a different terminology from that of traditional taxonomy. A good example of such a system is Danser's classification into commiscuum, comparium and convivium, which is based purely on interfertility criteria[1].

Many other classifications based on data provided by genetics, cytology and ecology have been proposed during this century[2], but these have for the most part either redefined the categories of traditional taxonomy in such a way as to destroy their general usefulness, or have employed mixed attributes as a basis for new categories. It is greatly to be desired that agreement should be reached on the employment of other classifications similar to Danser's (either new ones, or existing ones modified where necessary), based on other attributes. The number and complexity of such classifications are, of course, questions of meeting the ever-changing needs of biological investigation, and no limits either way can be set.

With regard to nomenclatural technique, it would seem possible that, where necessary, the method of employing Latin words with a prefix or suffix to distinguish them from the Latin names of genera, species, etc., which has already been used with success, for example, for the ecological categories of association, etc., might be extended to classifications based on other attributes.

[1] *Genetica*, **11**, 399 (1920).

[2] See Du Rietz, *Svensk. Bot. Tid.*, **24**, 333 (1930).

The Hammond Electric Organ

THE development of the loud-speaker, and more especially the demonstration of its capability of reproducing all types of music in connexion with the projection of the talking film in the cinemas, has suggested to a number of inventors the possibility of the replacement of the ordinary pipe organ by one which is entirely electric. Many patents have been taken out both in Great Britain and abroad, some utilizing electrically recorded wave forms and a photo-electric cell, and others building up the tone quality from combinations of sine waves; for it is well known that any periodic wave can be analysed into a series of sine waves of which the frequencies are multiples of that of the original wave. Of the latter, the two most successful are that of the Compton Organ Co., in which the waves are generated by a variable capacity, and the Hammond organ.

In the Hammond organ the currents are produced electromagnetically by rotating an iron disk *D* (Fig. 1), about the size of a half-crown, with a serrated edge, in front of the end of a permanent magnet *M* on which is a coil of wire *B*. The change of flux through the coil, caused by the variation of the gap between the serrated edge of the disk and the end of the magnet, produces an alternating E.M.F. in the coil; the edge of the disk and the pole of the magnet are so shaped that this E.M.F. shall follow a sine curve as closely as possible. There are twelve of these disks, each with its own magnet and bobbin of wire, to each octave. The disks of one octave are all mounted on a single shaft and rotate as a whole. The shafts and disks of the successive octaves are all similar and are so geared together that the shaft of each octave shall run at twice the speed of the preceding one.

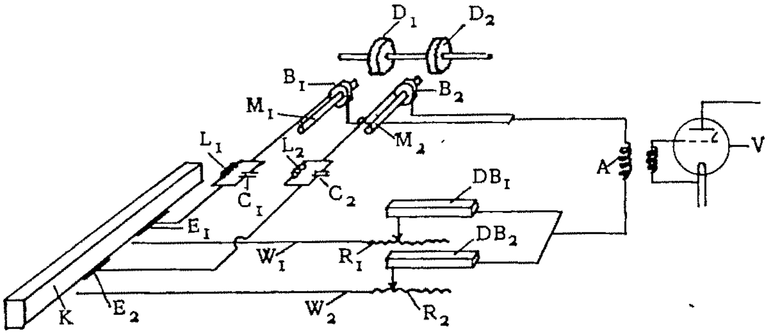

Fig. 1.

DIAGRAM OF ACTION OF THE HAMMOND ORGAN: *A*, COIL; B_1, B_2, BOBBINS; C_1, C_2, CAPACITIES; D_1, D_2, DISKS; DB_1, DB_2, DRAWBARS; E_1, E_2, CONTACTS; *K*, KEY; L_1, L_2, INDUCTANCES; M_1, M_2, MAGNETS; R_1, R_2, RESISTANCES; *V*, VALVE; W_1, W_2, WIRES.

The number of serrations on the edges of the twelve disks of one of these octaves has to increase progressively so as to give as approximately as possible the notes of the equitempered scale. The number of turns on the bobbins is reduced in the successive octaves to compensate for the increased flux due to the increased speed of rotation, and by this as well as by adjusting the distance of the magnets from the edges of the disks, the intensities of the notes produced are equalized throughout the whole range of the circuits, of which there are ninety-one in all.

There are two keyboards, each with five octaves. To combine the sine waves produced by the rotations of the disks in order to give the organ tones required, each note *K* (Fig. 1) on the keyboard can be connected to nine harmonically related bobbins, and the intensity of each of these circuits can be varied at will. For example, middle C can be connected not only to the bobbin giving the note of middle C, but also to the bobbins giving the fourth and the octave below (G_1 and C_1) and to those giving the octave above, the twelfth, the second octave, seventeenth, nineteenth, and third octave (C′, G′, C″, E″, G″, C‴.) These connexions are made by means of insulated contacts *E* under the keys, one connected to each bobbin, which are brought down, when the key is depressed, on to nine wires *W* stretching from side to side of the keyboard. The nine wires go to a group of nine draw-bars *DB* situated over the keyboard, each of which can be set at nine positions numbered from zero to eight. All the ninety-one circuits have initially the same resistances, and the draw-bars insert a resistance *R* which varies from infinity to nothing as they are drawn out, and thus each draw-bar adds a determined amount of the corresponding harmonic according to the position at which it is set.

To prevent the current from one bobbin feeding back through a key and the draw-bars to another bobbin and so giving false notes, there is a tuned circuit, consisting of a capacity and an inductance in parallel, between each bobbin and the keyboard.

Thus the complete circuit starting from the bobbin passes first through the tuned circuit, then branches and goes to the nine keys connected to that bobbin. Then it goes through the wires stretched across the keyboard to the nine drawbars and through their resistances. These resistances are all joined together and the combined current now goes to a coil *A* which may be considered to be similar to the aerial coil of a wireless set, and from that back to the bobbins. The current is now amplified in the usual way and after a second amplification by another valve it passes to a variable resistance controlled by the swell pedal; this swell effects an enormous change in intensity, amounting to a variation of some fifty decibels as compared with about thirty at most of the ordinary organ. It, in fact, is equivalent to the drawing of extra stops in an ordinary organ in addition to the increase produced by the opening of the swell box. From the swell pedal resistance the current is taken by a cable to the power cabinet, where it is amplified by a further range of valves and feeds the loud-speakers; of which there may be two or four or more according to the size of the building for which the organ is required.

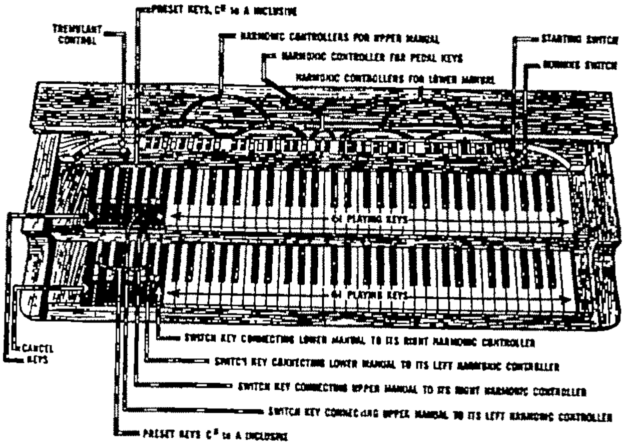
PRESET KEYS, C# to A INCLUSIVE
TREMULANT CONTROL
HARMONIC CONTROLLERS FOR UPPER MANUAL
HARMONIC CONTROLLER FOR PEDAL KEYS
HARMONIC CONTROLLERS FOR LOWER MANUAL
STARTING SWITCH
RUNNING SWITCH
61 PLAYING KEYS
61 PLAYING KEYS
CANCEL KEYS
SWITCH KEY CONNECTING LOWER MANUAL TO ITS RIGHT HARMONIC CONTROLLER
SWITCH KEY CONNECTING LOWER MANUAL TO ITS LEFT HARMONIC CONTROLLER
SWITCH KEY CONNECTING UPPER MANUAL TO ITS RIGHT HARMONIC CONTROLLER
SWITCH KEY CONNECTING UPPER MANUAL TO ITS LEFT HARMONIC CONTROLLER
PRESET KEYS C# to A INCLUSIVE

Fig. 2

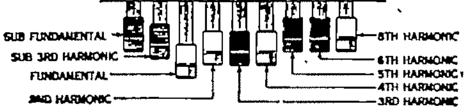

Fig. 3

As already mentioned, there are two five-octave keyboards (see Fig. 2). Above the keyboards there are four groups of harmonic draw-bars, nine bars to each group; the two left groups are for the upper keyboard and the two on the right for the lower keyboard. One of these groups is shown in Fig. 3. Between these in the middle are two harmonic controllers for the pedals. To the left of the five octaves of playing keys is another group of keys looking like the playing keys except that their colours are reversed. These correspond to the piston buttons in an ordinary organ, and eighteen of them give various combinations of tones which imitate very closely the types of combinations that are obtained on an ordinary organ—the diapasons, the reeds, diapasons and reeds, full organ, certain solo stops, etc.—pressing down one of these keys brings that quality of tone into action, at the same time cancelling the last combination used. Two of the keys bring one or other of the two groups of drawbars over the keyboard into action; thus the player can change from one of these groups to the other instantly, or to any one of the nine pre-set combinations, merely by pressing the appropriate key. The great variation in power of 50 decibels given by the swell pedal makes each of these pre-set combinations equivalent to a large number of organ stops.

To indicate the use of the drawbars a few tone colours as given by the makers are set out below. The numbers indicate the extent to which the bars are drawn (third from left is the fundamental).

007,755,220	Open diapason.
012,221,300	Soft strings.
145,645,553	Full swell.
015,656,342	Diapason chorus with mixtures.
006,470,520	Clarinet.
677,778,677	Full organ.

It is obvious that an almost infinite number of combinations of these harmonics is possible, and thus an immense variety of musical tones can be imitated. The beauty of the quality of the diapason and flute tones is remarkable, and the full pedal notes come out excellently.

There can be no doubt that the loud-speaker electric organ in some form has come to stay. The small compass in which the equivalent of a large organ can be housed—the manual occupies no more room than a piano and the loud-speakers about that of a wireless set—the small cost, and the small running cost, together with the fact that it never requires tuning, are very real advantages which it possesses both for churches and for home use

We are indebted to Messrs. Boosey & Hawkes, Ltd., 295 Regent Street, London, W.1, for information on which the above article has been partly based.

Obituary Notices

Prof. A. Wiedemann

ALFRED WIEDEMANN, professor of Egyptology at the University of Bonn, died suddenly at the end of 1936 in Bonn, at the biblical age of over eighty years. Both on his father's and his mother's side he belonged to academic families: his father, like his elder brother, Eilhard, was a well-known professor of physics and chemistry, and so was his mother's father, Mitscherlich. Wiedemann himself, although devoted from his youth to Egyptology, felt always a keen interest in natural history and anthropology, and was one of the first among his Egyptological fellow-students to become enthusiastic over de Morgan's theories on Neolithic Egypt. To the latter's book on the tomb of Naqada he contributed an exhaustive study on the methods of burial in the Naqada necropolis, and the origin of the Egyptian people: it was characteristic of Wiedemann to attempt to draw historical conclusions by interpreting Egyptian religious texts and Egyptian rites in the light of recently established archæological facts.

Wiedemann devoted much labour to the study of Egyptian religion, and he will perhaps be best known to the British public through his contribution to the *Proceedings of the Society of Biblical Archæology*, of which he was a member, and through his "Egyptian Religion", an entirely revised translation of a German book by himself. Maspero, on reviewing the German edition, regretted the lack of an elaborate bibliography imposed on Wiedemann by the editor. He alludes evidently to the notes in Wiedemann's "Egyptian History" and in his Commentary to the second book of Herodotus, where an almost incredible mass of information is put together from public and private museums, from publications and accounts of all times and countries, in which the student could find quoted nearly every opinion on any subject treated, every bit of an inscription, every scarab detected anywhere by the author, registered. This tremendous work has rendered great service, but unfortunately Wiedemann declined to make any distinction between important and less important material, and the reader found himself to a certain extent drowned by the flood of monuments big and small, and sometimes difficult of access. Wiedemann was more a sceptic than a critical spirit, and he was neither a philologist nor a historian in the narrower sense of the words. Some of his translations are excellent: his remarks on the age of Memphis against Erman's theory that the city was not founded until the Sixth dynasty, and his opposition to the attribution of the tomb at Naqada to Menes, were sound, but in both cases he missed the real point: the Naqada tomb certainly dates from the beginning of the First Dynasty, and Memphis, although existing before as a settlement, took its name from the pyramid of King Phiops.

Wiedemann disliked the sometimes too systematic way in which Erman, his pupil Sethe, and Eduard Meyer treated the language and history of Egypt. He was unjust to the undoubted achievements of these scholars, and finally resigned from collaboration in Egyptological work, being aware of the gulf which divided his methods from those of nearly all Egyptological scholars in the twentieth century. He devoted himself entirely to the study of the history of Godesberg, the native village (and now town) of his wife, his best companion in life and work.

Wiedemann was the pupil of Lepsius, Ebers and Maspero, and he was strongly influenced by the last. But he lacked the facility with which Maspero connected any new facts with his own knowledge, and he was more of a collector of sometimes very important material than a systematic worker. Maspero rightly once said of his work, that it had allowed many others to do original work, meaning that without the many references in Wiedemann's books and the many texts published by him (sometimes in small autographic pamphlets, which have become very rare), other scholars would never have been able to produce their own dissertations. This is true, and no living Egyptologist ought to forget what he owes to Wiedemann, even if many of his books and pamphlets are out of date. What is perhaps more, Wiedemann was always ready to allow anybody to make use of his library, his small but interesting collection of antiquities, and of his valuable copies, which sometimes contained passages destroyed since Wiedemann had copied them, perhaps so early as 1882–83. I have seen W. Max Muller spending weeks in Bonn in order to take notes from Wiedemann's archives.

A man so sociable as Wiedmann would naturally be a good teacher, he would put everything he knew and had at the disposal of his pupils, he would also open his house to his students, not only giving many of his lectures at home but also inviting his students on his regular Tuesday evenings, and, together with his wife, looking after them whenever they needed help. All who knew Wiedemann in his best years, before the War took his son from him and the inflation annihilated his fortune, will think with pleasure and gratitude of him and his home.

F. W. FREIH. V. BISSING.

WE regret to announce the following deaths:

Mr. R. J. Mitchell, C.B.E., chief engineer and designer of the Supermarine Aviation Works, on June 11, aged forty-two years.

Mr. J. L. Stocks, vice-chancellor of the University of Liverpool, formerly professor of philosophy and public administration in the University of Manchester, on June 13, aged fifty-four years.

News and Views

The Ultra-Centrifuge in Biochemistry

THE substance of lectures by Prof. The Svedberg, delivered in Oxford earlier this year at the inauguration of an ultra-centrifuge in the Department of Biochemistry of the University, is printed as a supplement to this issue of NATURE. The work described represents the culmination of a definite stage in Prof. Svedberg's research with the ultra-centrifuge. By a remarkable feat of engineering, he has succeeded in applying a simple principle to the measurement of molecular weights in a region which seemed inaccessible except through osmotic methods; and since these gave no information as to molecular homogeneity, no idea could be reached of the individual molecular weights of a possible mixture. His ultra-centrifuge, capable of reaching with a rotor of 180 mm. diameter speeds of at least 66,000 revolutions per minute and forces of 300,000 times gravity, seems to be for the moment the only method of getting adequate resolution in the 'mass spectrum' of a mixture of proteins. It is driven by oil turbine and has a horizontal rotor running in hydrogen at a pressure of about 25 mm. Particularly interesting is his mention of the experiments upon the best forms of steel to be used in rotor construction. They indicate all too briefly how much experimental work has been needed to evolve a final form of the apparatus. The studies upon proteins have clearly arisen in Uppsala from the long-continued interest of Prof. Svedberg in colloids. Even before the development of the recent work, he had already made valuable contributions to colloid chemistry; but these must be regarded as of minor importance in the light of the discoveries here summarized.

THE significance for biochemistry of the new work can scarcely be exaggerated. For the first time, it has been possible to know whether a protein solution is homogeneous, and knowing this to define quickly the number of molecular species present in a mixture. The latter enables us to follow the entry and presence of a foreign protein in such a medium as the blood plasma; the implications of this for a study of diseased conditions are clear. It also provides a means of following changes in molecular weight produced by varying treatment of a pure protein such as albumen. In this way it has been shown at Uppsala that slight changes in hydrogen ion concentration (which have always been realized to be of great importance in biochemistry), can cause either reversible or irreversible dissociation of a protein. Further, it is remarkable that in several cases there should be similar changes induced by crystalloids, sometimes present only in traces. A particularly striking instance is recorded for the effect of 0·001 gm. per cent of thyroxin upon a solution of thyroglobulin. Such effects, and there seem to be many of them, can scarcely fail to throw light upon the intimacy of the cell itself, where the proteins in their colloidal relations form one of the most significant features of life. The final table which records the analysis of all the proteins so far studied is remarkable for the regularities that have come to light. With few exceptions, it seems that the molecular weights of the proteins fall into well-defined multiples of 17,600. Here for the first time, we feel that there is some chance of reaching the protein ultimately by the methods of organic chemistry, since these results signify some underlying simplicity of construction.

Agriculture and Industry

IN his recent Mather Lecture to the Textile Institute on "Agriculture as a Potential Source of Raw Materials of Industry", Sir Harold Hartley described the present-day uses of many agricultural products for industrial purposes, and indicated some possibilities of further expansion. His method of approach was that of the short-term extrapolator rather than that of the Utopian dreamer, who, although a more successful prophet as a rule, is apt to disregard the mundane but essential element of cost. Sir Harold left the sphere of social economics severely alone, but he emphasized that development of agricultural industries would promote closer co-operation and better understanding between farm and factory. Only about 12 per cent, by value, of the world's agricultural production is now used for industrial purposes, but the proportion is raised to one third if forest products be included. In spite of the triumphs of the chemist, first in revealing the structure of many organic molecules, and then in synthesizing many natural products, or in processing them, the factory cannot compete with Nature in the cheap production of complex organic compounds; for supplies of cellulose, the key substance of fibrous structures, we must always rely on the plant. The future lies not in competition between Nature and the chemist, but in their closer association to produce the materials needed by man. Such a development of the use of agricultural products will help to conserve our supplies of coal and oil, for whereas these represent wasting capital assets, plant products, ever renewable by solar radiation, represent revenue without debit to capital.

IN the United States the Farm Chemurgic Council is working "to advance the industrial use of American farm products through applied science", and its members meet annually at Dearborn to discuss their problems. Among the many difficulties confronting American agriculture are soil erosion, loss of fertility due to continuous cropping, displacement of the horse by the tractor, and decreasing exports and increasing imports of farm products. It is hoped to combat some of the bad effects of these conditions by growing new crops to replace imported products, by finding new outlets for established crops, and by better utilization of agricultural waste. Among the new crops are the soya bean, which now covers six million acres. Substances extracted or made from it have manifold uses, and Henry Ford has built a large plant for making plastics out of the meal. Tung oil, valuable for paint and varnish making, is to be derived from extensive plantings of the tung-oil tree; and, also in the Southern States, the quick-growing Southern Pine has been planted over 200 million acres to provide pulp for newsprint and as a raw material for rayon and 'Cellophane'. Among the new outlets for old crops are the use of cotton fabric for reinforcing tarred roads, of inferior cotton and cotton linters for making cellulose derivatives, and of maize for the production of starch, dextrin, corn syrup, dextrose, corn oil and cake. Also under investigation is the utilization of the enormous quantities of straw, cotton stalks, and husks that now run to waste. By promoting agricultural industries on the above lines, it is hoped to put the farmer financially on his feet, and to make him a better customer of the factory.

Total Solar Eclipse of June 8–9.

THE fact that the expedition of the National Geographic Society and the U.S. Naval Observatory was accompanied by engineers and announcers of the National Broadcasting Company of America has led to the overlooking of the other expeditions organized to observe the recent total solar eclipse (see NATURE of June 12, p. 993). It is good to report that Mr. C. B. Michie, who led an expedition from New Zealand with the aid of the Royal New Zealand Navy also to Canton Island, shared in the good luck in the form of fine weather that came the way of the American party, and secured good photographs of the corona with several very long streamers. Further, it transpires that the Princeton party to Chembote in Peru—and it is hoped the Japanese party there also—had fine weather for the actual eclipse, though as at Canton Island weather prospects were anything but favourable not long before the eclipse. The value of the results obtained by the various parties (and by the party from Princeton, the Franklin Institute and the Cook Observatory on the S.S. *Steelmaker* near the point of maximum totality) cannot yet be assessed, but in view of the number of experienced observers concerned, one may confidently look forward to results of very considerable importance.

International Peace

THE annual report of the Director of the Division of Intercourse and Education of the Carnegie Endowment for International Peace for 1936 pleads for further support for genuine world organization and collective security through an effective world police force. Dr. Murray Butler refers to the existence of a deep-seated popular sentiment against war and to the necessity of this opinion finding expression not merely in emotional outbursts but also in support of definite policies of social, economic and political co-operation and the substitution of judicial process for the threat of force in settling international differences. The advocates of economic nationalism and of neutrality, he said, are making a most insidious attack upon the foundations of prosperity and of peace, for the first involves ultimate national suicide and world-wide disaster and the latter neglect of the highest international obligations. Dr. Butler pointed out that the wars which are most threatening at the present time are between fundamental philosophies of life and of public order, and he referred to the dangers confronting democratic nations.

THE Inter-American Conference at Buenos Ayres in December was the brightest feature of the year and received support from public opinion in both American continents. The report refers to co-operation with the International Chamber of Commerce and the adoption in August by the Joint Committee of thirteen practical recommendations for improving commercial relations between nations and dealing with monetary stabilization. Reference is also made to the distribution of literature, to the Leadership Training Conference held in Des Moines, Iowa, to the work of the visiting Carnegie professors, to the International Relations Clubs, of which 805 have now been formed, as well as to the work of such associated institutions as the American Academy of Political and Social Science, the Institute of Public Affairs at various universities, the Institute of Foreign Affairs, Earlham College, Richmond, Indiana, and the Institute of Pacific Relations. Details of similar work of the Division in Europe are included, indicating the great extent to which the Division utilizes the opportunities afforded by existing organizations for carrying out its educational work.

Archæological Discoveries in Northern Syria

SIR LEONARD WOOLLEY'S first report on the current season's work of the British Museum's Archæological Expedition to Northern Syria records important discoveries, which throw fresh light on the Hittite occupation of that area and would seem to confirm references in the Biblical narrative to the relations of the Hittite people and the inhabitants of Palestine in the patriarchal age, which hitherto have been regarded as anachronisms. The expedition, Sir Leonard reports (*The Times*, June 12), has completed its first season's work in the Amk plain, inland from Antioch. The time available was brief, as excavations begun last year at Mina had to be completed; but an isolated area about twenty yards square in what was believed to be the aristocratic quarter of the city, opened up to a depth of 13 ft., has revealed a magnificent building, one of the finest as yet found in northern Syria. This structure is Hittite. It was built of basalt, mud-brick and timber. The approach was from a tile-paved area by way of a flight of basalt steps between platform buttresses, and led through a colonnade into a wide entrance court. The building had been destroyed by a fire; but the chambers adjoining the court were rich in finds of pottery, local and imported, including

Cypriote pottery of the Bronze age. An important find consisted of portions of two literary texts, which, as the oldest cuneiform documents as yet found in northern Syria, may be expected to yield results of considerable historical interest. The date of the building can be fixed with tolerable accuracy, as information from the main excavation of the year, which was on a much larger scale, indicates consecutive periods ranging from the twelfth back to the sixteenth or seventeenth century B.C. Here, below cremation graves, was found a house, which on the evidence of Mycenæan pottery belongs to the thirteenth or fourteenth century B.C. Inscribed tablets afford evidence of the existence of a royal library. In the fourth level, dated at the sixteenth century B.C., was found a house which in its details corresponds to the larger building previously described, and being characteristically Hittite, serves also to place the Hittite occupation of northern Syria at a much earlier date than hitherto accepted.

Swanscombe Skull: Committee of Investigation

THE character of the Swanscombe skull and the conditions of its discovery both in themselves and in relation to the Piltdown skull, suggested that a certain suspension of judgment was advisable for further consideration of the evidence, before accepting the find at its face value as inferred by Mr. A. T. Marston on his announcement of the find (see NATURE of October 19, 1935, p. 637 and August 1, 1936, p. 200). A report was also promised on the palæontological evidence, which clearly would have an important bearing on any conclusion to be drawn. So far, anthropologists, while admitting the importance of the discovery as reported by Mr. Marston, have been inclined to caution. An announcement, therefore, is welcome that the Royal Anthropological Institute has appointed a committee to investigate the evidence which Mr. Marston has collected, and to co-operate with him in the further investigation of the site. This committee consists of Mr. M. A. C. Hinton, keeper of zoology, British Museum (Natural History), (*chairman*), Mr. K. P. Oakley, Department of Geology, British Museum (*secretary*), Prof. P. G. H. Boswell, Imperial College of Science, London, Prof. W. E. Le Gros Clark, Department of Anatomy, University of Oxford, Mr. H. G. Dines, Geological Survey of Great Britain, Mr. C. F. C. Hawkes, Department of British Antiquities, British Museum, Prof. W. B. R. King, Department of Geology, University College, London, Mr. A. T. Marston, Dr. G. M. Morant, Galton Laboratory, University College, London, and Mr. S. Hazzledine Warren.

The Empire Cotton Growing Corporation

AT a meeting of the Administrative Council of the Empire Cotton Growing Corporation held in Manchester on May 25, it was announced that the Corporation has recently acceded to a request from the Indian Central Cotton Committee that Dr. T. G. Mason should be permitted to spend some months in India to advise in connexion with an investigation into the causes of the periodic failure of the cotton crop in the Punjab. It was also reported that in letters that had been received from Prof. J. W. Munro, who is making a tour in Africa to advise the Corporation on its work on cotton insect pest control, he has written enthusiastically of the high quality of the work that was being carried out by the Corporation's staff, and recommended that it should continue to receive full support. An addition to the staff in Nyasaland may be necessary. It was naturally impossible to say whether it would prove possible to devise any practical measures for controlling these pests, but pests constituted the limiting factor in cotton-growing throughout considerable areas in Africa, and the Corporation should therefore leave nothing undone which might bring to light any information that might possibly lead to a reduction in the loss of crop thus caused.

Genetic Theory and Practice in the U.S.S.R.

IN a note on genetics in the U.S.S.R. (NATURE, 139, 185; Jan. 30, 1937), reference was made to the empirical work of Michurin on the hybridization of fruits, and his published work was said not to have been translated into any foreign language. Our attention had been directed to the fact that a translation, in an abridged form, is available for reference in the Bureau of Plant Genetics at Cambridge. The short published abstracts of the Bureau (*Plant Breeding Abstracts*, 5, 56, 376 and 7, 122) make the character of Michurin's work fairly clear. Like the recent work of Burbank in the United States, it belongs to the period of Kolreuter. It uses the assumptions and deals with the problems that were in favour in the late eighteenth century. Indifference to the refinements of later work has led Michurin, as it did Burbank, to somewhat fantastic conclusions in physiology and genetics. The reason for Michurin's indifference, however, is peculiar and significant. He states that the Mendelian principles are not in accordance with the dialectic of Engels, and must therefore be disregarded. It seems that Aristotelianism is appearing in a new quarter under a new guise.

Mechanized Farming

THE report on the discussions at the Oxford Conference on Mechanized Farming held in January last has been published. It contains the opening and concluding addresses given by Mr. C. S. Orwin and Mr. Roland Dudley respectively, and full accounts of the discussion that followed the papers dealing with tractor performance and row-crop cultivation, cultivations, the maintenance of fertility, grass drying and combine harvesting. Both the practical and scientific points of view are well represented and the publication is clearly a valuable complement to the papers themselves. The complete Proceedings of the Conference (2 vols.), which includes both the papers and discussions, may be obtained from the Conference Secretary, 10 Parks Road, Oxford, price 2*s*. 6*d*. post paid.

International Congress for the History of Science

THE arrangements for the Fourth International Congress for the History of Science, to be held in Prague on September 22–27, are proceeding. The President of Czechoslovakia, Dr. Eduard Beneš, has agreed to give his patronage, and with him are Dr. Em. Franke, Minister of Education, Dr. Kamil Krofta, Minister of Foreign Affairs, Dr. Josef Zadina, Minister of Agriculture, the rectors of the Czechoslovak universities and corresponding schools, the presidents of the academies of science and of the scientific societies of Czechoslovakia, and the Chief Mayor of Prague. On the Committee of Honour, prominent leaders in industry and science in Czechoslovakia are represented. For the plenary meetings lectures have been promised by Prof. B. Němec, formerly rector of the Charles University, president of the National Research Council of Czechoslovakia; Prof. O. Grosser, formerly rector of the German University in Prague; Prof. K. Studnička, of the Charles University; Prof. Gino Loria, of the University of Genoa, formerly president of the International Academy for the History of Sciences; Prof. Abel Rey, of the Sorbonne, director of the Institute for the History of Sciences and Technics. About a hundred papers, from Czechoslovakia and from Belgium, England, France, Germany, Italy, Poland, Portugal, Rumania, U.S.S.R., and Yugoslavia, have already been received. Members of the Congress will enjoy reductions on the railways of Czechoslovakia and of the other countries interested. Further information can be obtained from the general secretary of the Congress, Prof. Fr. Ulrich, Albertov 6, Praha II.

Institute for Research in Metals, Sendai

PROF. KÔTARÔ HONDA has lately completed his twenty-fifth year as professor of physics in the Tôhoku Imperial University, and the occasion has been commemorated by the publication of a special volume of the Science Reports of that University, contributed by his pupils and by friends from many countries. This substantial volume, of 1,126 pages, is an indication of the prominent part that Prof. Honda has played as teacher and also as director of the very active Institute for Research in Metals at Sendai. As might be expected from the special interests of Prof. Honda, from his work at Gottingen onwards, many of the papers, some sixteen in all, deal with the magnetic properties of metals, but the work of the Institute has covered a wide field in metallurgy, and most branches of the physical study of metals are represented. Another group treats of transformations of alloys in the solid state, including steels. The development of improved steels for permanent magnets has been one of the most important results of the investigations at Sendai, the discoveries made there having had profound industrial effects, through reducing the size of magnets and even of enabling them to take the place of electromagnets in machine tools, etc. Terrestrial magnetism is also represented, whilst other papers describe investigations in chemistry. Many well-known names are to be found among the contributors, and the occasion has been used to present surveys of the position of knowledge concerning several of the properties of alloys of current interest.

Transmission of Electricity in France

AN instructive lecture was given by P. M. J. Ailleret to the Transmission Section of the Institution of Electrical Engineers on April 29, the subject of the discourse being recent developments of electric transmission in France. The French system includes lines operating at 110, 120, 150 and 220 kV. The reason for this difference is partly historical and partly geographical. The grid was begun in France in 1920, the pressure used being 120 kV.; a few years later it was considered necessary to raise it to 150 kV., and the first 220 kV. line was erected five years ago. Every time a new line was proposed which did not interest existing producers, a new company had to be formed, and the whole system was financed by the co-operation between producers, distributors and interested industries. No less than thirty-nine companies were formed to finance the construction of the lines, but the responsibility for operation is entrusted to a fairly small number of them. Another reason for the use of several voltages is that in France the price of coal varies much more from one part of the country to another than it does in England. Hydro-electric generation is concentrated in limited mountain areas and nearly half the total production comes from this source. Some regions which are rich in water power have practically no local consumers, others have an important electrochemical and electrometallurgical load, constant during the day, but with seasonal fluctuations which are advantageously combined with the usual loads of a distribution system. For these reasons a voltage of 220 kV. has in some cases been necessary. An eleven mile underground cable at this voltage was found necessary to transmit the energy from the south-east to the St. Denis power station through a densely populated suburban area. This oil-filled cable can carry 150,000 kilovolt-amperes.

Fishing Gear

THE third edition of "An Account of the Fishing Gear of England and Wales" (H.M. Stationery Office. 6*s*. net), has recently been issued, since the first publication in 1923, a fact which bears full witness to its value. The subject is a vast one, for Mr. Davis's account ranges from the single hook handline to the modern otter trawl, from the whelk-pot to the fish weir nearly a quarter of a mile long. The most important modern fishing gears—otter trawl and drift net—are dealt with in detail, and the methods of shooting, fishing and hauling clearly explained. In this connexion it may be mentioned that many east coast drifters now shoot mackerel-nets forward, rather than over the stern. There is a section on the Danish plaice seine, and Mr. C. F. Hickling has rewritten the account of the Vigneron-Dahl trawl. Many of the instruments of the inshore fisherman described are now disused, or obsolescent, so that parts of the account are chiefly of historic interest. It is interesting to see how similar types of net have been evolved by fishermen on different parts of the coast, and how one type of net grades into another. The author points out that the Saltash tuck-seine is practically a trawl, and the Beer 'fly-backed otter trawl' a seine The braiding and setting of nets and their preservation is dealt with. Indeed, the use of Mr. Davis's paper would make clear any reference to the methods of fishing around the British coasts, or the description of the shape and construction of any net.

St. Kilda Papers 1931

A publication entitled "St. Kilda Papers 1931" has just been issued, and contains, in addition to a foreword, bibliography and large-scale map, reprints of eleven papers previously published in various scientific journals. These papers, which deal with the mice, the breeding birds, the early autumn migration in 1931, the St. Kilda wren, the Coleoptera, the flora and the vegetation of St. Kilda, comprise the chief scientific results of an expedition to the island in the summer of 1931, the year following the evacuation of the islanders. As "St. Kilda Papers 1931" is limited to an edition of only fifty copies, none is available for sale; but as the publication is intended as a basis for any future scientific work on the island, twenty-five copies have been presented to leading public libraries and to the libraries of learned scientific societies for reference purposes. Any further information relative to this publication or to the deposition of the library copies can be obtained from Mr. Malcolm Stewart, Hawridge Court, Nr. Chesham, Bucks.

The World Power Conference

We have received a summary of the annual report for 1936 of the World Power Conference, prepared by the Central Office, 36 Kingsway, London, W.C.2. The chairman is Sir Harold Hartley (Britain) and the vice-chairmen are O. C. Merrill (United States), G. T. T. Bakker (Netherlands) and M. Kamo (Japan). The plenary conference was held in Washington on September 7–12, 1936, and was attended by about 3,000 members from fifty-four countries. Year book No. 1 was published in October 1936, and it is hoped that No. 2 will be published in September next. Statistics on manufactured gas and coke will be added in this and subsequent year books. The work of the international sub-commission on special cements is going steadily forward, and work on an international technical dictionary in connexion with dams will soon be begun. The International Executive Council has unanimously accepted the invitation of the German National Committee for the second chemical engineering congress to be held in Berlin in 1940. There is little doubt that the fourth World Power Conference will take place in 1942, thus preserving the interval of six years between successive plenary meetings.

University of Lausanne

The fourth centenary of the University of Lausanne was celebrated on June 4–5, when honorary degrees were conferred on the following, among others: Sir Maurice Amos, Quain professor of comparative law in University College, London (Doctor of Laws); Sir Frederick Gowland Hopkins, Sir William Dunn professor of biochemistry, in the University of Cambridge (Doctor of Medicine, *in absentia*); Prof. G. Barger, professor of chemistry in relation to medicine in the University of Edinburgh (Doctor of Pharmacy); and Prof. G. Rudler, Foch professor of French in the University of Oxford (Doctor of Letters). The University of Lausanne began in 1537 as the first college for the training of Protestant ministers, and other faculties were added during the nineteenth century.

National Baby Week

The National Baby Week Council announces that National Baby Week will be held on July 1–7. The theme selected for discussion and publicity this year is "Housing and Home in Relation to Maternity and Child Welfare", and a housing manifesto has been issued embodying certain ideals and ideas that may serve as a basis for discussion. This and other particulars may be obtained on application to the Secretary at 117 Piccadilly, London, W.1.

Announcements

The University of Athens, on the occasion of its centenary celebrations, has conferred on Prof. F. G. Donnan, University professor of chemistry in University College, London, the honorary degree of D.Sc.

Mr. Edgar P. Chance, of Bulwell, Burchetts Green, near Maidenhead, has arranged a second exhibition of his collection of British birds' eggs to be held at the above address on June 25–26. The exhibition comprises about 150 drawers or trays selected from Mr. Chance's collection. Admission, from 10 a.m. until 8 p.m., is free.

A Conference on Magnetism will be held in the Physics Department of the University of Manchester on July 1–2, under the auspices of the Manchester and District Branch of the Institute of Physics. Prof. W. L. Bragg, the chairman of the Branch, will preside over the Conference and the following will give lectures: G. Richer, D. A. Oliver, Prof. N. F. Mott, Dr. C. Dannatt, Dr. E. C. Stoner, and Dr. A. J. Bradley. Visitors will be welcome, and further particulars may be obtained from Dr. C. Sykes, Research Department, Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, 17.

The fifty-sixth annual meeting of the Society of Chemical Industry will be held at Harrogate on July 5–9 under the presidency of the Right Hon. Lord Leverhulme. Prof. G. G. Henderson, recipient of the Society's Medal, will give an address entitled, "A Retrospect; Notes on some Development in the

(*Continued on p.* 1063)

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SUPPLEMENT

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The Ultra-Centrifuge and the Study of High-Molecular Compounds

By Prof. The Svedberg, University, Uppsala

Introduction and Theory

An atomic weight determination of a 'natural' mixed element by chemical methods gives only a mean value. It does not furnish any information about the individual weights of the different atomic species or isotopes constituting the mixture. Such data may be collected by mass-spectroscopic studies.

Molecular weight determinations by osmotic pressure and viscosity methods likewise give only mean values. Now in the case of high-molecular compounds, there are often present in the same solution a number of different molecular species differing in mass and shape. The properties of the solution as well as of the dried substance depend to a great extent upon the distribution of the different molecular species. A molecular weight analysis is therefore of considerable importance when studying high-molecular compounds. The ultra-centrifuge enables us to carry out such an analysis.

The interest in high-molecular compounds has been rapidly growing during recent years. The role of proteins in the organism is a matter of life and death, and the elucidation of the constitution and physico-chemical properties of these substances is therefore an urgent task. Certain industries dealing with proteins are also interested in progress in this field. For our understanding of the properties of polysaccharides, such as starch, glycogen, cellulose and their derivatives, as well as the behaviour of the associated hydrocarbons and the high-molecular dyestuffs, it is necessary to study their molecular size under various conditions. The ultra-centrifuge offers a possibility of solving many of the problems in question.

What we aim at in ultracentrifuging is an accurate determination of the molecular sedimentation in a strong centrifugal field. Two lines of approach are possible. We can measure the rate of settling of the molecules—the sedimentation velocity—or we can measure the competition between settling and diffusion—the sedimentation equilibrium—which is finally reached after prolonged centrifuging. In the former case we need an independent determination of the diffusion constant in order to calculate the molecular weight. The latter method furnishes directly the molecular weight[1-7].

The sedimentation velocity reduced to unit centrifugal field and to standard frictional conditions represented by water at 20° C. is called the sedimentation constant.

$$s = \frac{dx}{dt} \cdot \frac{1}{\omega^2 x} \cdot \frac{\eta}{\eta_0} \cdot \frac{1 - V\rho_0}{1 - V\rho} \quad . \; . \; . \quad (1)$$

where dx/dt is the observed translational velocity, x the distance from centre of rotation, ω the angular velocity of the centrifuge, η and ρ the viscosity and density of the solution, η_0 and ρ_0 the same quantities for water at 20° C., and V the partial specific volume of the solute.

From the sedimentation constant s and the diffusion constant D, we get the molecular weight

$$M = \frac{RT\,s}{D(1 - V\rho)} \quad . \; . \; . \; . \; . \quad (2)$$

where R is the gas constant and T the absolute temperature.

The knowledge of the distribution of concentration c with distance from centre of rotation in equilibrium enables us to calculate the molecular weight from the following formula:

$$M = \frac{2\,RT \ln c_2/c_1}{(1 - V\rho)\omega^2(x_2^2 - x_1^2)} \quad . \; . \; . \; (3)$$

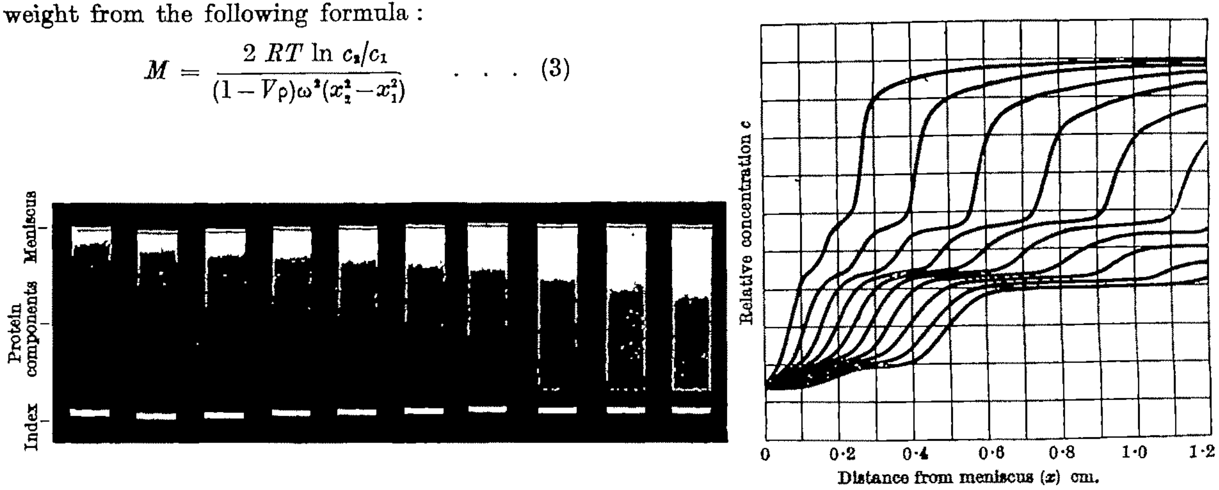

Fig. 1.

(*Left*) SEDIMENTATION PICTURES OBTAINED BY MEANS OF THE LIGHT ABSORPTION METHOD; AND (*right*) CURVES OF CONCENTRATION DISTRIBUTION FOR *Limulus* HÆMOCYANIN AT pH 6·8; SEDIMENTATION CONSTANTS OF COMPONENTS, $56{\cdot}6 \times 10^{-13}$, $34{\cdot}6 \times 10^{-13}$, $16{\cdot}1 \times 10^{-13}$, $5{\cdot}9 \times 10^{-13}$; CENTRIFUGAL FORCE 120,000 TIMES GRAVITY; TIME BETWEEN EXPOSURES 5 MIN. (I.-B. ERIKSSON-QUENSEL[20]).

If the substance is electrolytically dissociated, the disturbing influence of the charges may be eliminated by the addition of a non-sedimenting electrolyte.

APPARATUS AND EXPERIMENTAL PROCEDURE

In order to determine molecular sedimentation velocities, centrifugal fields of high intensity have to be used so as to shorten the time of observation, thus avoiding undue blurring of the boundary due to diffusion. In sedimentation equilibrium measurements, the centrifuging is carried on long enough at a comparatively low speed so as to attain an equilibrium between sedimentation and diffusion.

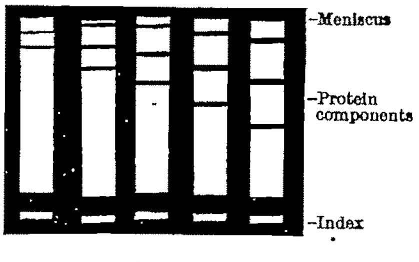

Fig. 2.

SEDIMENTATION PICTURES FOR *Limulus* HÆMOCYANIN OBTAINED BY MEANS OF THE TŒPLER *Schlieren*-METHOD AT pH 6·8, SHOWING THE FASTEST THREE SEDIMENTING COMPONENTS OF $s = 56{\cdot}5 \times 10^{-13}$, $34{\cdot}6 \times 10^{-13}$, AND $16{\cdot}1 \times 10^{-13}$; CENTRIFUGAL FORCE 120,000 TIMES GRAVITY; TIME BETWEEN EXPOSURES 5 MIN. (I.-B. ERIKSSON-QUENSEL[16]).

In both cases a small quantity of the solution to be studied is enclosed in a sector-shaped cell provided with plane-parallel ultra-violet transparent windows and rotated at constant (or but slightly changing) temperature. Freedom from convection currents is an essential feature of the procedure. Given the height and thickness of the column of solution and its distance from the centre of rotation, all other characteristics of the ultracentrifuge can be unambiguously derived. The dimensions of the sample of liquid determine the size of the observation windows of the cell and its outer diameter. The dimensions and situation of the cell holes determine the size of the rotor and its shape, as well as the maximum speed attainable with given rotor and cell materials.

In velocity measurements, the column of solution should be high enough to give sufficient space for undisturbed sedimentation. If it is too short, the molecules reflected from the bottom of the cell (backward diffusion) will interfere with the sedimentation before sufficient data have been collected.

The diameter of the rotor should be large enough to allow of the cell being placed at a suitable distance from the centre of rotation. In velocity measurements, the accuracy is decreased if the sample of solution studied is rotating with too small a radius. The part of the liquid where the concentration is independent of distance becomes impoverished too quickly, decreasing with time inversely as the square of the distance from the centre of rotation.

For low-speed runs, the rotor may be made with cylindrical outline, which has the advantage of good heat-exchange with the surrounding casing. At high speed, an oval shape with two cell holes—one for the solution cell and one for the balancing cell—must be chosen in order to reduce the strain. A vane of proper diameter screens off false light.

As rotor material chromium-nickel steel has proved the best. The highest centrifugal forces (1,000,000 times gravity) were reached using hard steel, but at the same time accidents during the test runs were often met with. Soft steel has been found more reliable, especially in the case of big rotors.

To diminish friction, the rotation has to take place in a medium of low viscosity. Vacuum is advisable only when the construction is such that practically no heat from the bearings is transferred to the rotor. An atmosphere causing some friction but possessing a high heat-conductivity is preferable. In those circumstances, the heat generated will be conducted away so quickly that satisfactory thermal conditions can be permanently maintained and convection currents avoided. For low-speed runs, hydrogen at normal atmospheric pressure may be used. For higher speeds, the hydrogen pressure should be cut down to about 25 mm. in order to reduce the friction without diminishing the heat-conductivity of the gas.

Up to speeds of about 20,000 r.p.m. or even somewhat higher, the rotor can be supported by ball-bearings. At high speed (20,000–160,000 r.p.m.) they become unreliable and have to be replaced by journal bearings. In the Uppsala machines oil-lubricated white-metal was chosen. With good balancing, the bearing pressures are very low, hence the surface of the bearings may be kept small and the heat-production and energy loss by friction low. For a recent type of our rotors it is 0·7 kW. at 60,000 r.p.m.

If the rotor is not self-balancing, it is of considerable importance not only that it should be in perfect balance, both statically and dynamically, but also that provision should be made for some sort of damping device to take care of small accidental irregularities in the movement and to prevent such disturbances from building up dangerous vibrations. A special type of damping bearings was therefore developed at Uppsala. The bearing surface is divided into six parts, three of which are fixed and three others form the ends of moving pistons acted upon by oil pressure. The movement of one of the pistons can be adjustably limited by means of a micrometer screw.

In the air-driven self-balancing ultra-centrifuge developed by Beams[8], Bauer[9], and Wyckoff[10], a light duraluminium rotor is hanging on a thin steel shaft and supported by an air-film bearing. The friction, and consequently the energy consumption, are therefore very low. The air-turbine is sealed off from the vacuum chamber in which the rotor moves by surrounding the vertical shaft with an oiled gland-shaped bearing.

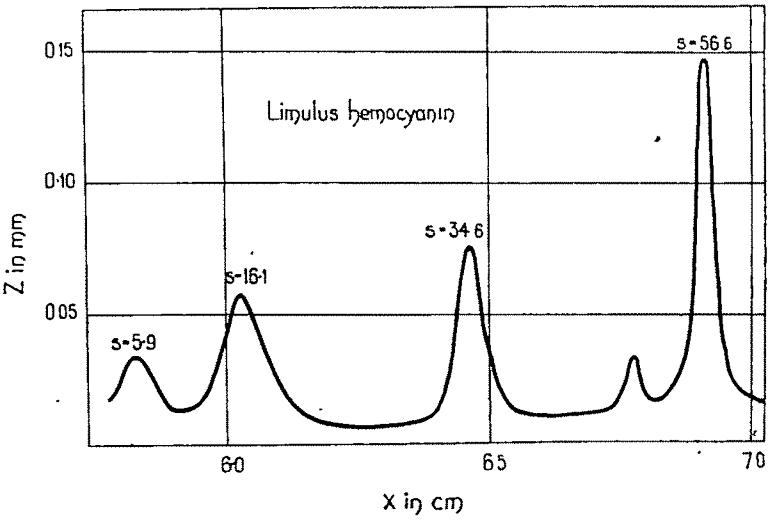

Fig. 3.

SEDIMENTATION DIAGRAM FOR *Limulus* HÆMOCYANIN OBTAINED BY MEANS OF THE REFRACTIVE INDEX METHOD AT pH 6·8 SHOWING THE SAME FOUR MAIN COMPONENTS AS IN FIG. 1 AND ALSO A SMALL AMOUNT OF A FIFTH ONE; CENTRIFUGAL FORCE 120,000 TIMES GRAVITY; TIME AFTER REACHING FULL SPEED 35 MIN. (K. O. PEDERSEN).

Direct electric drive with a heavy rotor self-balancing on top of a vertical shaft has proved very good for speeds up to 20,000 r.p.m.[11]. Beams has succeeded in spinning electrically a hanging duraluminium rotor supported by an air-film bearing up to 60,000 r.p.m.[12]. For driving a heavy rotor at high speed, turbines appear to be the best means[13,14,15]. Oil-turbines have been chosen by us for the following reasons. There is no danger of contaminating the atmosphere around the rotor by gas from the turbine. The same compressor may be used for delivering the lubricating oil and the oil operating the damping bearings. The output of our oil-turbines compares favourably with that of air-turbines of similar power dimensions. In recent constructions the energy consumption of the oil compressor motor at a centrifuge rotor speed of 60,000 is 2·8 kW.

For the calculation of sedimentation constants and molecular weights, knowledge of the temperature in the rotating sample is necessary. In low-speed runs the temperature of the cell may with sufficient accuracy be taken as equal to the temperature in the thermostat bath surrounding the rotor chamber. In high-speed runs with the oil-turbine centrifuge, a radiation thermocouple placed very close (0 15 mm.) to the surface of the rotor near the cell hole registers the actual temperature of the cell.

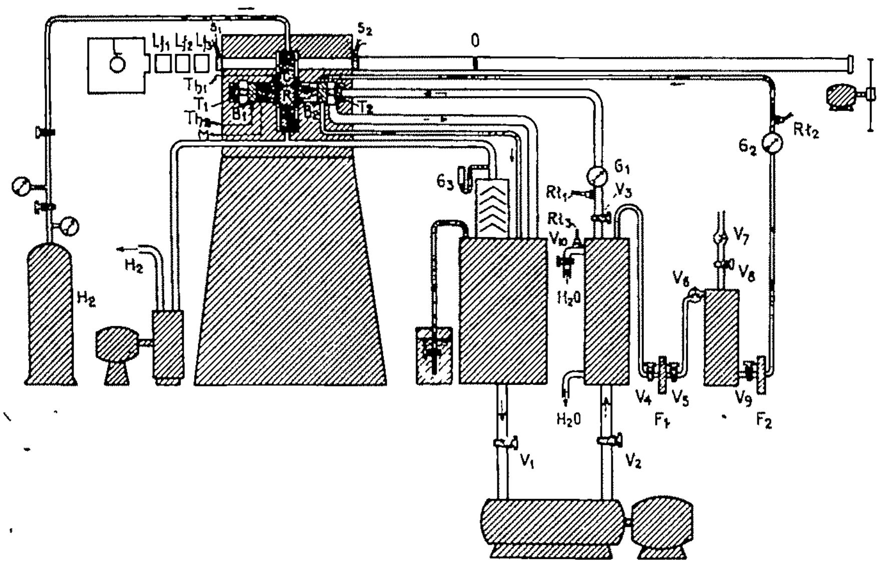

Fig. 4.

DIAGRAM OF THE HIGH-SPEED OIL-TURBINE ULTRA-CENTRIFUGE EQUIPMENT.

The angular velocity enters to the second power in the formulæ for sedimentation constant and molecular weight. The accurate determination of this quantity is therefore of great importance in ultra-centrifugal technique. In the case of direct drive by an A.C. motor, a measurement of the frequency of the electric current suffices, because with ball-bearings and the rotor running in hydrogen there is no noticeable slip. For the high-speed oil-turbine centrifuge, a stroboscopic tachometer was at first used. A more convenient magneto-electric method for speed measurement has recently been worked out. Part of the shaft of the centrifuge rotor is magnetized and surrounded by a two-pole soft iron armature provided with coils. This device constitutes a magneto-electric generator which produces an A.C. current of the same frequency as the revolutions per minute of the rotor. After amplifying, this current is fed to a vibration frequency meter or to an oscillograph.

The process of sedimentation is followed by optical means. Two different properties of the solute may be utilized for the determination of the concentration distribution in the rotating solution, namely, the light absorption and the refraction. In both cases the thickness of the layer of liquid studied necessitates long-focus lenses in order to avoid parallactic errors. When using the absorption method, photographic exposures of the sedimenting column are made from time to time by light of a wave-length absorbed by the solute. These pictures are then measured by means of a microphotometer and give the relation between concentration c and distance x from centre of rotation. Each molecular species is brought out as a step on the c–x curve (Fig. 1). The change in refractive index can be made use of in various ways. The simplest way is to apply the Tœpler *Schlieren*-method (A. Tiselius and K. O. Pedersen[16]). The different molecular species present are then recorded on the plate like the lines of a mass-spectrum (Fig. 2). A more accurate procedure to obtain the real concentration distribution in the sample studied is to take pictures of a finely ruled scale through the sedimenting column of solution by light of a wave-length which is not absorbed (O. Lamm[17]). By measuring the displacement of the lines, we get the concentration gradient dc/dx as a function of the distance from the centre of rotation. Each molecular species is therefore shown as a maximum on a curve (Fig. 3).

The resolving power of the ultra-centrifuge is given by the expression $\omega^2 xh$ where ω is the angular velocity, x the distance from centre of rotation and h the height of column of solution in the cell. Insufficient centrifugal force, $\omega^2 x$, may be compensated, therefore, by high column of solution, and vice versa. The method of rotor construction limits the maximum value for $\omega^2 xh$

attainable to $5 \cdot 8 \times 10^5$, which corresponds to a speed around 65,000–75,000 r.p.m., a rotor diameter of about 180 mm. and a height of column of solution of about 18 mm.

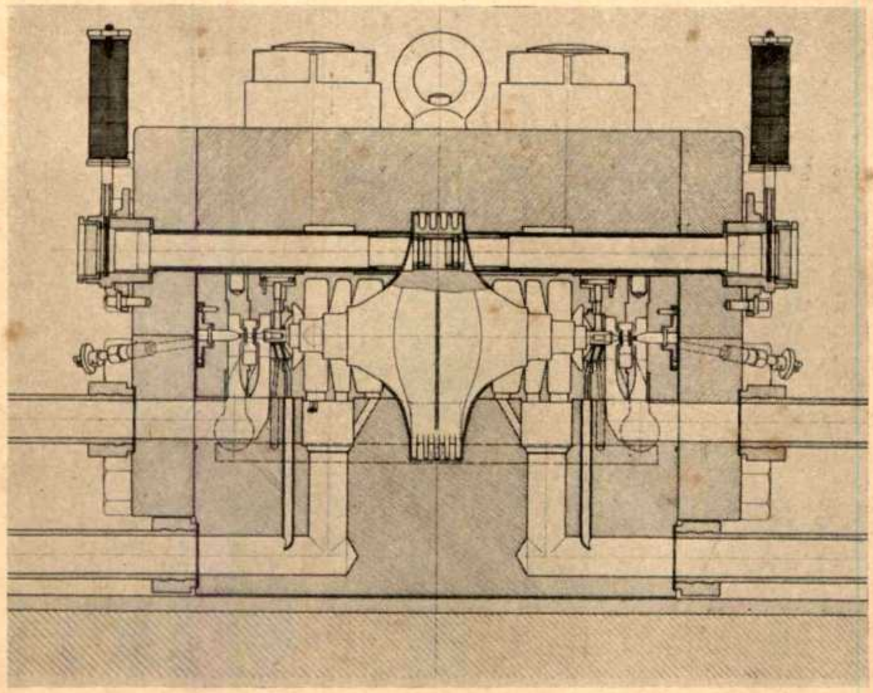

Fig. 5.
AXIAL SECTION OF THE OIL-TURBINE ULTRA-CENTRIFUGE.

The high-speed oil-turbine ultra-centrifuge equipment devised for sedimentation velocity measurements on substances of high molecular weight (in the case of proteins from 15,000,000 down to about 1,000) and for sedimentation equilibrium measurements on low-molecular substances is represented diagrammatically in Fig. 4. A detailed section of the centrifuge through the axis of rotation is shown in Fig. 5, and a photograph of rotor and cell in Fig. 6.

The rotor R (Fig. 4) is supported by horizontal bearings B_1 and B_2, and kept in rotation by the two small oil twin-turbines T_1 and T_2, one on each end of the shaft. Hydrogen is let in at the periphery and constantly pumped off so as to maintain a pressure of about 25 mm. Thermocouples Th_1 and Th_2 serve for temperature determinations of the bearings and the rotor. A beam of light from a mercury lamp L filtered through Lf_1, Lf_2, Lf_3 passes the cell C in the rotor on its way to the camera. The exposures are timed by means of the electromagnetic shutters S_1 and S_2. The stroboscope or the magnetic generator M enables the observer to measure the speed of the rotor. The pressure oil which feeds the turbines is produced by a special oil-compressor and cooled to a suitable temperature before entering the turbine chambers. The lubricating oil for the bearings passes through an oil filter and is controlled by the valve V_5. By changing the speed of the motor which drives the compressor and by operating the valve V_3, the pressure of the oil entering the turbines may be regulated so as to make possible measurements at any desired speed between 20,000 and 140,000 r.p.m. (corresponding to centrifugal forces 30,000–700,000 times gravity). The resistance thermometers Rt_1, Rt_2, Rt_3 and the manometers G_1, G_2, G_3 enable the operator to control temperature and pressure in the different parts of the machinery.

Fig. 7 shows the oil-turbine ultra-centrifuge with the upper part of the heavy steel casing lifted, laying bare the rotor and the turbine chambers. The cell with its sector diaphragm is in the vertical position, upside down. Behind the centrifuge is the lamp house and the filters. The two halves of the thick steel casing are held together by bolts of chromium-nickel steel firmly anchored in a

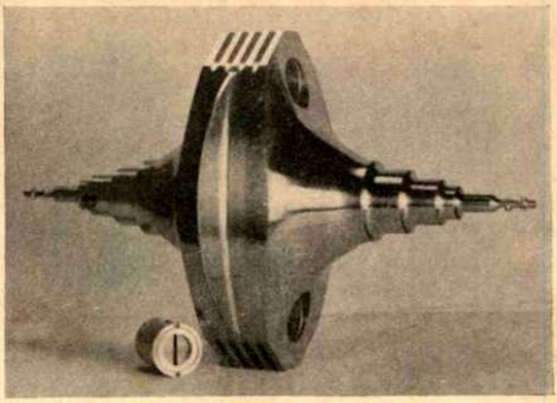

Fig. 6.
ROTOR WITH TURBINES AND CELLS FOR THE OIL-TURBINE ULTRA-CENTRIFUGE.

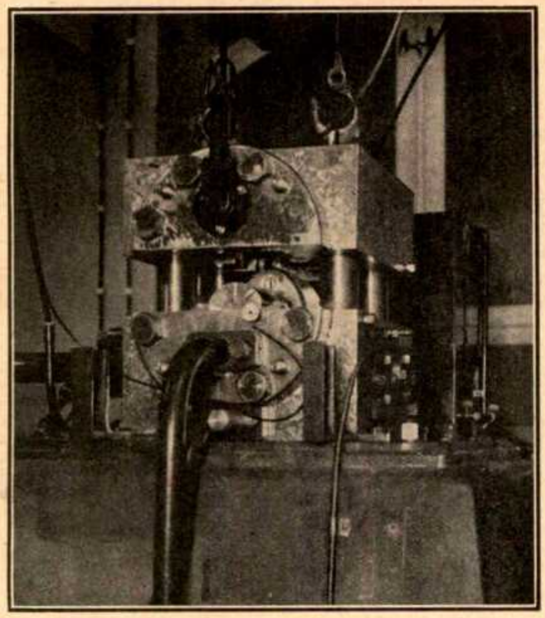

Fig. 7.

THE OIL-TURBINE ULTRA-CENTRIFUGE WITH THE LID RAISED.

concrete foundation. Fig. 9 is a photograph of the whole installation showing, from right to left, the lamphouse, the centrifuge on its foundation, the camera and the oil-coolers and containers ; in the foreground are the steps down to the machine pit where the oil-compressor, the oil filters and the vacuum pump are mounted.

INVESTIGATIONS ON PROTEINS

Among the various groups of high-molecular compounds the mass analysis of which has been attempted by means of the ultra-centrifuge, the proteins stand out as an especially interesting and peculiar class[7,18,19].

A very striking but rather unexpected property of protein solutions discovered by the ultra-centrifugal analysis is the perfect molecular homogeneity. This means that the solution of a certain protein is either uniform with regard to molecular weight or contains a limited number of different molecular species, as a rule in equilibrium with each other. Change in protein concentration, in *p*H, or in concentration of other solutes present may bring about dissociation or association.

If the sedimentation proceeds so quickly that no appreciable diffusion takes place during a run, the molecular homogeneity can be tested simply by studying the degree of sharpness of the receding boundary (Fig. 8).

An example of the behaviour of a high-molecular substance become non-homogeneous by slight denaturation is given in Figs. 10 and 11.

In cases where the sedimentation proceeds more slowly, so that noticeable diffusion occurs during a run, the homogeneity can be tested by comparing the theoretical sedimentation-diffusion curves with the observed ones (Fig. 12).

A homogeneity test may also be performed by means of sedimentation equilibrium measurements (Fig. 13). Here the molecular weight values should be independent of distance from centre of rotation.

The dependence of a protein on *p*H is exemplified by the stability diagram of *Helix* hæmocyanin (Fig. 14). At the isoelectric point the protein contains only one component, but on lowering or raising the *p*H, points are reached where a very small change in *p*H causes a great change in the

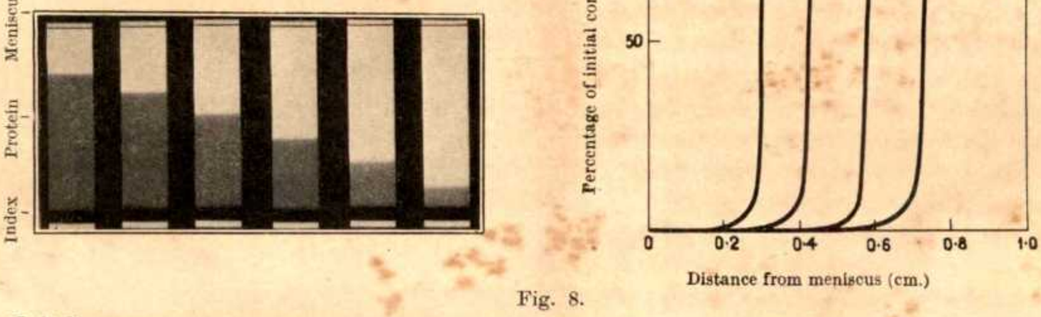

Fig. 8.

(*Left*) SEDIMENTATION PICTURES OBTAINED BY MEANS OF THE ABSORPTION METHOD ; AND (*right*) CURVES OF CONCENTRATION DISTRIBUTION FOR *Helix* HÆMOCYANIN at *p*H 5·5 ($M = 6{,}740{,}000$, $s = 98{\cdot}9 \times 10^{-13}$) ; CENTRIFUGAL FORCE 45,000 TIMES GRAVITY ; TIME BETWEEN EXPOSURES 5 MIN. THE SHARPNESS OF THE BOUNDARY AND STEEPNESS OF THE CURVES DEMONSTRATE THE HIGH DEGREE OF MOLECULAR HOMOGENEITY OF THIS PROTEIN (I.-B. ERIKSSON-QUENSEL[20]).

molecular state. The original molecule of weight 6,740,000 ($s = 98 \cdot 9 \times 10^{-13}$) dissociates step-wise into halves ($s = 62 \cdot 0 \times 10^{-13}$), eighths ($s = 16 \cdot 0 \times 10^{-13}$) and sixteenths ($s = 12 \cdot 1 \times 10^{-13}$). The *p*H-dissociation products represent perfectly homogeneous components[20]. The presence of divalent ions ($Ca^{\cdot\cdot}$, $Mg^{\cdot\cdot}$) causes a considerable change in the stability diagram of *Helix* hæmocyanin. Measurements of the Tyndall effect gave the first indication of this interesting phenomenon (J. Brosteaux[21]). An analysis by means of the ultracentrifuge (I.-B. Eriksson-Quensel) has shown that upon addition of 0·01 molar calcium chloride, the dissociation on the alkaline side of the isoelectric point does not become noticeable until a *p*H of about 9·5 is reached, where splitting of the molecule into halves and eighths takes place. Without $Ca^{\cdot\cdot}$ the dissociation starts already at *p*H 7·4.

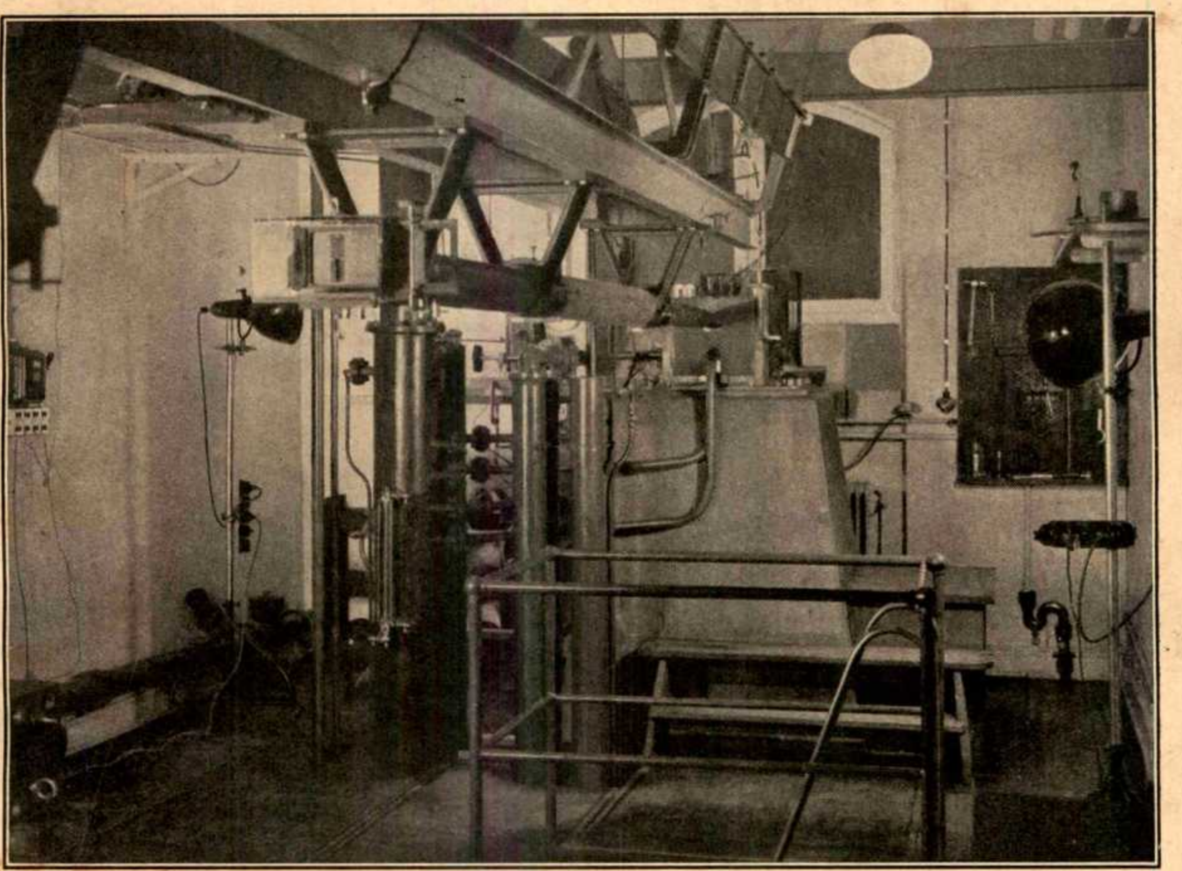

Fig. 9.

THE OIL-TURBINE ULTRA-CENTRIFUGE INSTALLATION.

The reversibility of the dissociation-association process influenced by hydrogen ion concentration is demonstrated by the following experiment. A solution of *Helix* hæmocyanin at *p*H 6·8 of sedimentation constant $98 \cdot 9 \times 10^{-13}$ (molecular weight 6,740,000) was brought to *p*H 8·0, where it contains three components with the sedimentation constants $98 \cdot 9 \times 10^{-13}$, $62 \cdot 0 \times 10^{-13}$, $16 \cdot 0 \times 10^{-13}$ (molecular weights 6,740,000, 3,370,000, and 842,000). The *p*H was then changed back to 6·8 and a sedimentation analysis performed. It was found that all the fragments of dissociation had completely united to form the original component of $s = 98 \cdot 9 \times 10^{-13}$ (molecular weight[20] 6,740,000).

High dilution often causes dissociation. Thus hæmoglobin is partly dissociated into half molecules upon dilution[29]. In dilute solutions of thyroglobulin there are present several dissociation products[23]. The addition of an amino acid or another protein often causes dissociation. Thus serum albumin may be split by adding clupein[42].

In certain cases even extremely small amounts of foreign substances may cause appreciable dissociation. Thus the addition of 0·001 per cent thyroxin gives rise to an appreciable dissociation of thyroglobulin (Fig. 15)[23].

The action of a dissociating compound on a protein is more or less specific. An amino acid which acts strongly upon a certain protein may have no effect on another protein, and vice versa.

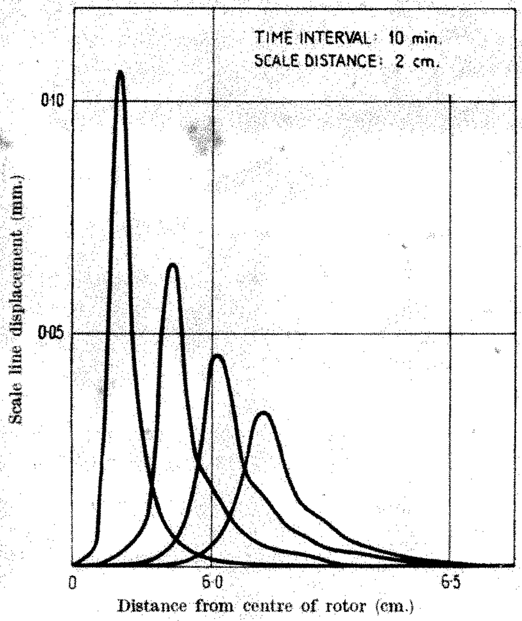

Fig. 10.

Sedimentation diagram obtained by means of the refractive index method from slightly denatured tobacco-mosaic virus protein at pH 9.5; centrifugal force 10,000 times gravity; time between exposures 10 min. (I.-B. Eriksson-Quensel [20a].

Thus arginin plus ammonium chloride dissociates serum albumin but not *Helix* hæmocyanin, while lysin plus ammonium chloride splits the latter protein but not the former. Guanidin chloride affects *Helix* hæmocyanin very strongly but has only a very slight effect on serum albumin. Clupein splits both, and arginin without ammonium chloride has no effect on either of them (K. O. Pedersen, I. B. Eriksson-Quensel).

High salt concentration may cause dissociation or association. In solutions of thyroglobulin ($s = 19{\cdot}2 \times 10^{-13}$; $M = 640{,}000$), the addition of 4 molar sodium chloride gives rise to a homogeneous association product of $s = 196 \times 10^{-13}$, corresponding to a molecular weight[23] of about 16,000,000.

The above survey has aimed at giving a general picture of the physico-chemical properties of the protein molecules, especially with regard to the influence of environment. In the following, a short summary of some of the results obtained in Uppsala for special groups of proteins will be presented.

The serum proteins are among those which have been most fully studied, but which still present notable difficulties. Serum albumin ($M = 67{,}000$; $s = 4{\cdot}5 \times 10^{-13}$) is found to be homogeneous both in sedimentation and electrophoresis. Serum globulin is complex. Molecules ($s = 7{\cdot}1 \times 10^{-13}$) of mass double that of serum albumin and reversibly dissociating into halves make up the bulk of it. Usually there is also present components of larger mass, among which the most prominent one has a sedimentation constant of 17×10^{-13} (v. Mutzenbecker[24], McFarlane[25]).

Fig. 16 shows the sedimentation pictures (*Schlieren*-method) for a pathological serum (amyloid-nephrosis) with three protein components clearly resolved and a fourth just beginning to show up at the meniscus.

In antitoxic sera the amount of globulin is very much increased. This rise in globulin content may be due to formation of molecules of the normal globulin mass ($s = 7{\cdot}1 \times 10^{-13}$) or molecules of mass corresponding to the sedimentation constant 17×10^{-13}. The former is the case with rabbit antibody globulin against pneumococcus type specific polysaccharides. The analogous horse antibody globulin is composed entirely of molecules sedimenting with the high constant (M. Heidelberger, K. O. Pedersen, A. Tiselius[26]).

The milk proteins are very complex and have not yet been completely disentangled. In cow's milk there are two albumins, the α-lactalbumin, of molecular weight 17,600 and sedimentation constant $1{\cdot}9 \times 10^{-13}$ and β-lactalbumin (also called Palmer's lactoglobulin) with $M = 39{,}000$ and $s = 3{\cdot}12 \times 10^{-13}$. Then there is a typical globulin of probably the double molecular weight, and several caseins[27].

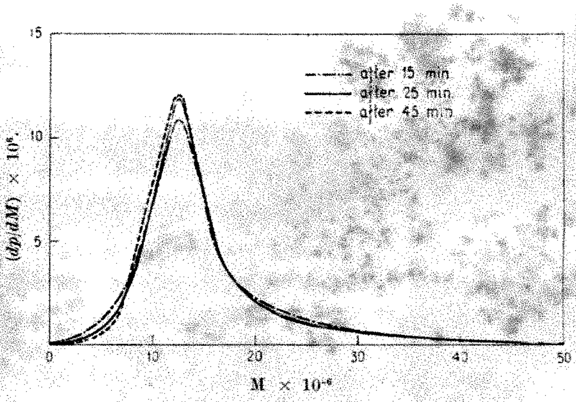

Fig. 11.

Molecular weight distribution curves for a slightly denatured tobacco-mosaic virus protein at pH 9·5 (I.-B.Eriksson-Quensel [20a]).

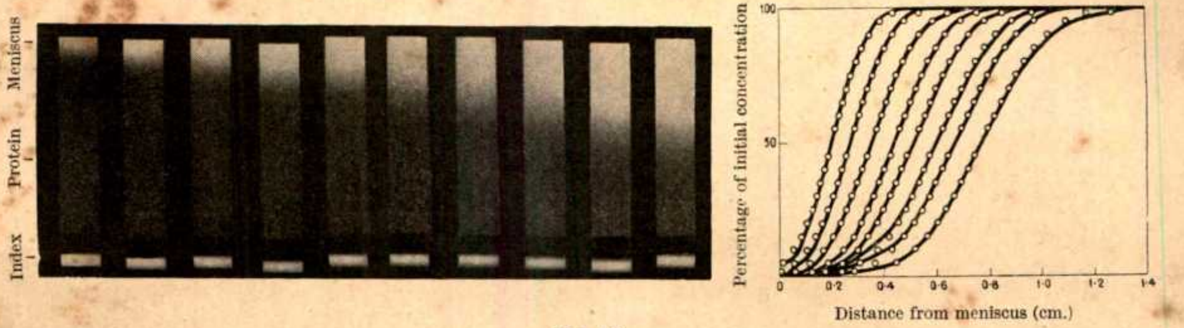

Fig. 12.

(*Left*) SEDIMENTATION PICTURES OBTAINED BY MEANS OF THE ABSORPTION METHOD; AND (*right*) CURVES OF CONCENTRATION DISTRIBUTION FOR α-LACTALBUMIN ($M = 17,600$; $s = 1{\cdot}9 \times 10^{-13}$; $D = 10{\cdot}6 \times 10^{-7}$); THE OBSERVED AND THE THEORETICAL VALUES AGREE, WHICH SHOWS THAT α-LACTALBUMIN IS HOMOGENEOUS WITH REGARD TO THE MOLECULAR WEIGHT; CENTRIFUGAL FORCE 310,000 TIMES GRAVITY; TIME BETWEEN EXPOSURES 40 MIN. (K. O. PEDERSEN).

The respiratory proteins are of great interest not only because of their unique physiological importance but also from a physico-chemical point of view. With regard to the nature of the prosthetic group, these proteins may be divided into four groups; red pigments (erythrocruorins, hæmoglobins), green pigments (chlorocruorins), brown pigments (hæmerythrins), and blue pigments (hæmocyanins). The first three types contain iron, the last one copper.

One of the most striking points is the fact that low sedimentation constants, and therefore, comparatively small molecular weights are (with one exception) only found for pigments enclosed in blood corpuscles, while the respiratory proteins which occur dissolved in the plasma are characterized by high sedimentation constants and consequently by large molecular weights. The corpuscles of all the vertebrates, with the exception of the species belonging to the lowest class, the Cyclostomata, contain a pigment of the same molecular weight 68,000 (hæmoglobin) with four atoms of iron per molecule. The protein from the Cyclostomata corpuscles has a molecular weight one quarter of that of hæmoglobin, and certain invertebrates have corpuscle erythrocruorin of one half the hæmoglobin weight (A. Hedenius[10]). The mammalian hæmoglobin dissociates reversibly into half molecules upon addition of certain amino-compounds such as urea, acetamide, formamide (J. Steinhardt[29]). As shown by Anson and Mirsky, it is possible to resynthesize hæmoglobin from globin and hæme, and this synthetic pigment has proved identical with the native protein with regard to molecular mass. The isoelectric point is slightly lower and the chemical processes used seem, therefore, not to have left it entirely unchanged (N. Gralén). Erythrocruorins of high molecular weight occur in the blood plasma of the crustacean *Daphnia* ($M = 400,000$), the snail *Planorbis* ($M = 1,600,000$) and certain worms, *Arenicola*, *Lumbricus* ($M = 3,200,000$)[30,31].

The hæmocyanins form an interesting class with a number of inner connexions. The molecular

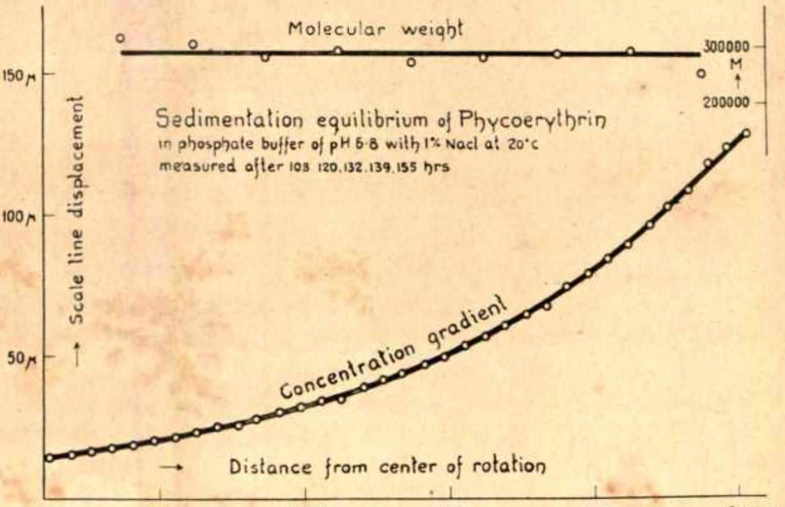

Fig. 13.

RELATION BETWEEN MOLECULAR WEIGHT AND DISTANCE FROM CENTRE OF ROTATION FOR PHYCERYTHRIN ($M = 290,000$) AT pH 6·8; THE CONSTANCY OF THE MOLECULAR WEIGHT THROUGHOUT THE WHOLE X-REGION DEMONSTRATES THE HOMOGENEITY OF THIS PROTEIN (I.-B. ERIKSSON-QUENSEL).

MOLECULAR CONSTANTS OF PROTEINS.

Protein	s_{20}*	D_{20}†	M_s	M_e	$M_{\text{calc.}}$	
Erythrocruorin (*Lampetra*)	1·87	10·65	17,100	19,000	17,600	I.-B. Eriksson-Quensel (31), A. G. Polson (32)
Lactalbumin α	1·9	10·6	17,500	—		R. A. Kekwick (33), A. G. Polson (32)
Cytochrom *C*	1·89	10·13	15,600	—		K. Andersson and K. O. Pedersen (22)
Myoglobin	2·04	11·25	17,200	17,500		A. G. Polson (32)
Gliadin	2·0	6·72	26,000	—		S. Arrhenius (34), A. G. Polson (35)
Zein	1·9	4·0	35,000	—	35,200 = 2 × 17,600	C. C. Watson, S. Arrhenius and J. W. Williams (36)
Erythrocruorin (*Arca*)	3·46	—	—	33,600		I.-B. Eriksson-Quensel (31)
Erythrocruorin (*Chironomus*)	2·00	—	—	31,400		I.-B. Eriksson-Quensel (31)
Lactoglobulin	3·12	7·27	41,800	37,900		K. O. Pedersen (37)
Pepsin	3·3	9·00	35,500	39,200		J. St. L. Philpot (38), A. G. Polson (32), I.-B. Eriksson-Quensel (39)
Insulin	3·47	8·20	40,900	35,100		B. Sjögren (40), A. G. Polson (32)
Bence-Jones α	3·55	—	—	35,000		B. Sjögren (41)
Bence-Jones β	2·85	7·33	37,700	—		K. Andersson and K. O. Pedersen (22), A. G. Polson (32)
Egg albumin	3·55	7·76	43,800	40,500		K. O. Pedersen (42), A. Tiselius and D. Gross (43)
CO-Hæmoglobin (horse)	4·5	6·3	69,000	68,000	70,400 = 4 × 17,600	T. Svedberg and R. Fåhraeus (44), A. Tiselius and D. Gross (43)
CO-Hæmoglobin (man)	4·5	6·9	63,000	—		K. O. Pedersen (42), A. G. Polson (35)
Serum albumin (horse)	4·5	6·17	70,200	66,900		P. v. Mutzenbecker (24), I.-B. Eriksson-Quensel (39), A. G. Polson (32)
Yellow Ferment	5·76	6·28	82,800	77,800		R. A. Kekwick and K. O. Pedersen (45), A. G. Polson (32)
Serum globulin (horse)	7·1	4·05	167,000	150,000	140,800 = 8 × 17,600	P. v. Mutzenbecker (24), I.-B. Eriksson-Quensel (39)
Phycocyan (*Ceramium*, diss. comp.)	6·2	4·58	131,000	146,000		I.-B. Eriksson-Quensel (39), A. G. Polson (32)
Phycoerythrin (*Ceramium*)	12·0	4·00	290,000	292,000	282,000 = 16 × 17,600	I.-B. Eriksson-Quensel (39), A. Tiselius and D. Gross (43)
Phycocyan (*Ceramium*, main comp.)	11·4	4·05	272,000	273,000		I.-B. Eriksson-Quensel (39), A. Tiselius and D. Gross (43)
Edestin	12·8	3·93	309,000	—		A. G. Polson (32)
Excelsin	13·3	4·26	294,000	—		A. G. Polson (32)
Amandin	12·5	3·62	329,000	—		A. G. Polson (32)
Erythrocruorin (*Daphnia*)	16·3	—	—	—	422,000 = 24 × 17,600	I.-B. Eriksson-Quensel (31)
Hæmocyanin (*Pandalus*)	17·4	—	—	397,000		I.-B. Eriksson-Quensel (20)
Hæmocyanin (*Palinurus*)	16·4	3·4	446,000	447,000		I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Hæmocyanin (*Helix pomatia*, diss. comp.)	12·1	2·23	503,000	—		I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Hæmocyanin (*Busycon*, diss. comp.)	13·5	3·29	379,600	—		I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Hæmocyanin (*Eledone*, diss. comp.)	10·6	2·25	440,000	—		I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Thyroglobulin	19·2	2·65	628,000	650,000		M. Heidelberger and K. O. Pedersen (46), A. G. Polson (32)
Hæmocyanin (*Nephrops*)	24·5	2·79	820,000	—	845,000 = 48 × 17,600	I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Hæmocyanin (*Homarus*)	22·6	2·78	752,000	803,000		I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Hæmocyanin (*Helix pomatia*, diss. comp.)	16·0	1·82	814,000	797,000		I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Hæmocyanin (*Helix nemoralis*, diss. comp.)	16·6	1·92	799,000	—		I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Erythrocruorin (*Planorbis*)	33·7	1·96	1,636,000	1,539,000	1,690,000 = 96 × 17,600	I.-B. Eriksson-Quensel (31), A. G. Polson (35)
Hæmocyanin (*Calocaris*)	34·0	—	—	1,329,000		A. Hedenius (28), I.-B. Eriksson-Quensel (20)
Hæmocyanin (*Octopus*)	49·3	1·65	2,785,000	—	2,960,000 = 168 × 17,600	I.-B. Eriksson-Quensel (20), A. G. Polson (47)
Hæmocyanin (*Eledone*)	49·1	1·64	2,790,000	—		I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Erythrocruorin (*Arenicola*)	57·4	—	—	3,000,000	3,380,000 = 192 × 17,600	I.-B. Eriksson (30)
Chlorocruorin (*Spirographis*)	55·2	—	—	—		I.-B. Eriksson-Quensel (39)
Hæmocyanin (*Rossia*)	56·2	1·58	3,316,000	—		I.-B. Eriksson-Quensel (20), A. G. Polson (32)
Erythrocruorin (*Lumbricus*)	60·9	1·81	3,140,000	2,946,000		I.-B. Eriksson (30), A. G. Polson (32)
Hæmocyanin (*Helix pomatia*, main comp.)	98·9	1·38	6,630,000	6,680,000	6,760,000 = 384 × 17,600	I.-B. Eriksson-Quensel (20), A. G. Polson (47)
Hæmocyanin (*Busycon*, main comp.)	101·7	—	—	—		I.-B. Eriksson-Quensel (20)
Hæmocyanin (*Busycon*, aggr. comp.)	130·4	—	—	—		I.-B. Eriksson-Quensel (20)

* In units of 10^{-13} † In units of 10^{-7}

weights of the hæmocyanin molecules found in the blood of a certain species are always simple multiples of the lowest well-defined component. Thus for the Malacostraca the relationship is 1 : 2 and for the Gastropoda 2 : 8 : 16 : 24. Moreover, the weights of all the well-defined hæmocyanin molecules seem to be simple multiples of the lowest among them. In most cases the hæmocyanin components of a certain species are interconnected by reversible, *p*H-influenced dissociation-association reactions. At certain *p*H values a profound change in the number and percentage of the components take place. The shift in *p*H necessary to bring about reaction is not more than a few tenths of a unit. Consequently the forces holding dissociable parts of the molecule together must be very feeble[20].

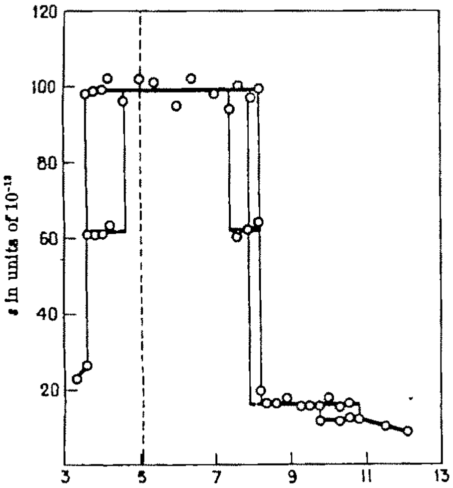

Fig. 14.

THE *p*H-STABILITY DIAGRAM FOR *Helix* HÆMOCYANIN; THE ISOELECTRIC POINT IS INDICATED BY THE DOTTED LINE (I.-B. ERIKSSON-QUENSEL[10]).

Not only the molecular weights of the hæmocyanins but also the mass of most protein molecules —even those belonging to chemically different substances—show a similar relationship. This remarkable regularity points to a common plan for the building up of the protein molecules. Certain amino acids may be exchanged for others, and this may cause slight deviations from the rule of simple multiples, but on the whole only a very limited number of masses seems to be possible. Probably the protein molecule is built up by successive aggregation of definite units, but that only a few aggregates are stable. The higher the molecular weight the fewer are the possibilities of stable aggregation. The steps between the existing molecules therefore become larger and larger as the weight increases. These statements are born out by the accompanying table (p. 1060), in which are collected recent data for the various constants of protein molecules as determined in Uppsala.

An examination of this table shows that the individual molecular weights within the groups differ considerably, but on the other hand it cannot be denied that a random distribution of molecular weights would give an entirely different picture. One might perhaps venture to compare

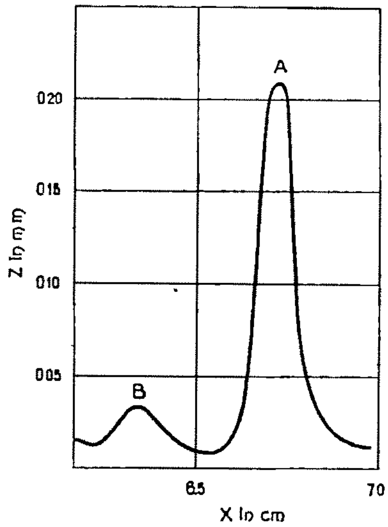

Fig. 15.

SEDIMENTATION DIAGRAM OF THYROGLOBULIN IN 0·001 PER CENT THYROXIN SOLUTION; THE RAPIDLY SEDIMENTING MAXIMUM, *A*, REPRESENTS NORMAL THYROGLOBULIN, *B* and *C* THE DISSOCIATION PRODUCT (H. LUNDGREN[11]).

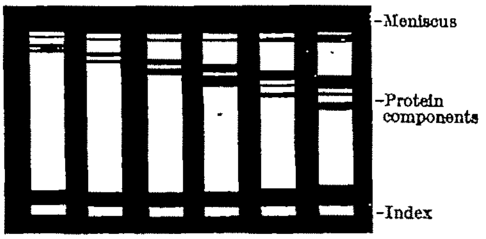

Fig. 16.

SEDIMENTATION PICTURES FOR AN AMYLOID-NEPHROSIS SERUM OBTAINED BY MEANS OF THE *schlieren*-METHOD SHOWING THREE PROTEIN COMPONENTS (K. O. PEDERSEN).

the regularities of this table with the whole number tendencies shown by the table of the atomic weights of the elements. In both cases there is an unmistakable regularity partly obscured by obvious deviations. As in the case of the periodic table of the elements, the underlying simple principle was not understood until quite recently (Aston's work on the isotopes); so perhaps the future will give us the key to a better understanding of the table of the molecular weights of the proteins and furnish the explanation for the regularities disclosed.

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Theory and Practice of Chemistry in the last Half Century"; Prof. R. V. Wheeler will read a paper on "The Problem of Dust in Coal Mines; and the Food Group will hold a symposium on "Fruit Juices", when papers will be read by A. Charley, Long Ashton Research Station, T. N. Morris, Low Temperature Research Station, Cambridge, and J. A. Reavell.

THE Eugenics Society has set up a Population Investigation Committee with Prof. A. M. Carr-Saunders as chairman and representatives from various societies, including one from the British Population Society, Mr. D. V. Glass acting as research secretary. He and Dr. C. P. Blacker have produced a pamphlet of thirty pages which discusses "The Future of our Population", issued by the Eugenics Society, 69 Eccleston Square, S.W.1, at the price of 6*d*. This introduces the subject on the basis of material supplied in the books of Carr-Saunders and Kuczynski, pointing out how present trends will affect future population decline. This is followed by a discussion of the reasons why families are being curtailed in the present generation, and ends with an appeal for financial support.

THE following appointments have recently been made in the Colonial Service: N. E. Davis, and W. G. Harper, forecasters, Meteorological Services, Bermuda; P. L. Mellier-Smith, inspector of mines, Malaya; H. O. Walker, European assistant, Meteorological Service, East Africa; A. G. G. Hill (senior geneticist, Department of Agriculture, Mauritius), director, East African Agricultural Research Station, Amani, Tanganyika; J. A. Cowan (pathologist, Penang), pathologist, Straits Settlements and professor of pathology, King Edward VII College of Medicine, Singapore; S. Bray (assistant inspector of mines), inspector of mines, Northern Rhodesia; A. D. Combe (field geologist), mining geologist, Uganda; K. A. Davies (field geologist), senior assistant geologist, Uganda; L. L. De Verteuil (late assistant agricultural officer, Leeward Islands), inspector of plants and produce, Gold Coast; A. E. C. de S. Gunasekera (assistant irrigation engineer), irrigation engineer, Ceylon; H. P. Rowe (district surveyor), chief surveyor, Survey Division, Lands and Mines Department, Tanganyika; F. G. Taylor (telegraph engineer, Railway Department), wireless engineer and broadcast officer, Sierra Leone.

PROF. OTTO HAHN, director of the Kaiser Wilhelm Institute for Chemistry in Berlin, has been made a corresponding member of the Bavarian Academy of Sciences.

PROF. A. CHEVALIER, professor of colonial agronomy in the National Museum of Natural History, Paris, has been elected a member of the Section of Botany of the Paris Academy of Sciences in succession to the late Prof. J. Constantin.

THE annual congress of the German Society of the History of Medicine, Natural Science and Technique will be held at Coblenz on September 3–6. Further information can be obtained from Dr. Artelt, Universitätsstrasse 3 b, Berlin, N.W.7.

A TRAFFIC clinic has recently been set up at Detroit for the elimination or improvement of dangerous drivers. Among the first hundred accidents studied, fourteen chauffeurs were too disabled to drive properly, seven were suffering from various psychoses and ten were mentally deficient.

THE twenty-fourth centenary of the birth of Hippocrates will be celebrated in the course of the summer by a cruise to Cos, Athens and Epidaurus organized by the Latin Medical Union, commonly known as Umfia. Further information can be obtained from Dr. Dartigues, Bureau de l'Umfia, 81 rue de la Pompe, Paris 16^e.

A CONGRESS of Medical Meteorology and Biometeorology will be held in Paris on July 4 under the presidency of Prof. Maurain, president of the Society of Medical Meteorology. Further information can be obtained from the General Secretary of the Society, Dr. Dujarric de la Rivière, 28 rue du Dr. Roux, Paris XV^e.

ACCORDING to the Central Statistical Department of the State Planning Commission of the U.S.S.R., the number of women employed in 1936 in the factories, in agriculture, transport, trade, public catering, health protection, education, etc., was 8,492,000, forming thirty-four per cent of the total number of employed workers. There were 15,338 women scientific workers, or little less than half the total medical practitioners in the country.

THE anti-noise campaign in New York, in which the Mayor, Mr. La Guardia, has taken an active part, began more than a year ago. In April 1936, the police issued 9,288 warnings, while summonses and arrests totalled 547. In May, legal enactments were adopted providing fees for offending. In November the police issued 15,661 warnings, and the number of arrests and summonses rose to 1,012. Motors continue to be the worst offenders, and radios come next.

THE Argentine Society for the Progress of Science awarded travelling fellowships during the year 1935 to Dr. Juan Carlos Speroni, to study the technology of wool in England, Dr. Santiago A. Celsi, for electrochemical investigations in the Institute of Physics and Chemistry at Madrid, and Dr. Jorge Thenon, to study psychiatry in Paris. In 1936 four more travelling fellowships were awarded respectively to Prof. Marcos A. Morinigo for studying American linguistics in Paris, Dr. Rodolfo Schwartz of Cordoba for the study of the bacteriology of tuberculosis and Dr. Ignacio Pirosky for the study of immunology at the Institut Pasteur in Paris, and Dr. Alberto Manso Soto for the study of bacteriology in England.

IN NATURE of May 29 a request was made for copies of NATURE for a boys' secondary school in London. Several offers have been received and the headmaster of the school informs us that his needs are now met.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1072.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Sidereal Time Periodicity of Cosmic Rays and its Phase Shift

WITH a coincidence apparatus—aperture in north-south direction 10°, east-west direction 40°—we have since July 1934 recorded continuously the intensity of the cosmic radiation (hourly records, sidereal time). The counters were arranged in the first series vertically one above the other, and later with 36 cm. lead between the counters in vertical position of the plane of the counter axes, and the plane inclined 24°, 50° and 64° towards the south. The material of the total number, 720 days of observation was subjected, after reductions for barometer and terrestrial magnetic field effects, to harmonic analysis, whereby we determined the time and the amplitude of the first harmonic wave. Arranging the time of the occurrence of the maximum in accordance with the total thickness of the absorbing matter, we get as a first approximation a straight line connexion (Fig. 1). The equation of the line of regression has the following form:

$$y = 29^{\text{h}}\,40^{\text{m}} - 0{\cdot}90\,E \pm 1^{\text{h}}\,10^{\text{m}}$$

(where E is the thickness of the absorbing material in metres of water), for the measurements in which the counters were filled with air (efficiencies about 27 per cent); and

$$y = 33^{\text{h}}\,4^{\text{m}} - 0{\cdot}94\,E$$

for counters filled with argon plus alcohol (efficiency about 95 per cent).

We are most probably confronted with a maximum, corresponding to a definite direction, and with its phase shift under the influence of the earth magnetic field. From the inclination of the line it can be deduced that negatively charged particles are involved in it.

The inclination of the line of regression for air-filled counters is nearly the same as for argon plus alcohol-filled counters, but is displaced sideways with respect to it. This is probably due to the argon plus alcohol-filled counter reacting in a higher degree upon the softer components. The circumstances that the maximum for directions so widely different fits so well a straight line relationship and, moreover, that the amplitudes are on the average nearly equal, suggest the conclusion that the wave is not caused by anisotropy in outer space (for example, a greater density of radiating matter away from the direction of the Milky Way) but that its source should be looked for in an effect of the galactic rotation pointed out by Compton and Getting[1]. In this case the time of the maximum for undeflected rays would be at $20^{\text{h}}\,40^{\text{m}}$ of the foregoing day. They have calculated the magnitude in the increase of the intensity, which one should expect for a coincidence apparatus through the increase in the number n of the incoming particles:

$$\frac{\Delta n}{n} = \left(\frac{1}{(1-\beta)^{3}} - 1\right) F\,,$$

where $F = \frac{1}{2}\,(\cos\varphi_{\text{max.}} - \cos\phi_{\text{min.}})$, ϕ is the angle between the observer's zenith and the direction of motion and $\beta = 0{\cdot}001$ speed of the motion. In our latitudes (47° 30′ N.) and with the inclinations used—if we neglect the deviation in the north-south direction caused by the earth's magnetic field—we find for the average value of F, $0{\cdot}6$; and hence for the amplitude of the wave to be expected, $\pm\,0{\cdot}18$ per cent. The experimental results, however, lead to a value of about $\pm\,0{\cdot}9$ per cent. This disagreement can probably be met by the following considerations. From our measurements of the diurnal variation[2], performed with the same counter arrangements, an increase in the horizontal intensity of the earth's magnetic field by 10^{-5} gauss involves a decrease in the intensity of the radiation of about $0{\cdot}06$ per cent. For every point along the path of any charged particle in the earth's magnetic field, the radius of the curvature is (for high energies) proportional to E/H, where E is energy of the particle, and H is intensity of the magnetic field. So long as the relative changes are small, the effect of the decrease of the magnetic field is identical with an effect caused by an increase in the energy of the incoming particle:

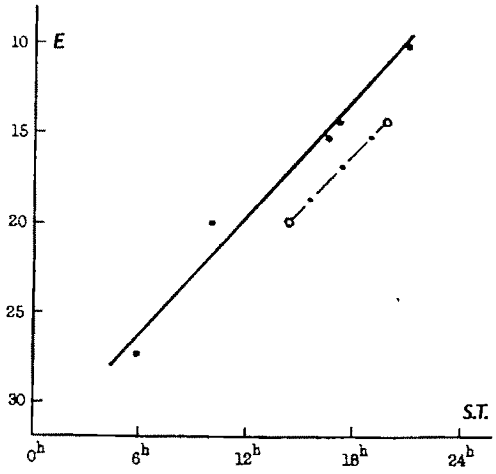

Fig. 1.

RELATION OF TIME OF THE MAXIMUM OF THE FIRST HARMONIC WAVE (SIDEREAL TIME) TO THE THICKNESS OF THE ABSORBING MATERIAL (E). SOLID CIRCLES FOR AIR-FILLED COUNTER, OPEN CIRCLE FOR ARGON PLUS ALCOHOL-FILLED COUNTER.

$$\frac{d(\Delta J/J)}{d(\Delta H/H)} = -\frac{d(\Delta J/J)}{d(\Delta E/E)} = -12\,; \quad \frac{\Delta J}{J} = 12\,\frac{\Delta E}{E}$$

due to the galactic-rotation effect the change in the energy is of the order $\frac{\Delta E}{E} = \frac{1}{1-\beta} - 1 = 10^{-3}$; so that the amplitude of the sidereal-time wave will be:

$$\frac{\Delta J}{J} \cdot F = 12\,\frac{\Delta E}{E} \times 0{\cdot}6 = 0{\cdot}7 \text{ per cent.}$$

Adding to it the expected amplitude according to the calculations of Compton and Getting (± 0·18 per cent), we get as a result an amplitude of about ± 0·9 per cent, in good agreement with the experimental values.

It should be mentioned that for other counter arrangements, or for an ionization chamber—since the sidereal time wave depends largely on the magnetic effect—the amplitude is as likely to be smaller as larger. By coincidence apparatus the predominant part of the amplitude is proportional to the magnetic effect; for harder rays (greater filtering) the magnetic effect will be smaller, and in accordance with it, the amplitude of the sidereal time wave should also be smaller; this conclusion seems to be detectable also in our measurements, as the amplitude in the direction 64° was only ± 0·5 per cent (but the deflection in the north-south direction should also be taken into consideration in determining the value of F). In the case of the ionization chamber, the diurnal variation[3], and hence the magnetic effect, is much smaller, so that here the effect calculated by Compton and Getting is predominant, and the sidereal time wave will have a much smaller amplitude.

The measurements were made through the kindly assistance of the Hungarian Council for Natural Science and the Széchenyi Scientific Society.

J. BARNÓTHY.
M. FORRÓ.

Institute for Experimental Physics,
University of Budapest.
April 13.

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[2] Barnóthy, J, and Forró, M, *Z. Phys*, **104**, 534 (1937)

[3] Hess, V F., and Graziadei, H Th, *Ter Mag Atm Elec* (March 1936).

The Continuous β-Ray Spectrum

QUANTUM mechanics deals with object systems composed of only a few particles out of the total number of particles in the universe. The particles of the local object system, which may be an atom or atomic nucleus, are supposed to be incapable of dropping into vacant energy levels in the background consisting of the unspecified particles of the universe. Also an unspecified particle of the background is supposed to be incapable of falling into one of the vacant levels of the local specified system. As Eddington[1] has pointed out, this means that quantum mechanics *postulates* that the levels of the background are all below the ground-level of the local object system, and further, that all the levels in the background are occupied by one particle, a neutral scalar particle in Eddington's theory, in each level in accordance with the exclusion principle. The *limit* energy of the unspecified background particles corresponds to the *threshold* energy of the local specified system. The background forms a uniform isotropic 'comparison fluid' which is postulated by our statement of the quantum theory.

The disintegration β-particles are believed to arise from the transformation of a neutron into a proton and an electron inside the nucleus. In order to conserve spin and energy, since the β-particle spectrum is continuous, the existence of a neutrino has been assumed.

Let us suppose that a neutron in an upper energy level of the nucleus reverts to an unspecified particle of the background. To make room in the background for this particle, one of the unspecified background particles must be specified, and so it becomes a particle in the object system, that is, the nucleus. Let the background particle be specified as a proton in a lower energy level of the nucleus. The energy lost by the nucleus is now resident in the background and can be employed in raising an unspecified particle of the background to the limit energy (that is, the threshold energy of the object system), where it becomes specified as an electron and is endowed with kinetic energy equal to the energy change in the nucleus less the amount of energy required to raise the particle to the limit level.

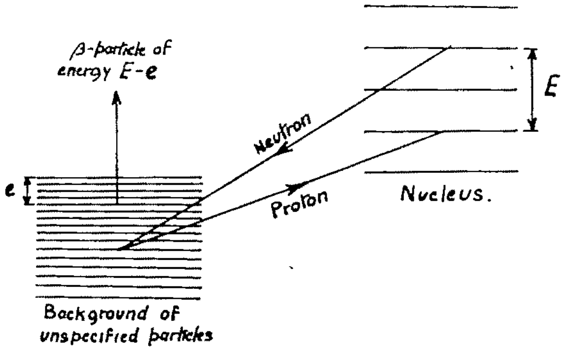

Fig. 1

Since the energy levels in the background just beneath the limit energy are practically continuous, for they have quantum numbers of the order of 10^{28}, the β-particle spectrum will be continuous. Since the electron comes from the background it will have the requisite spin. The process suggested above is shown diagrammatically in Fig. 1. It should be added that Eddington has shown[2] that the emission of an electron does not leave a vacant level in the background.

F. L. ARNOT.

University,
St. Andrews.
April 28.

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[1] Eddington, "Relativity Theory of Protons and Electrons", p. 261 (Cambridge, 1936)

[2] Eddington, *ibid.*, p 267.

Supraconductors of Small Dimensions

MENDELSSOHN[1] has suggested that the high threshold value of supraconductive alloys and impure metals might be confined to regions of very small dimensions. In connexion with subsequent experiments[2], it was pointed out that for thermodynamical reasons there might exist a causal relation between small dimensions and high threshold value, and that supraconductivity might persist to a higher field strength in sufficiently fine wires than in the massive metal at the same temperature. This assumption is supported by results obtained in Toronto[3] on supraconductive films deposited on another metal. Owing to the possibility, however, that in this case the phenomena may have been influenced by the formation of an alloy at the boundary of the two metals, definite proof cannot be obtained by these experiments.

Conductivity experiments on fine lead wires in a longitudinal magnetic field at 4·2° K. have now been carried out. The specimens were made by the Taylor process from pure lead (99·999 per cent) and annealed. The largest diameter at which a change of threshold value (that is, the field strength at which the first resistance appears) was found is 14·2 μ. From this size downwards, however, the threshold value increased with decreasing diameter of the wire as can be seen from Fig. 1. In the smallest wire (5·6 μ) the threshold field exceeded the normal value by 4·08 per cent. Hysteresis phenomena were observed at the return to the supraconductive state.

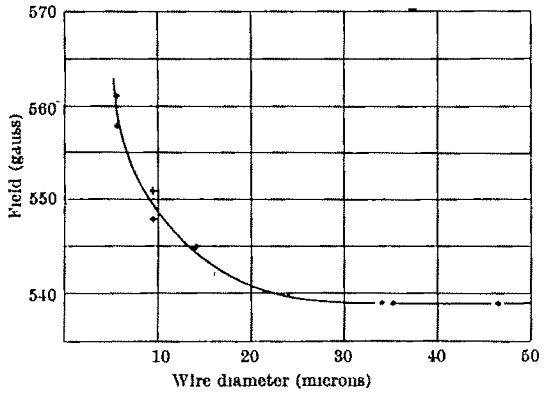

Fig. 1.

THRESHOLD FIELDS OF FINE LEAD WIRES AT 4 21° *K*.

This result shows that the depth to which a magnetic field penetrates a supraconductor at the surface cannot be neglected as soon as the size of the supraconductor becomes of the order of 5×10^{-4} cm., thus indicating a depth of penetration of the order of 10^{-5} to 10^{-4} cm. In connexion with the calculations of H. London[4], this would mean that the number of supraconduction electrons is of the order of Avogadro's number. However, more experiments, especially on the free energy of supraconductors, have to be carried out before definite conclusions concerning this last point can be drawn.

R. B. PONTIUS.

Clarendon Laboratory,
Oxford.
May 11.

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[1] Mendelssohn, *Proc Roy. Soc.*, A, **152**, 34 (1935)

[2] Mendelssohn and Moore, *Phil Mag.* (7), **21**, 532 (1936). Mendelssohn, Moore and Pontius, "Reports of the Seventh International Congress of Refrigeration", **1**, 431, 1937.

[3] Misener, *Canad. J Research*, **14**, 25 (1936) Misener, Grayson Smith and Wilhelm, *Trans. Roy. Soc Canada* (3), **29**, 13 (1935).

[4] London, H., *Proc. Roy. Soc.*, A, **152**, 650 (1935).

Sedimentation Equilibrium in the Simplest Air-driven Tops

IT has been highly desirable to develop a simple device everywhere available for accurately measuring sedimentation equilibrium of particles of all sizes from the smallest molecules in solution to the largest colloids or filter-passing organisms. We have used one method of limited scope throughout the past year for measuring the molecular weight of sucrose within 5 per cent in a one-piece hollow air-driven rotor[1].

We have more recently perfected for universal use a rotor consisting of two pieces of steel and a rubber sac in which is laid a pile of 100 ordinary annular washers of coin silver containing 10 per cent copper, and each 0·003 in. thick. The washers are alternately wide and narrow, the outside diameter being the same in all cases. They are held pressed together so that the liquid between the wide washers is immobilized in annular layers, 0·003 in. thick and several millimetres deep. Sedimentation equilibrium is set up in this immobilized liquid in any desired centrifugal field up to a few hundred times gravity.

However, the immobilized liquid is inaccessible. The simple device for studying it is to have a thin layer of excess liquid completely mobile and convecting, lining the cylindrical space within the pile of washers. This liquid is necessarily identical in composition with the most dilute portion of the sedimented liquid. Knowing the speed, the composition of the liquid originally put into the rotor, and the dimensions of the latter and of the washers therein, it is only necessary after the rotor is stopped to withdraw a sample of the supernatant mobile liquid for analysis in order to determine the molecular weight of any molecules or particles of uniform size. Sucrose has given a molecular weight 331 and 339 instead of the theoretical 342. Full details are being published elsewhere.

Another variant in design permits sampling of the liquid in contact with the outside radius of the immobilized liquid as well, to test whether the molecules of particles are all of one size.

JAMES W. MCBAIN.
CLAUDIO ALVAREZ-TOSTADO.

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Stanford University,
California.

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[1] See McBain, NATURE, **135**, 831 (1935), and McBain and Stuewer, *Kolloid-Z.*, **74**, 10 (1936), a specimen of the latest model was deposited with Prof. Dr. Wolfgang Ostwald, Kolloidchemische Gesellschaft, Leipzig, in July 1936.

Automatic Plotting of Electron Trajectories

AN apparatus developed independently in this laboratory plots trajectories of charged particles in potential fields entirely automatically. A similar scheme has recently been reported by Gabor[1], but the apparatus described below has certain differences and perhaps advantages.

The basic principle of both systems is the same; namely, the plotting of a trajectory by adjusting the radius of curvature at each point of the path to the value $2V/E_n$, where V is proportional to the total kinetic energy of the particle and E_n to the force acting normal to the path.

In the apparatus here, both these quantities are measured by an electrode unit consisting of two platinum wires 0·005 in. in diameter and spaced about 0·005 in. apart, the leads from which are connected to the primary of a specially designed shielded transformer. The centre tap from the primary goes to the input of an amplifier used for measuring V, while the secondary is connected to an amplifier which measures E_n. The probe is mounted on a carriage, shown in Fig. 1, which rolls on a piece of plate glass placed directly over the electrolytic tank. A rigid connexion between probe and carriage is formed by a U-shaped bar, one end of which is attached to the carriage, the probes being mounted at the other end, under the glass plate. The pencil is placed directly over the probes. This permits the probe and carriage to move over the entire area of the tank without being obstructed by the glass plate. The paper on which the path is to be recorded is laid on the glass. Moving parts are thus reduced to a minimum, the probes, while rigidly attached to the carriage, are always aligned so as to measure the gradient perpendicular to the trajectory, and the mechanical and frictional difficulties associated with pantographs and parallel links are avoided.

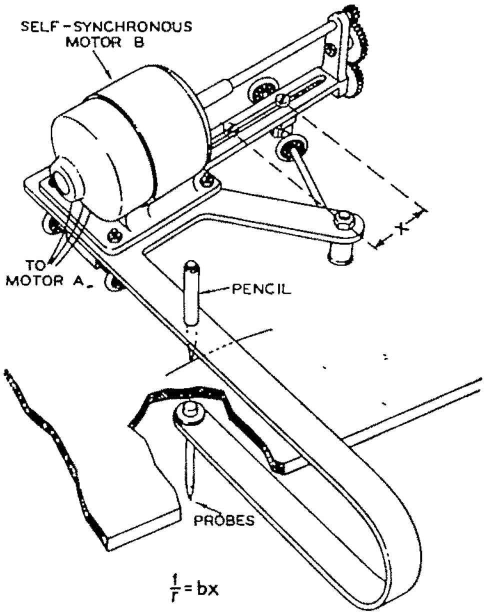

Fig. 1.

V and E_n are measured by null methods on Kohlrausch slide-wire potentiometers. An electric motor controlled by an amplifier is coupled to each potentiometer and adjusts it automatically to the null position. The accuracy of this automatic setting is approximately 3 parts in 10,000, which is higher than the overall accuracy of the system at its present stage of development. The quotient E_n/kV is obtained on a third automatically driven potentiometer using the circuits shown in Fig. 2. The displacement of the drumhead of the third potentiometer is translated directly to the movable axle of the carriage by means of a pair of self-synchronous motors, one coupled directly to the motor (No. 3) which drives the potentiometer, and the other mounted on the carriage, coupled to a lead screw which varies the displacement X. A method of accounting for initial velocity is indicated in the diagram.

The carriage itself is driven slowly (about 1 mm. per second) along the trajectory by a small electric motor. The process of plotting a trajectory is thus continuous and completely automatic.

The accuracy of the machine is at present limited by the measurement of E_n, which is in error by ± 1–2 per cent. A typical example of the present overall performance is the following: A uniform field was produced by applying 5 volts at 420 cycles between plane parallel electrodes 100 cm. apart in the electrolyte (water). A trajectory was traced starting at $V/V_0 = 0{\cdot}085$ (V_0 = total voltage across the tank), at such an angle that the predicted curve was $y = 1{\cdot}93x + 0{\cdot}138x^2$. The path actually drawn could be accurately represented by $y = 1{\cdot}91x + 0{\cdot}132x^2$ (x varied from 0 cm. to 13 cm.). A retraced path produced by moving the carriage back again deviated by 1·5 mm. from the original at the starting point. As the development is still in progress, these figures must not be regarded as final.

The significance of the constant k is of interest. $k = 1$ signifies that $Ve = \frac{1}{2} mv^2$, and $E_n e = mv^2/r$ in accordance with classical dynamics. If $k = 1$ the transverse acceleration is different from the classical value. Two cases of practical interest in which this is true are, respectively, motion in a transverse magnetic field, and motion at relativistic speeds. By properly adjusting the value of k during the description of a trajectory, either or both these conditions can be taken into account.

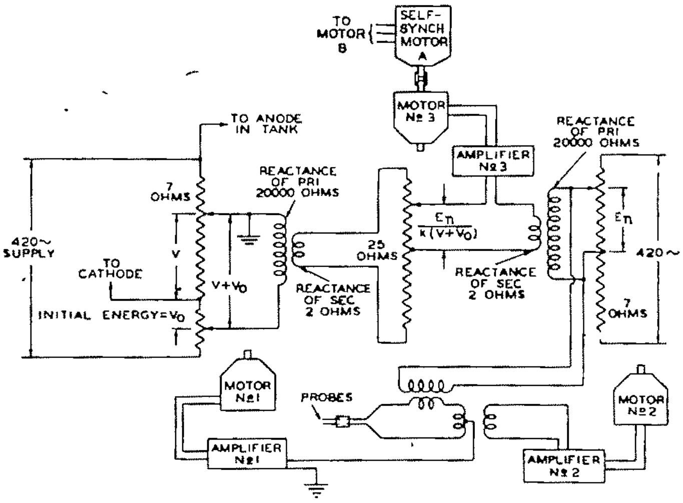

Fig. 2.

DAVID B. LANGMUIR.

RCA Manufacturing Co., Inc.,
Radiotron Division,
Research and Development Laboratory,
Harrison, New Jersey.
April 3.

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[1] Gabor, D., NATURE, 139, 373 (Feb. 27, 1937).

Phosphorus Metabolism in Normal, Rachitic and 'Treated' Rats

In a letter to Nature[1], Chievitz and Hevesy made a provisional communication on the use of radioactive indicators in the study of phosphorus metabolism in rats. In a recent paper to the Royal Society of Copenhagen[2], a detailed account of these investigations was given. Since 1936, we have been making experiments on phosphorus metabolism in normal, rachitic and 'treated' rats, utilizing also a radioactive phosphorus isotope as an indicator[3] Although the detailed figures will be published shortly in the *Proceedings of the Royal Academy* at Amsterdam, we think a brief review into our experiments may be of general interest.

In six series with about sixty rats, we tried to investigate the absorption, retention and deposition in bone of normal, rachitic and 'treated' animals. The 'treated' rats are those rachitic rats, which received a dose of halibut oil a few hours before the oral administration of the radioactive isotope.

In our experiments the 'labelled' phosphorus was administered as sodium phosphate in an aqueous solution of *p*H 6–7. For that purpose, in four series, a fixed quantity of the radioactive solution was inserted by an exactly calibrated pipette into the stomach of the rat through a small stomach tube. In the fifth and sixth series the radioactive solution was injected in the tail vein.

A certain time after the administration of the active sodium phosphate—in our experiments after 1, 2, 8 and 8½ hours—the rats were decapitated and then quickly sectioned. The œsophagus was ligatured near the pro-stomach, whereas the ileum was doubly ligatured close to the cæcum. Then the œsophagus was cut orally to the ligature, the ileum between the two ligatures. The limb bones were then dissected and cleaned, and the residue of the body with the head was collected. Now the preparations of the several organs to be measured were made. The determination of the radioactivity of the samples of blood, small and large intestine, fæces, urine, bones and residue was done with the compensation ionization chamber, whereby the ionization current produced by the radioactive preparations was compared each time with the ionization current of a constant source[4].

The first series of experiments, in which the rats were decapitated after one hour, showed that the blood in normal and rachitic rats contains scarcely any radioactive phosphorus, perhaps a little in the rachitic rats, whereas the skeleton contains sometimes a considerable amount. The 'treated' rats, on the contrary, contain a large quantity of the labelled phosphorus in the blood. The rapid entrance of the phosphorus isotope into the bone is perceptible as well in the normal and rachitic rats as in the 'treated' rats[3].

In the second series the rats were decapitated two hours after the administration of the active sodium phosphate. The radioactivity of the residue was also determined, and it was found that we could recover fully the whole of the quantity of the radioactive isotope administered. So our technique is reliable. But significant differences between the three groups of rats could not be found. The variation in the figures is too large to permit reliable conclusions.

Therefore in the third series the rats were decapitated after 8 hours, and here we think we can see small differences in the distribution of the labelled phosphorus in the body of the three groups. The deposition in normal rats averaged 55 per cent, whereas in rachitic rats the deposition of the active phosphorus averaged 75 per cent. These figures also show a large variation, so that we are convinced that many experiments are necessary to make a significant difference certain. This fact is clearly shown in the fourth series; the rats were decapitated after 8½ hours; but we could not confirm the results of the third series.

In the fifth and sixth series the active phosphorus was injected into the tail vein. Here it is to be noted that, one hour after the injection, a considerable amount of the labelled phosphorus could be detected in the small intestine.

Summarizing, we can say that the distribution in the organism of the active phosphorus could be followed up easily. Of the labelled phosphorus administered, nearly 100 per cent could be recovered in our experiments. Both by administration with the stomach tube, and by injection in the tail vein, a very rapid entrance of the active phosphorus into the bone was perceptible. Furthermore, it was observed that one hour after the injection into the tail vein, a considerable amount of the radioactive phosphorus was re-excreted into the small intestine. This re-excretion can only happen with the digestive juices, after the labelled phosphorus had been moved with the blood stream and deposited in the several organs. So far as the gross absorption is concerned, that is the difference between the quantity of phosphorus administered and the quantity present in the stomach and small intestine after a certain period, we could not see any difference in the period between 1 and 8 hours after the administration in the normal, rachitic and 'treated' rats. The same can be said about the re-excretion into the gut. A characteristic mode of action of vitamin D on the absorption or re-excretion into the gut from the administered phosphorus could not be demonstrated.

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April 28.

[1] Chievitz, O , and Hevesy, G , Nature, 136, 754 (1935)

[2] Chievitz, O., and Hevesy, G , *Kgl Danske Vid. Selsk., Biol Medd* , 13, 9 (1937).

[3] Dols, M J L., VI Weltgeflugelkongress, Berlin-Leipzig, *Kongressber.*, 3, 198 (1936)

[4] Sizoo, G J., and Koene, C P , *Physica*, 3. 1053 (1936).

Œstrogenic Activity of *p*-Hydroxy Propenyl Benzene (Anol)

Following the publication of our letter in Nature of April 10, p. 627, concerning the high œstrogenic activity of anol, we have received information from some workers who have confirmed our observations, and from some others who have been unable to demonstrate activity with doses very much greater than those described by ourselves.

A re-investigation of the problem has indicated to us that some batches of apparently pure anol, melting point 93°, are highly active, whilst others are relatively inactive. Prof. W. Schoeller, of the Haupt Laboratorium, Schering Kahlbaum A.G., Berlin, has very kindly shown us his experimental results on this problem, and he has demonstrated that the mother liquor from chloroform crystallization of anol contains a highly active substance. We ourselves have repeated this, and by the distillation of material from the chloroform mother liquor have obtained a fraction which distils from this material at a temperature between 160° and 230° C. at 20 mm. and is highly active.

That this activity is not derived from some impurity in the inactive starting material (anethole), is demonstrated by the following experiment. Two grams of anol, which was completely inactive in doses of 10 mgm., was heated with alcoholic potassium hydroxide for 15 hours at 180°–200° C. After removing the alcohol, the alkaline solution was acidified and a brownish oil was precipitated which partly solidified at room temperature. From this crude product, it is possible to isolate a highly active fraction.

From this it would appear that the high activity originally described by us was due to some substance from the mother liquor and separating occasionally with the anol. The problem is extremely complex since large doses—for example, 100 mgm.—of all preparations of anol are active. This in itself is not surprising, since we have demonstrated that *p*-propyl phenol is active in doses of 100 mgm. It would appear, therefore, that there must be present in the mother liquor a substance of such a high degree of activity that its presence in some batches of anol is not sufficient to lower their melting point. The activity therefore of some batches of anol must be two-fold: first, an activity in the region of 100 mgm. per rat dose due to anol itself; and secondly, the very high degree of activity due to the presence of the unknown substance from the mother liquor. Anol polymerizes with the greatest of ease, and it is possible that the active substance is a polymer.

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Production of Local Depressions in the Development of *Drosophila* Pupæ

IN a previous paper[1], which is now in the press, I have shown that the respiration of the pupæ of *Drosophila melanogaster* is depressed by carbon monoxide, and that the effect is, to a certain extent, reversible by light. (This latter fact may be interpreted as a dissociation, under the influence of light, of the chemical compound, which carbon monoxide forms with the iron-containing respiratory enzyme.) These findings make it possible to apply Runnström's device[2], which he used to obtain local inhibition of the cleavage process in *Ciona* eggs. The apparatus, constructed by Prof. J. Runnström, consists of a microscope with a strong condenser, through which a narrow beam of intense light can be focused on the stage of the microscope. If a living object is put under the microscope in a carbon monoxide atmosphere (for example, in a Carrel dish, filled with the suitable gas mixture), and part of it is illuminated with the beam, while the rest is kept shielded from light, its respiration should be more intense in the regions illuminated, than in the regions in the dark. Thus the apparatus is to a certain extent the reverse of the so-called ultra-violet point radiation, by which local defects can be produced with a narrow beam of ultra-violet light.

Following the suggestion of Prof. Runnström, the method was applied to developing *Drosophila melanogaster*. (The experiments were started in the Department of Experimental Zoology, University of Stockholm, and continued in this laboratory, where they are still going on.) After several unsuccessful attempts, it was found that early stage pupæ (less than 40 hours from pupation, when reared at constant temperature, 25° C.), in a suitable gas mixture (10 per cent oxygen and 90 per cent carbon monoxide), can be affected locally in their development by this method. Almost all external characters of superficial nature seem to be affected. If, for example, the treatment is applied laterally in such a way that one side of the pupa is illuminated and the other kept in the dark, the legs are found in some cases (if the treatment has begun early enough) shorter on the side kept in the dark. Similarly the wing is somewhat less pigmented and less advanced in growth (less folded), etc. The most striking differences are found in the bristles and in the colour of the eyes. The former are much shorter and often also deformed, as in the mutants 'stubble', or 'stubbloid'.

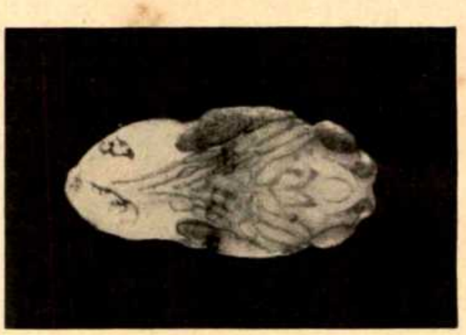

Fig. 1

Drosophila melanogaster. PUPA, SHORTLY BEFORE HATCHING, TAKEN OUT OF PUPAL CASE AND SEEN FROM THE VENTRAL SIDE. IT WAS TREATED ON ITS LEFT SIDE FOR 8 DAYS, FROM THE BEGINNING OF THE PUPAL PERIOD. NOTE SHORTER LEGS, AND BRISTLES, PALER EYE AND UNDERDEVELOPED WING ON THE TREATED SIDE.

The following data may serve as a preliminary example (lengths in μ, in brackets the controls, that is length of the corresponding bristles on the untreated side):

Orbitals: 60 (80), 45 (70), 60 (105), 105 (140), 45 (70), 25 (90), 45 (60).

Verticals: 105 (115), 30 (140), 125 (175), 80 (125).

Supra-alars: 80 (140), 35 (60), 115 (170), 35 (115), 70 (105), 45 (90).

Post-alars: 70 (105), 105 (140), 70 (105), 185 (285), 55 (80), 115 (130).

Dorso-centrals: 140 (200), 90 (140), 200 (250), 125 (140), 115 (160).

Scutellars: 160 (205), 140 (185), 275 (300), 230 (265).

The eye colour is always definitely paler on the side kept in the dark, and in this respect, again, the difference is especially striking when the treatment is begun soon after pupation (Fig. 1). Control experiments have shown that this result is not due to lack of light, because the same treatment applied in a normal atmosphere does not produce any differences in eye colour. Thus the effect must be due to the differential depression of cellular respiration in the tissues of the two respective eyes. In this connexion it is of great interest to note that the pigment of the *Drosophila* eye has been shown to act as a reversible redox-system, being colourless when reduced, and fully coloured when shaken with oxygen (cf. Schultz[3]).

The importance of the method for embryological experimentation seems to be that deficiencies are produced by a well analysed physiological treatment, instead of by the more crude method of killing or extirpating certain parts.

Lately the method has been modified. Instead of using one single beam, the whole dish, filled with carbon monoxide, was illuminated, and several pupæ were put in at once, but the pupal cases were first varnished at various places with a quick drying, thick black varnish, as used in blinding experiments on insects.

It is proposed to extend the studies to the histology of the treated pupæ, and also to earlier developmental stages (eggs), where they may give a welcome completion of the experiments of Geigy[4] with local ultra-violet treatment.

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April 21.

[1] Wolsky, A., *J. Exp. Biol.* (in the press).
[2] Runnström, J., *Protoplasma*, **10**, 106 (1930).
[3] Schultz, J., *Verhandl. internat.* 6. *Kongr. Vererbwiss.*, **2**, 178 (1932).
[4] Geigy, R., *Roux's Archiv.*, **125**, 406 (1931).

Genes for Dwarfing in Rice

THE typical dwarf varieties of rice vary in height from 10 cm. to 75 cm. They are characterized by shortened internodes, short and broad leaves and small compact panicles. Crosses of dwarf with normal varieties have generally shown that they are mono-recessive (Parnell[1], Akemine[2], Nagai[3] and Yamaguti[4]). Sugimoto[5], however, reports a dominant dwarf. Except for Akemine's work[2], there have been no attempts to determine the number of genes for dwarfing in rice. He crossed two dwarfs, differing in height, and obtained tall F_1 plants. In F_2 the segregation was 9 tall; 3 first type of dwarf; 3 second type of dwarf; 1 third type of dwarf; the last phenotype being the result of segregation.

Through the courtesy of rice workers in India, Japan, Australia and the United States of America, I obtained a number of dwarf varieties. These were crossed in various combinations with the view of determining the number of genes causing dwarfness. The studies have revealed that five genes are responsible in causing short stature. The various varieties are grouped below according to the existence of genes:

Gene.	Varieties.
d_1	Japan-I
d_2	Japan-II, Ratanghose, Kr-226, T-433, Mohmyaw, "Louisiana" and "California"
d_3	Kolamba-dwarf[6]
d_4	Y-2139
d_5	Bunketu-to

It will be seen that the gene d_2 occurs very extensively. The reactions of the various gene combinations are very varied.

The full results will be reported elsewhere.

B. S. KADAM.

Karjat, Bombay Presidency,
April 17.

[1] Parnell *et al.*, *Mem. Dept. Agr. India*, *Bot. Ser.*, **11**, 185–208 (1922).
[2] Akemine, *Rept. Jap. Assoc. Adv. Sci.*, **1**, 308–314 (1925).
[3] Nagai, *Jap. J. Bot.*, **3**, 55–66 (1926).
[4] Yamaguti, *Ber. Ohara Inst.*, **5**, 1–56 (1931).
[5] Sugimoto, *Jap. J. Genetics*, **2**, 71–75 (1923).
[6] Kadam, NATURE, **129**, 616–617 (1932).

Growth of *Lemna minor*.

IN view of the recent work on the growth and metabolism of *Lemna minor*[1], the following observations are of interest.

The multiplication of fronds in a colony of *Lemna* under favourable conditions has been regarded as exponential. While this conveniently expresses the growth of a *colony*, it does not express the rate of appearance of the daughter fronds from the individual 'mother'.

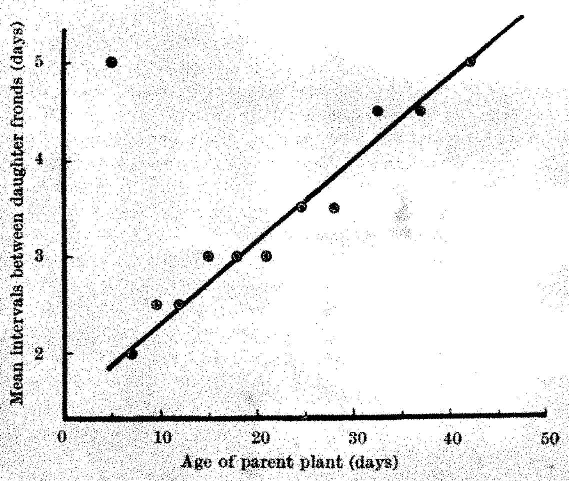

Fig. 1.

Under standard controlled conditions (full nutrient medium, illumination of 400 foot candles, temperature 25° C.) a frond produces 10–12 daughter fronds in succession. These appear alternately on two sides of the mother frond. The whole process takes 40–42 days; at the end of this time the mother frond dies. The mean interval between the appearance of successive daughter fronds is not constant.

The relation between rate of production of fronds and the age of the mother frond is illustrated by the accompanying graph (Fig. 1), on which the mean intervals between daughters are entered. Apart from the five-day period before the appearance of the first daughter frond, the observations lie on a straight line. The rate of frond production is therefore a hyperbolic function of time, and for the particular environment described above may be expressed by the equation:

$$r = \frac{1}{0\cdot089t - 1\cdot26}$$

where r is the rate, and t is time in days.

There is remarkable uniformity in the number of daughter fronds produced, the life of the mother frond, and the history of frond production described above. The effect of changes in the environment on the process is under investigation in this laboratory, and a fuller communication will be published in due course.

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The University,
Bristol.
May 7.

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[1] Ashby *et al.*, *Ann. Bot.*, **42** (1928); **43** (1929); **49** (1935); White *et al.*, *ibid.*, **50** (1936); n.s. **1** (1937).

Neutrino Theory of Light

RECENTLY some doubts have been expressed about the neutrino theory of light, and Fock[1] has claimed to have found some general rigorous arguments against the possibility of such a hypothesis, especially in its existing form. We believe that Fock's arguments are not valid, though it seems that Jordan's original work[2] on the derivation of the photon amplitudes $b(k)$ from neutrino amplitudes, $a(k),c(k)$ is somewhat ambiguous, as it contains in fact an indefinite expression of the type $\infty - \infty$; later, Jordan proved the convergence of the result but in a somewhat artificial way.

We wish to remark that all these difficulties can be avoided at once by using the following expansion for the neutrino wave functions satisfying the one-dimensional Dirac equation:

$$\psi(x,t) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+\infty} \Big[A_\varrho(k) \exp(-ic|k|t + ikx) + C^*_\varrho(k) \exp(ic|k|t - ikx) \Big] \, dx$$

where $A_\rho(k)$ and $C_\rho(k)$ are readily found to relate to *neutrino* and *antineutrino* respectively[3]. These Fourier coefficients are expressed through independent amplitudes $a(k)$, $c(k)$ obeying the Fermi commutation rules $a^*(k')a(k) + a(k)a^*(k') = \delta(k' - k)$, etc.

For the photon wave, we take the analogous expansion from the well-known paper of Dirac[4] with the coefficients $b(k)$ satisfying the Bose commutation rules:

$$b(k')b^*(k) - b^*(k)b(k') = \frac{ch}{2|k|} \delta(k' - k).$$

Now, we can easily proceed to the construction of the Bose amplitudes $b(k)$ from the Fermi amplitudes $a(k),c(k)$. For this, we consider the absorption of a photon as due either to the absorption of a neutrino and antineutrino of frequencies $(k - l)$ and (l), respectively, or as due to the absorption of a neutrino (antineutrino) of frequency $(k + l)$ and to the simultaneous emission of the same particle of frequency (l) (Jordan's neutrino Raman effect without change of direction). In this way we find:

$$b(k) = \frac{1}{k}\sqrt{\frac{ch}{2}} \left[\int_0^{\infty k_1} a^*(l)a(l+k)\,dl - \int_0^{\infty k_1} c^*(l)c(l+k)\,dl - \int_0^k a(l)c(k-l)\,dl \right].$$

($k = k/|k|$ defines the sign of the upper limit) where usually one takes all states above a certain one as unoccupied[5].

With $b(k)$ constructed analogously, one immediately verifies the required Bose commutation rules for $b(k),b^*(k)$ and thus proves the validity of the neutrino theory in a quite straightforward way. Apparently, Fock obtained his result by using, for the wave function, insufficiently general Fourier expansion.

A. SOKOLOW.

Siberian Physical-Technical Institute,
Tomsk.
March 26.

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[1] Fock, V., NATURE, **138**, 1011 (1936). *Phys. Z. Sowjetunion*, **11**, 1 (1937).

[2] Jordan, *Z. Phys.*, **93**, 464 (1935). Iwanenko, D., and Sokolow, A., *Phys. Z. Sowjetunion*, **9**, 692 (1936). The purely statistical-thermodynamical developments of the last article are quite independent of any considerations about the connexion of Bose and Fermi amplitudes.

[3] Iwanenko, D., and Sokolow, A., *Phys. Z. Sowjetunion*, in the press, where the application of such expansions to the Dirac theory is discussed.

[4] Dirac, P. A. M., *Proc. Roy. Soc.*, A, **136**, 453 (1932).

[5] Born, M., and Nath, N., *Proc. Ind. Acad. Sci.*, **3**, 318 (1936).

A Lead Extrusion Phenomenon

DR. DUNSHEATH has referred[1] to the presence, in polished and etched sections of lead cable sheathing, of radial lines which pass through the crystals. It was held as one possible explanation that segregation of dissolved oxide might be responsible.

The presence of similar, but more pronounced, lines has frequently been observed in etched sections cut through lap welds in lead sheet. The appearance of such lines is shown in the photomicrograph (Fig. 1), and it is deduced from their position and direction that they coincide with the surfaces of successive layers of cast metal with which the weld was built up. As each layer solidifies, a surface skin of oxide is formed; this skin forms the base of the next layer and it is suggested that some oxide is taken into solution during the application of the welding flame each time fresh metal is added. The heat applied is so local and solidification so rapid that any oxide taken into solution would only diffuse to a minor extent.

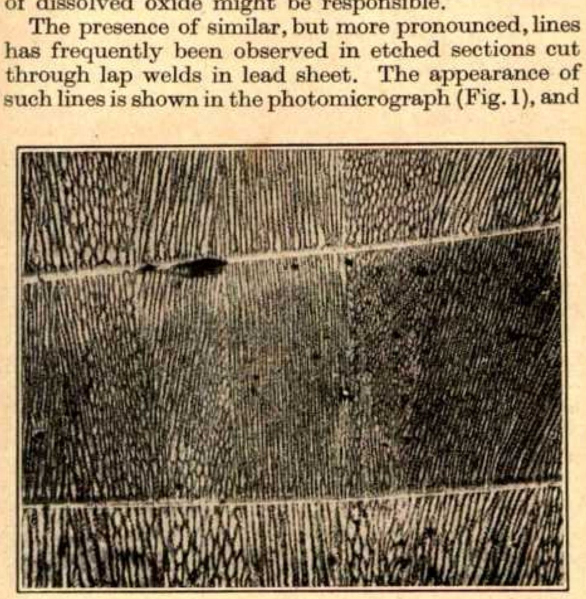

Fig. 1.

× 40 DIAMETERS.

The coring effect shown in the photomicrograph is due to the small amounts of impurities present in the particular lead illustrated.

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Goodlass Wall and Lead Industries, Ltd.,
Research Laboratories,
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May 11.

[1] NATURE, 139, 755 (May 1, 1937).

Calcium Iodate as a Temporary Preservative

FOR the past two years we have been using a 0·1 per cent solution of calcium iodate as a temporary preserving agent for class material. The iodate is dissolved in distilled water and warmed to ensure thorough solution.

We find it particularly valuable for material to be preserved in a fresh and pliable condition from one practical class to the next. With the exception of Arthropods, it will keep any comparatively small object fresh and odourless for two to three weeks, and we have kept specimens of *Heterosepiola*, *Rana* and *Bufo* for six months. At the end of that period, the flesh of all specimens was soft and pliable, though slightly brown, and in *Rana* and *Bufo* the blood was still red in the arteries. Results with dogfish have not proved successful for a period longer than ten days.

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Points from Foregoing Letters

BY subjecting to harmonic analysis the hourly records of the intensity of cosmic rays observed over a period of two years by means of 'counters' inclined at various angles to the horizon, Drs. J. Barnóthy and M. Forró find that there is a straight line relation between the maximum of the first harmonic wave (sidereal time) and the total thickness of the absorbing material through which the cosmic rays have passed. They consider this effect to be related to the galactic rotation.

From considerations of energy interchanges between an atomic nucleus and the universal 'background', Dr. F. L. Arnot concludes that the continuous beta-ray spectrum (the emission of electrons of varying energy by radioactive substances) can be explained without assuming the existence of undetectable neutrinos.

A graph showing the dependence of the threshold value of supra-conductivity (field strength at which resistance appears) in thin lead wire at 4·2° K. is given by B. Pontius. A change in threshold value was first noticed at 14·2μ diam., and the effect reached a value of 4 per cent in excess of normal at 5·6μ diam., indicating a depth of penetration of 10^{-5}–10^{-6} cm. for the magnetic field.

Prof. J. W. McBain and C. Alvarez-Tostado give a brief description of a simple 'rotor' for ultracentrifuging solutions of pure substances such as sugar in order to determine their molecular weight. It consists essentially of a pile of very thin (0·003 inch) silver washers, alternately wide and narrow, pressed together so that the liquid between the wide washers is imprisoned in anular layers. This enables the central core of liquid to be withdrawn and analysed after centrifugation.

An apparatus is described by D. B. Langmuir which draws the trajectories of charged particles in potential fields continuously and entirely automatically. Methods of accounting for initial velocity, transverse magnetic fields, and relativistic change of mass are described, and data illustrating the precision are presented.

The influence of vitamin D on phosphorus metabolism in normal and rachitic rats has been the object of a series of experiments made by Dr. M. J. L. Dols and Prof. B. C. P. Jansen in collaboration with Prof. G. J. Sizoo and J. de Vries. A radioactive phosphorus isotope was used as an indicator. In all the experiments a very rapid entrance of the labelled phosphorus into the bones was perceptible. One hour after the injection of the active phosphorus into the tail vein, a considerable amount was re-excreted into the small intestine.

Further experiments on the œstrogenic action of *p*-hydroxypropenyl benzene (anol) indicate, according to Prof. E. C. Dodds and W. Lawson, that while the pure compound has in itself a certain activity when given in large doses, the very high activity shown by certain specimens in small amounts is due to an unknown substance, probably a polymer of anol.

A. A. Wolsky finds that by means of partial illumination in a carbon monoxide atmosphere, local depressions in the development of *Drosophila* pupæ can be induced in the regions which are not illuminated. It is believed that the respiration of the pupæ is depressed by carbon monoxide, but illumination diminishes the effect, possibly because the chemical compound, formed between carbon monoxide and the iron-containing respiratory enzyme, dissociates under the influence of light.

By crossing a number of varieties of dwarf rice plants from India, Japan, Australia and the United States of America, B. S. Kadam has been able to determine that five genes are responsible in causing short stature.

E. J. Winter points out that although growth in a colony of a duckweed, *Lemna minor*, is exponential, yet when the individual frond is considered this is not the case. The rate of production of daughter fronds from a parent frond is shown to be a hyperbolic function.

A. Sokolow submits equations to overcome the difficulties raised by Fock in connexion with the new neutrino theory of light.

Brinley Jones submits a photomicrograph to support his view that the lines observed in etched sections cut through lap welds in sheet lead are due to a surface skin of oxide on each layer of metal used in building up the weld.

Research Items

Archæological Exploration in Peru: Cañete Valley

IN a third report on the results of an archæological expedition to Peru for the Field Museum, Chicago, in 1925 and 1926, Prof. A. L. Kroeber describes (*Anthropology, Memoirs, Field Museum, Chicago*, **2**, 4) excavations at Cerro Azul and Cerro del Oro, in the valley of Cañete, a large valley, as Peruvian coastal valleys go, but containing no town of much importance. The Cañete River, which has a large catchment area, maintains a considerable flow in all seasons, and the valley contains a number of well-known groups of ruins. Of the two sites under investigation, Cerro Azul is an imposing cluster of pyramidal ruins set immediately at the back of the modern port of Cerro Azul. Only one culture is represented here, belonging to the Late period, more or less synchronous with the Inca dominion, though no doubt partly antedating it. It is very similar to the Late Chincha culture, previously described by the author and other investigators. The Cerro del Oro is a nearly free-standing hill about four kilometres inland. It is connected by a low saddle with hills beyond, but otherwise is surrounded by ditches and cultivated lands. San Luis, a kilometre to the south-east, may represent an ancient settlement of which the inhabitants used the hill for their cemetery. It contains no remains of a non-funerary character. Many thousands of burials represent two cultures. One is the Late Cañete culture; the other, here provisionally called Middle Cañete, is shown to be earlier by its stylistic affiliations and by an established stratification. The Middle Cañete culture is characterized by skulls deformed fronto-occipitally, structures of small cubical hand-made adobe, a scarcity of metal, and by pottery and textiles, which show some Nasca influence, but no direct Tiahuanaco influence. The Nasca elements in the pottery are of Late Nasca type. On the other hand, there are occasional elements which suggest later Peruvian styles of the coast, Late Ica especially. While it has distinctive stylistic elements, the Cañete Middle is post-Early and pre-Late chronologically; but the absence of Tiahuanaco elements makes chronological correlations with other Middle period cultures uncertain.

Horned Ruminants of North America

THE deer, antelopes and other horned ruminants now existing in North America are few in number and give no hint of the vastness of the fauna inhabiting the continent in Tertiary and Quaternary times, of which they are the veriest remnant. This is brought out with great effect in the monograph on the horned ruminants of North America by Childs Frick (*Bull. Amer. Mus. Nat. Hist.*, **69**, 669, 103 text figures; 1937), a worthy companion to the similar volume previously published on Siwalik fossil deer and antelopes. The evidence upon which the account is based consists of more than 7,000 fossil skulls or parts of skulls, horns and limb bones. Most of the still-existing forms have been identified in the superficial deposits of the Ice Age, but so far only the prong-horn and deer groups have been found in the much older deposits of Late and Middle Tertiary. Even in glacial deposits, however, the modern types are associated with distinctive species which must have become extinct long before the advent of white races to America. It is difficult to account precisely for the impoverishment which has taken place since the great assemblage of the Tertiary fauna, but changes in topography and climate, accompanied by the shifting of faunas and the ravages of predators of both the animal and the plant world have played a great part. To these in latter days the destructiveness of man has been added, and the preservation of the remnant of a once magnificent and diversified fauna now lies in his hands.

Biological Races in Fruit-Flies

IN the *Canadian Journal of Research*, **15**, Sec. D, March 1937, Mr. A. D. Pickett gives an account of an investigation of the biological and morphological relations of certain species of flies belonging to the genus *Rhagoletis* of the family Trypetidæ. The author concludes from his observations that the practice of separating species on the basis of very slight morphological characters, which may all be the result of influences exercised by the particular plant host in which any such species has developed, is open to criticism and of doubtful soundness. The forms of the genus in question, which develop in apple, hawthorn and blueberry, were studied extensively with the view of ascertaining their relations to their hosts. The conclusion is reached that one species, namely, *Rhagoletis pomonella*, is involved, and that the female insects show a decided preference for laying their eggs in the plant host in which they themselves have developed during the larval instars.

Anatomy of the Carpel

DR. MABEL S. FRASER has recently published a very thorough study of the vascular supply to the carpels in the follicle-bearing Ranunculaceæ (*Trans. Roy. Soc. Edin.*, **59**, Pt. 1, 1936–7). This study brings into prominence the variations in the vascular supply not only in the different genera but also within the individuals of the species, and shows that caution is necessary in attaching wide evolutionary significance to isolated facts of anatomy. She adduces evidence of a carpellary trace of five vascular strands in many genera, as *Caltha* and *Trollius*, two strands running between midrib and marginal strands, and concludes that the primitive carpel may have been a palmately veined structure with a five-trace supply. The secondary vascular supply in the carpel wall varies widely within the species, but in the majority of genera it arises as a branch system from the marginal veins. In *Trollius* and *Caltha* there is variation in the vascular supply to the style which, in one gynæcium, may be provided by midrib or marginal bundles or both. On the whole, the author's position brings her near to the interpretation of the carpel advanced by Prof. A. J. Eames, but the paper is valuable for its wealth of anatomical data and the conservative and cautious treatment they receive. The author concludes that our knowledge of the putatively primitive angiosperm only suffices to show "the tremendous gap in our knowledge of the probable primitive Angiosperm from which our present-day carpel arose".

Cytology and Genetics of Cotton

A FURTHER study of the chromosomes and their pairing in various hybrids of *Gossypium* has been made by Dr. A. Skovsted (*J. Gen.*, **34**, No. 1). He concludes that the results confirm the division of the genus into three groups: (1) the cultivated New World cottons and certain wild species from America and the Pacific Islands, with $2n=52$ chromosomes; (2) wild species from America and the Pacific Islands having $2n=26$; (3) species from Africa, Asia and Australia, all having $2n=26$. In hybrids between members within each group the chromosome pairing in meiosis is almost normal. In hybrids between groups (2) and (3) the conjugation was incomplete and variable, while hybrids between members of (1) and (2) generally showed 13 bivalents and 13 univalents. From these and other results the inference is drawn that the genus *Gossypium* is monophyletic, with an early separation between the American and the Old World diploids. The New World tetraploids are believed to have originated from a hybrid between Asiatic and American diploid species. From the secondary pairing in American wild species, it is suggested that 13 is a secondary polyploid number from 6, five chromosomes being duplicated and one triplicated. In the same journal, Dr. S. C. Harland has investigated the inheritance of red petal spot in a series of *Gossypium* hybrids. By successively back-crossing plants of *G. purpurascens* heterozygous for spot with a spotless *G. hirsutum*, the spot was progressively weakened in the segregates and the tendency of the spot gene to show somatic and gametic mutation was greatly increased. From these and similar results it is concluded that the species of cotton may possess a complex of modifiers, the general effect of which is to preserve the stability of the genes and prevent them mutating at an excessive rate.

Distribution of Deep-Focus Earthquakes

MR. S. YAMAGUTI has made an interesting study of the distribution of 241 deep-focus earthquakes recorded in the "International Seismological Summary" for the years 1919–30 (*Bull. Earthq. Res. Inst.*, **15**, 170; 1937). The epicentres are plotted on a map of the world, and four lines are drawn in various regions surrounding those in which the focal depths are greater than 700, 500, 300 and 100 km. The regions of very deep foci are near Japan, in the middle of South America, the southern part of the Philippines, and the ocean east of Australia. On the Mediterranean coast, deep-focus earthquakes do not exist, while in North America they are rare. By projecting the foci of those in South America on a vertical plane containing the equator, the points obtained tend to lie on a zone through the middle of the continent and inclined towards the Pacific with a slope of one in five from the horizontal.

Troublesome Radio Echoes

IT is well known that radio signals passing between two points on the earth follow great circle paths, the radio energy being confined only by the earth and the ionosphere. There are two directions that a radio signal can take in passing from London to New York. One path extends westerly in the great circle plane and the reverse path extends easterly. As the latter has much the longer distance to travel, it arrives later, and may interfere with the former, causing an 'echo'. Short-wave transmission over long distances depends largely on the reflection of the waves between the earth and the ionized layer high overhead. In a paper by A. C. Peterson on "Around-the-World Radio Echoes" published in the *Bell Laboratories Record* of March, an account of the difficulties that radio engineers have to overcome is given. The altitude of the reflecting layer varies from 60 miles to 150 miles in height. The reflecting behaviour of this layer depends both on the frequency of the waves and on the exposure of the layer to light from the sun. When the layer is in darkness, frequencies greater than 10,000 kilocycles are generally not reflected and so transmission is poor. When the layer is illuminated, these waves are reflected and long-distance communication becomes possible. Observations show that the average intensity of the echoes varies in about the same way as the percentage illumination at different seasons of the year. Owing to the long round-the-world path, the echoes are considerably attenuated, and so a double or a treble echo is difficult to observe. Oscillograph records are given which show the echo plainly. The echo signal is rarely found to have a serious effect on the intelligibility of fixed carrier radio-telephone circuits.

Finite Elastic Deformations

IN the classical theory of infinitesimal deformations a fundamental principle (Hooke's law in its most general form) is equivalent to the statement that, in a virtual displacement of the strained elastic medium, the virtual work of all the forces, both surface and body, acting on the medium, may be obtained by integrating over the medium the scalar product of the stress tensor by the variation of the strain tensor. F. D. Murnaghan (*Amer. J. Math.*, **59**, 235; 1937) shows that this principle is merely an approximation, valid in the infinitesimal theory, but not valid in the finite theory, in which the variation of the strain tensor must be replaced by the space derivative of the virtual displacement vector. Fortunately the exact equations for an isotropic solid are sufficiently simple to yield numerical results, which the author compares with the experimental data obtained by P. W. Bridgman, showing a remarkably close agreement. A treatment of the Young's modulus experiment gives a qualitative explanation of the yield point phenomenon, which cannot be explained by the classical theory.

Is τ Tauri a Double Star?

MR. BERTRAND M. PEEK has published a short paper (*J. Brit. Astro. Assoc.*, **47**, 6, April 1937), with the title, "Occultation of τ Tauri". On January 22 he observed that the star was occulted with a succession of flickers, the process lasting about 0·4 second. On referring to his notes of February 1929, he found that he recorded the star as going out in two stages. He suggests that it is a double star, the separation not being less than 0·2″. It is worth noticing that Mr. G. F. Kellaway at Yeovil saw a similar phenomenon with this star on January 22, a fainter star continuing to be visible at least 0·5 sec. after the observed time of disappearance. Mr. Peek points out that the star will not be occulted in Great Britain before 1947, but a series of occultations will occur in the southern hemisphere until the end of the present year, and observers are asked to pay particular attention to the manner of disappearance.

Rockefeller and Philanthropy

By Willard Connely,

Director of the American University Union in London

THE life of John D. Rockefeller, who died on May 23, was a history of system, not only in the American business of oil, but also in the American business of philanthropy. Whilst Rockefeller was learning how to accumulate money, he was concurrently learning methods by which he should in time give it away. The nearer he approached monopoly, the easier it was for him to retreat to charity. It is because of Rockefeller's skill in the ways of corporations, in planning, shaping and extending them, that the vast 'benevolent trusts' which he created, trusts operated by business men as able as the executives of Standard Oil a generation ago, have become a model of American philanthropic enterprises to-day. That model has stood for 'efficiency in giving'.

These trusts admittedly share leadership in kind with the great Carnegie funds, which originated at almost the same time near the turn of the century. But Rockefeller early set an example to his eminent associates—Harkness, Archbold, Flagler, Folger—in giving money to the public cause. When still other capitalists devised similar charities, capitalists who in the era which Rockefeller dominated had like himself learnt from business the principle of consolidation, there ensued that rise of American philanthropy which has left few corners of the world untouched.

Shortly after the Rockefeller family moved west (1853) from New York State to Cleveland, Ohio, their son, aged about sixteen years, left school, to become a clerk at 4 dollars a week (16*s*.). Even then he began his lifelong practice of giving. He used to give dimes (5*d*.) to poor children worth helping. Of every such item Rockefeller kept a record; his meticulous juvenile notebook, which he called 'Ledger A', shows even the deposit of a penny at church. Establishing a commission firm of his own at nineteen years of age, he soon admitted partners, who multiplied his profits. There was in Cleveland an infant industry, the refining of petroleum. Rockefeller saw that if he could get a start in this business, he could make use of the competing transport facilities which Cleveland offered by both rail and water to distribute the oil widely at low cost. By the time he was twenty-eight he had formed the company of Rockefeller, Andrews and Flagler, and had bought a large oil refinery. Three years later, though his personal fortune was only £10,000, Rockefeller brought into being the Standard Oil Company, capitalized at £200,000. In another five years he had made his first million pounds. He was thirty-six years old. The rest of the story—the Oil Trust, its dissolution in 1892, its renewed prosperity as a New Jersey corporation, its second dissolution in 1911—is the story as well of the growth of Rockefeller's millions to the point at which he believed he could engage in effective and continuous philanthropies.

In planning his gifts, Rockefeller relied for many years on the advice of the late Frederick Gates, his intimate friend. One result of their collaboration was to place the disposal of capital as well as interest entirely in the hands of self-perpetuating trustees. In this respect the Rockefeller charities differed from other great American foundations. If the trustees decided to liquidate a trust, they could give all the capital away and discontinue the fund. This was recently done in the case of the International Education Board. The policy of Rockefeller in allowing absolute discretion to his trustees has been followed by his son, who although one of the trustees, casts only one vote.

Founding his first great benefaction in 1901, ten years before he retired from the presidency of Standard Oil, Rockefeller, while still in the business of accumulating, was able to apply his experience to the business of giving. This first trust was the Institute for Medical Research. He gave it a hospital in New York, and laboratories in New York and in Princeton (New Jersey). Such names as Flexner, Carrel and Noguchi are sufficient to remind one of the quality of work carried out, which has included the discovery of the anti-serum for cerebro-spinal meningitis, and the development of a serum for yellow fever, now in wide use in the tropics, especially by aviators. Huge sums have, of course, been expended as well on the study of cancer, infantile paralysis, and other diseases the mysteries of which are not yet fully solved.

The second trust, created by Rockefeller a few years later, was the General Education Board, designed to assist American universities. Rockefeller from the start had been anxious to help the Negro, particularly in medical education, and the Board contributed heavily to the medical schools of Negro universities in the South: Howard University, in Washington; Maharry Medical College of Fisk University, Tennessee; and Dillard Medical School in New Orleans. But on a wider scale, one of the signal appropriations of this Board was £2,000,000 for medical schools in general, to ensure a high quality of clinical instruction; schools which specially benefitted from this fund were those of Harvard, Yale and Columbia in the east, Johns Hopkins and Vanderbilt in the south, and Chicago and Iowa in the west. Having given medicine this great lift up, the Board turned to the basic sciences, physics, chemistry, biology, and in like manner established them on a sounder footing of research and teaching in important American university centres. Yet perhaps no grant of the General Education Board has been more welcome than the distribution of another £2,000,000, just after the Great War, to endow and increase salaries in all departments of higher education. The scheme was to match dollar for dollar, though in some cases the scale was one dollar to two, and in still others one to three. Graduates rushed to the call. Under this scheme, 170 American colleges large and small received grants, which needless to say have gone far to transform the quality of their staff.

In 1909 the third trust, the Rockefeller Foundation, came into being, a £20,000,000 corporation, with the world as its field of effort—"for the well-being of mankind". The Foundation has co-operated with

Governments of many countries to combat, for example, hookworm, malaria and yellow fever; and at the same time to institute centres of public health, to promote nursing education, and to develop medical schools. An instance of significant medical benefaction has been the support in large part of the Peking Union Medical College in China; again, the London School of Hygiene and Tropical Medicine was built and equipped by a gift of half a million sterling. The recent larger gifts of the Foundation in England have been mainly for other than medical purposes, such as funds for the University of London site in Bloomsbury, the grant to the London School of Economics, the grant to Cambridge to include the new library, and about three fifths of the sum needed for the Bodleian extension at Oxford, the foundation stone of which will be laid on June 25 by Queen Mary. The total of these benefactions amounts to £1,872,000.

In 1929, the trustees of the Foundation, again acting with the free hand which the policy of Rockefeller accorded them, absorbed a fourth trust set up some years earlier by the founder, the Laura Spelman Rockefeller Memorial, named after his wife and dedicated to the aid of the social sciences and to the welfare of children. The work of the whole now comprehends not only the international health division of the Foundation and the social sciences division of the Memorial, but also divisions for medical sciences, natural sciences and the humanities.

A characteristic of the Rockefeller philanthropies is that their practice comes from time to time under systematic review and revision by the trustees. This is done in order to meet the altering social needs of given countries. Vigilant attention to system, at home in the General Education Board and in the Institute for Medical Research, abroad in the Foundation whose work now encompasses the world, is the heritage of the business genius of John D. Rockefeller.

Regularities and Irregularities in the Ionosphere

PROF. E. V. APPLETON, in the Bakerian Lecture before the Royal Society, delivered on June 10, surveyed the information derived from radio sounding of the ionized regions of the upper atmosphere and compared the results with those derived from a theory of simple layer formation by solar ionizing radiation, travelling rectilinearly and attenuated according to a mass-absorption law. Such a formation is called a 'simple region'. The comparisons are concerned chiefly with the variation of maximum electron content N_m with solar radiation angle of incidence χ, with the total conductivity for direct currents such as determines the quiet-day magnetic variations and with the high-frequency absorption of radio waves traversing such a region, the two latter quantities being, to some extent, related.

For the lower Region E, where the daytime recombination is sufficiently rapid to maintain the electron concentration close to the equilibrium value, recombination substantially balancing ionization, the value of N_m is found to vary, experimentally and theoretically, as $(\cos \chi)^{1/2}$. The high-frequency absorption for radio transmission, on the other hand, varies theoretically as $(\cos \chi)^{3/2}$. Here fair agreement is found with the experimental seasonal noon variation when the sun is high, as in summer, but the winter values show disagreement, the absorption being then greater than simple theory predicts. For the case of the diurnal variation of absorption during a summer day, Best and Ratcliffe, working at Cambridge, have found good agreement with the theoretical relation.

No evidence is found suggesting the existence of permanent highly reflecting regions in the lower or middle atmosphere.

From the high-frequency absorption and other data, the transverse direct-current electron conductivity of a simple region is estimated and found to be less than that calculated by Schuster and Chapman from the magnitude of the magnetic variations, even after allowing for the revised estimates of upper-atmospheric motions recently made by Pekeris. This difficulty is met by the assumption of the existence of quantities of positive and negative ions in the lower part of the ionosphere, undetectable by radio methods, but which contribute to the conductivity for steady electromotive forces. From this assumption follows an explanation of the high effective electron recombination coefficient in the lower region, where the value is high because of the large number of positive ions. There is a marked difference between the day and night values of the effective electron recombination coefficients in Region E.

The identification of the lower regions of the ionosphere with the levels at which flow the currents affecting terrestrial magnetism is supported by evidence from systematic measurements of the value of $N_{\text{max.}}$, for Regions E, F_1 and F_2, which show that the ionization in Regions E and F_1 varies by about 50 per cent over the sunspot cycle, as does the magnetic variation. The variation of Region F_2 ionization, on the other hand, exhibits no parallelism with the magnetic changes, either in respect of seasonal or sunspot cycle trends, indicating that the magnetic currents do not flow at high levels.

The two types of ionospheric abnormalities, the one associated with bright solar eruptions and the other with terrestrial magnetic storms, were compared and discussed.

An estimate of the actual heights reached by radio waves at the level of reflection leads, in turn, to an estimate of the proportional variation of air density with height for the ionized component. From the fact that Region F is found to be some four or five times as thick as Region E, it follows that the local 'scale-height', H, in Region F is correspondingly greater than in Region E. The atmosphere therefore extends to much greater heights than are estimated from the simple exponential decrease of pressure with height found in the lower atmosphere. Such an extension of the ionizable gases to great heights indicates either that the temperature at 300 km. is higher than at lower levels, or else that it is there composed largely of a light gas such as helium. Difficulties in the way of the acceptance of the latter alternative are discussed.

Television Exhibition at the Science Museum

THE choice of the Science Museum, South Kensington, as a venue for the Television Exhibition which was opened there on June 10 is a singularly appropriate one, for not only does it enable an outline of the technical development of television to be well illustrated, but also it will enable the general public to observe and appreciate the value of television as a new form of home entertainment in a manner which is impossible at any commercial demonstration. The Exhibition is to remain open for about three months.

While it is probable that the only way of appreciating fully the entertainment value of the new service is by the installation of a receiver in one's own home, yet an endeavour has been made at the Science Museum to enable the general public to observe the broadcast programmes for considerable periods by the installation of eight receivers, one from each of the principal manufacturers. These receivers will be in operation daily from 3 p.m. until 4 p.m., receiving the B.B.C. programme, and they will also be operated at intervals throughout the day by means of a film transmitter which has been specially installed in the Exhibition by Messrs. A. C. Cossor, Ltd., for this purpose.

In the technical section of the Exhibition there is a considerable number of exhibits to illustrate the past and present trends of development. The early work of J. L. Baird is illustrated by several exhibits, and there is a working demonstration of the 30-line television which was broadcast from 1932 until 1935. An important part of this section of the Exhibition is devoted to the development of cathode ray tubes. The old Crookes and Braun tubes are shown in operation, and all the important stages of development of the modern television tube are illustrated by appropriate exhibits.

From the scientific point of view, there can be little doubt that the chief interest is centred around a series of exhibits which have been provided by the Scophony Company, relating to their system of large-screen television. As is indicated in the handbook which has been produced in connexion with the Exhibition, one of the major difficulties of large-screen television is that of controlling a sufficient intensity of light and of projecting it on to the screen. The familiar Kerr cell is practically useless for large-screen television since the optical difficulties and low efficiency are insuperable, even if the cell could be made to operate at the very high frequencies required.

The Scophony system makes use of a patented 'supersonic light control cell' in which the principle of diffraction is employed to control the light intensity. The cell consists of two pieces of glass, between which is a transparent liquid; the beam of light is passed through this liquid. A small plate of piezoelectric quartz is mounted at the base or side of the cell and connected with a source of high-frequency oscillations. The mechanical oscillations thus induced in the quartz crystal produce stress waves in the liquid, which travel through the liquid in a direction transverse to the beam of light with a velocity equal to that of sound in the liquid. The waves in the liquid cause the production of diffraction spectra, the intensity of which is proportional to the intensity of the quartz oscillations. By stopping out the normal ray through the cell and by modulating the quartz oscillations by the incoming television signals, the light in the spectra may be employed to form the television image on the screen.

Used in this simple manner, the supersonic light control would possess no great advantage over the Kerr cell. Its great superiority lies in the fact that, with scanning and optical systems of appropriate design, the velocity of the transverse waves of the cell enables between 400 and 500 elements of the picture to be simultaneously active. With a cell of the Kerr type, only a single elemental area can be active at any instant.

The optical system employed makes use of crossed cylindrical lenses for focusing the light beam, thus making possible the use of very small rotating scanners. The focusing and scanning systems associated with the supersonic light control are radically different in design from any previously used for mechanical systems of television. Space must forbid a description here, but the special features are all illustrated by suitable exhibits.

The Scophony Company's exhibits conclude with two demonstrations of large-screen television, one of which employs a screen measuring 5 feet by 4 feet. The programmes are being transmitted by radio from the Company's laboratories at Campden Hill on a standard of 240 lines, 25 pictures per second.

Another exhibit relating to large-screen television is one provided by the Baird Company of an experimental 'projection cathode ray receiver'. This exhibit comprises a conventional receiver, but instead of reproducing the picture on the fluorescent screen of a large-diameter cathode ray tube, an extremely bright image is reproduced on the screen of quite a small tube. A few inches in front of this tube is fitted a wide-aperture lens which projects an enlarged image on to a ground glass screen placed two feet in front, thus providing an image measuring 18 inches by 12 inches. This type of receiver is only experimental at present, and it is understood that one of the chief difficulties is the short life of the screen of the high-intensity cathode ray tube.

Although the Exhibition gives some indication of a trend towards larger screens, one is forced to wonder if a genuine demand for larger screens exists. Obviously, the larger the screen, the larger is the overall bulk of the apparatus, and, to some extent, the larger is the initial cost and upkeep. If, as seems likely, the future development of television proceeds on the lines of home entertainment, the size and cost of a receiver are of vital importance, and while a small increase in the size of the screen as provided on the present commercial receivers would be an improvement, there is a wide belief amongst owners of receivers that the present size of screen is adequate for home entertainment purposes.

There is, however, a potential field of application for television in the provision of entertainment for large audiences in public halls and cinemas, especially when the broadcasting of important current events becomes a daily feature of the television programmes. For such applications, receivers having the largest possible screens will be required.

The Fuel Research Station

ANNUAL VISITATION

THE Fuel Research Station at Greenwich, the headquarters of the fuel research organization of the Department of Scientific and Industrial Research, was inspected by nearly four hundred representatives of science and industry on June 1. The visitors were received by Sir Harold Hartley, chairman of the Fuel Research Board, and the director of fuel research, Dr. F. S. Sinnatt.

The work of the fuel research organization is divided into a number of programmes which are given a different degree of priority from year to year; individual programmes may be curtailed, concluded or extended according to national and industrial requirements.

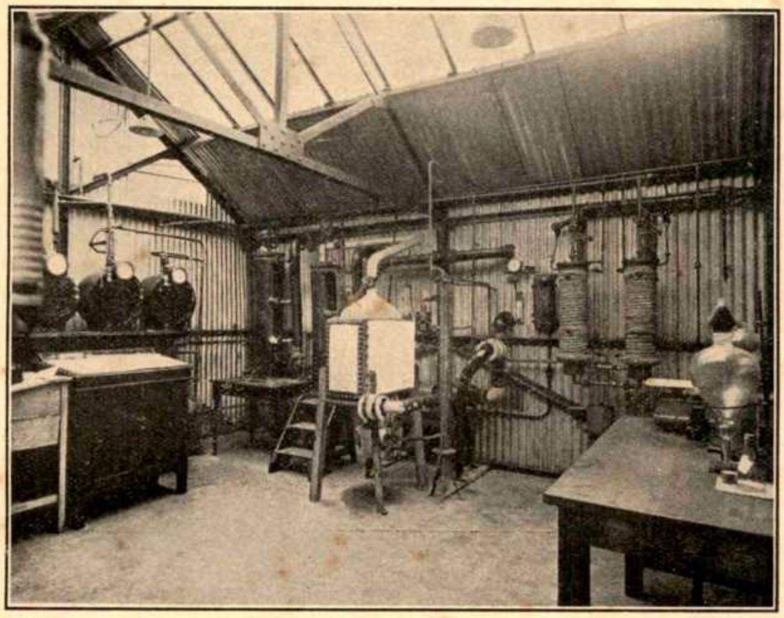

Fig. 1.

EXPERIMENTAL PLANT FOR THE SYNTHESIS OF HYDROCARBONS FROM MIXTURES OF HYDROGEN AND CARBON MONOXIDE. *Crown copyright reserved.*

The National Coal Survey is one of the major programmes. It is necessarily carried out at central points in the chief coalfields, where nine fully equipped laboratories have been established. In these laboratories the properties of the coals of the districts are examined, but equipment is available at the Fuel Research Station for extending the scale of the investigations, so that the results may be applied in industrial practice. Detailed knowledge of the coal seams is becoming increasingly valuable as the methods of utilizing coal grow more precise. New processes such as hydrogenation call for coals with special characteristics, and the study of these is incorporated in the scheme of work at Greenwich.

This scheme comprises laboratory and large-scale investigations of the following problems:

(1) Screening, washing and sizing of coal.

(2) The combustion of coal (*a*) in a marine boiler and (*b*) in the pulverized form, and the elimination of dust and sulphur from the flue gases.

(3) The hydrogenation of coal and tar.

(4) The carbonization of coal.

(5) The complete conversion of coal into gas.

(6) The synthesis of hydrocarbons from mixtures of carbon monoxide and hydrogen.

(7) The burning of coal in the open domestic grate.

(8) The use of pulverized coal in the internal combustion engine.

A brief description of the nature of these problems and of the recent advances made is given below.

(1) Work on the purification and cleaning of coal has lately been concerned with the elimination of dust. Coal treated, according to its type, with 3–20 lb. of oil per ton is quite freed from dust, and possesses certain characteristics which may be of commercial significance. The effect of the presence of very fine material, largely fusain and clay, upon the efficiency of coal washing has also been studied and a process for eliminating this fine material has been developed. Advances have been made in the development of the so-called 'desliming process'.

The importance of the size of coal is being recognized to an increasing extent in industry, and, in collaboration with a number of collieries in several of the coalfields, an exhaustive study is being made of the problems associated with the production of sized materials. This work is being reinforced by more fundamental study at the Station and at the Imperial College of Science, South Kensington.

(2) Since the system, devised at the Station, of burning coal in the pulverized form is already in commercial operation in a number of works, investigation of this problem is now less urgent. Attention has been devoted to the burning of coals containing a low percentage of volatile matter, in order that methods of using this valuable material should be available. The effects upon combustion of blending low-volatile coals with different proportions of high-volatile coal are being explored. The whole problem of the elimination of fine grit and sulphur from flue gases is being investigated, largely with the view to devising a process which can be applied to relatively small units.

(3) The work on the hydrogenation of tar and of coal has aimed at increasing the range of products that can be obtained, and, during the year, methods have been worked out for the conversion of tar and coal into aviation spirit. It has been found possible to produce a volume of aviation spirit equal to the tar treated. Some 140 gallons have been obtained from a ton of coal. The work on the treatment of

high-temperature tar has been partially successful, in that catalysts have now been found by which the tar from vertical retorts can be hydrogenated to produce motor spirit.

(4) The blending of non-caking coals with caking coals is being studied in gas-making plant of the intermittent chamber type.

(5) A process has been worked out by which non-caking coals can be completely gasified in a water-gas plant. If this process can be introduced into commerce, then it will be possible to replace the coke generally used for this purpose and thus conserve the caking coals of the country.

(6) In the search for new products an investigation is in an advanced stage upon the conversion of carbon monoxide and hydrogen into hydrocarbons. This has been worked out in the laboratory, and now a plant is in operation yielding about 10 litres of primary product a day. Lubricating oil has been made from certain fractions of this hydrocarbon product. Fig. 1 shows the actual converter in the centre, and the plant for the removal of organic sulphur from the gases behind it on the left; the condenser is immediately on the right of the converter, and the activated carbon scrubbers on the wall to the right.

(7) Considerable interest is attached to the results which have been obtained upon the burning of coal in the open domestic grate, the investigation of which is financed by funds provided by the Coal Utilisation Council.

(8) As a preliminary study of the combustion of coal in an engine, the effect of coal ash upon engine components is being measured.

University Events

CAMBRIDGE.—Prof. H. R. Dean, master of Trinity Hall and professor of pathology in the University, has been elected vice-chancellor for the academical year 1937–38, beginning in October. He will succeed Mr. G. H. A. Wilson, master of Clare College, whose customary two years of office will then expire. Prof. Dean was educated at Sherborne and New College, Oxford. He went to Cambridge as professor of pathology in 1922, and since then has been a fellow of Trinity Hall, being elected Master in 1929.

Candidates for the Michael Foster studentship in physiology are requested to send their applications, with a statement of the course of research they propose to undertake, to Sir Joseph Barcroft, Physiological Laboratory, by July 7. The student receives the annual value of the fund (about £100), and may be re-elected for a second year.

LONDON.—In recognition of the pre-eminent services rendered, first, by Sir William Beveridge in connexion with the purchase of the Bloomsbury Site and, later, by Lord Macmillan in the raising of the funds necessary to carry out the first part of the building scheme, it has been decided to name two of the halls now completed in the new buildings the "Macmillan Hall" and the "William Beveridge Hall".

OXFORD.—E. S. Duthie has been appointed University demonstrator in pathology for four years from October 1.

Prof. P. Jacobsthal, formerly of the University of Marburg, has been appointed University reader in Celtic archæology for three years from October 1.

Science News a Century Ago

Snow Harris at the United Service Museum

ACCORDING to the *Nautical Magazine* of 1837, on June 12 and 19 lectures were given by Snow Harris at the United Service Museum on atmospheric electricity and the means of defending buildings and ships from its effects. In his second lecture, Harris "described thunder-clouds as insulated and highly charged surfaces, extending sometimes over an area of 40,000 or 50,000 acres, opposed to the surface of the earth as a conductor, with the air as an intervening insulating medium. The electricity accumulated in the clouds, in order to regain a more equal distribution, passes over the lines where the resistance is weakest, or breaks through the intervening air, discharging itself upon the nearest conductor. The lecturer's plan for conducting lightning from ships was illustrated by the model of a frigate floating in a trough of water, with gunpowder at the royal masthead, and with a boat astern filled with gunpowder. A metallic ball, charged with lightning, was made to traverse a wire, by which the gunpowder exploded and also that in the boat, but the lightning was conducted into the water without damage to the vessel. A mast without the conductor, in a similar experiment, was shivered to pieces."

On Lightning Conductors for Ships

FIVE days after Snow Harris gave his lecture at the United Service Museum, Martyn Roberts on June 24, 1837, read a paper to the Electrical Society of London entitled "On Lightning Conductors, particularly as applied to Vessels". Roberts had been led to inquire into the causes of the many accidents to ships through lightning and to suggest improvements. "The conductor most in use", he said, "is a chain, each link of which becomes by the action of the saline moisture in the atmosphere highly oxidated . . . and therefore when the vessel is struck by lightning, every joint in this conductor becomes a point at which an explosion may take place."

Roberts's suggestion was that a metallic rope of fine annealed copper wires should be led from a copper point at the masthead, down the mast and then to a back stay, from which it was to be taken outside the ship and there fastened to the copper sheathing. Harris's conductor consisted of a double copper tape led down the mast and connected to copper bolts passing through the ship's bottom timbers. This plan was favourably reported on in 1839 and was soon widely adopted.

Lyell's Forecast of Submarine Telegraphy

WRITING on June 21, 1837, from Copenhagen to his sister Caroline, Lyell referred to Wheatstone's telegraph. "By-the-bye," he wrote, "have you heard of this wonderful invention? It has made a large figure in my waking dreams ever since I first heard of it at Babbages' and I shall be disappointed if it fail to work a mighty change in the 'march of intellect', at least of civilisation." After describing how Wheatstone had experimented with four miles of silk-covered wire in the crypts of King's College, London, and how with four wires and four needles sixty distinct signs could be sent, he went on, "It has been found that by employing small ropes steeped in india-rubber gum, you may isolate the wires much cheaper than by silk and then each wire shall only cost between £3 and £5 per mile, or for the four wires under £20. Now they had been obliged on the Birmingham and Liverpool railroad to use a very much more expensive telegraph, to give notice of trains coming to tunnels or places where they cross, by means of long iron tubes through which a blast of air is sent which blows a whistle at the end. So when this new rope with the four copper wires is substituted, we shall have not only railway news but all others sent out with the speed of lightning, ciphers being used for private confab. A few days after I left, a tarred rope was to be continued from the end of the four miles of wire, and thrown into the Thames and then carried to the shot tower on the other side, and the rapidity of conveying intelligence through about five miles was to be tried. So perhaps a rope in the sea may carry news from Dublin to Holyhead. . . ."

Captain Graah's Expedition to Greenland

IN the *Athenæum* of June 24, 1837, is a review of the "Narrative of an Expedition to the East Coast of Greenland by Captain W. A. Graah, of the Danish Royal Navy". Captain Graah had proceeded to Greenland at the command of the King of Denmark. He arrived off the coast in May 1828, spent ten months examining the coast towards Cape Farewell and in 1829–30 proceeded to explore the eastern side of Greenland in boats. "The expedition of Captain Graah", said the *Athenæum*, "appears to set at rest for ever the question which it was designed to elucidate. That able officer explored the east coast of Greenland as far north as the latitude of Iceland; he sojourned on it a year and a half; and yet he discovered no vestiges whatever of ancient Icelandic civilization. He found there no iron, no bell metal, no stones with inscriptions or other relics, such as are found on the western coast; and he was assured by the natives, who are well acquainted with the interior of their firths, that they never saw nor heard of ruins in their country."

Autopsy on William IV

THE *London Medical Gazette* of June 24, 1837, contains the following account of the post-mortem examination on William IV, who died on June 20, aged seventy-one years. "On opening the body the heart was perceived to be enlarged and flabby, with a few shreds of soft lymph gluing the surfaces of the pericardium together. The right side was comparatively healthy, but the left side showed very extensive disease of both sets of valves; those of the aorta were ossified, presenting an obstruction to the passage of blood into that vessel, which was rough on its internal surface, but without dilatation. The mitral valves were also ossified, and suffered the blood to regurgitate. The tendency to bony degeneration extended to the respiratory organs, the larynx, trachea, and even the bronchi, being ossified. The left lung was greatly gorged, and the pleuræ on this side firmly united by thick adhesions of ancient date. In the right cavity of the chest were some 12 or 14 ounces of serous fluid, probably poured out during the few days immediately preceding dissolution. The liver was enlarged and granulated; there was also slight granular disease of one kidney. To the medical reader it will be obvious that the deficiency in the general circulation and the overloaded state of the lungs are clearly explained by the dilatation without hypertrophy of the left ventricle, the obstruction of the aortic and patulous condition of the mitral valves."

Societies and Academies

Dublin

Royal Dublin Society, April 20.

D. A. WEBB: Spectrographic analysis of marine invertebrates, with special reference to the chemical composition of their environment. Quantitative data for the occurrence of 25 elements in a variety of forms are presented, and considered in relation to the concentration in which the same elements are found in sea water. Li, B, Sr, Al and Ag can frequently be detected in organisms, but not in concentrations significantly higher than in the environment. Si, Cu, Fe, Co, Ni, V, Cr, Zn, Cd, Sn and F, can be accumulated by some species from food or water in which they are scanty or undetectable. Pb, Ba and Mn, are intermediate. Previous work on the subject is discussed, with more than a hundred references.

J. CARROLL: Potato eelworm investigations. Recent research on the potato root eelworm, *H. schachtii*, has demonstrated conclusively that the eelworm can by itself give rise to 'potato sickness' in its most severe form. It has also been established that healthy crops of potatoes can be produced on eelworm-infected soil whenever the plants make a fair amount of growth before normal hatching of eelworm eggs in the soil commences. Experiments are designed to test the usefulness of trap-cropping with potatoes for the purpose of reducing the eelworm population of the soil.

C. S. RONAYNE: A curious lightning photograph. An exposure of about two minutes with an aperture *f*/6·3 at about 11.30 p.m. B.S.T. in the month of July recorded two flashes. One was completely solarized, and appeared on the print as a thin black line, with the exception of the lower end which was white. Another neighbouring flash was not reversed and appeared white and of appreciable width. This flash showed a thin black edge and black branches. It would seem that the effect must be due to double reversal of the photographic image.

Paris

Academy of Sciences, May 3 (*C.R.*, 204, 1285–1374).

RICHARD FOSSE and ROGER DE LARAMBERGUE: The synthesis of cyanamide by the oxidation of glucose and ammonia. Cyanamide is produced by the oxidation of glucose in ammonia solution by potassium permanganate.

CHARLES ACHARD, AUGUSTIN BOUTARIC and MME. MADELEINE ROY: The optical activity of sera and their proteins separated by the acetone method in the cold. The rotations produced by sera or by the proteins separated from the sera are practically identical. From this it is concluded that the extraction by the acetone method causes no change in the proteins.

GEORGES CLAUDE: The search for aeroplanes lost at sea. Suggests the use of dyes in special containers giving a coloured area visible for about six hours.

SERGE BERNSTEIN: Quadrature formulæ with non-negative coefficients and equidistant abscissae.

JEAN BAPTISTE SENDERENS: Researches on benzoyl chloride. Aromatic ketones.

LAUGE KOCH: The question of the Caledonian chain in northern Greenland.

Paul Vincensini : A property of convex bodies of space of *n* dimensions.

Szolem Mandelbrojt : The regularization of functions.

Radu Badesco : The cyanide method in the extraction of gold. A mathematical discussion of some problems arising in the cyanide extraction of gold ores.

Raymond Tremblot : The spectroscopic triple star 113 Hercules.

Léon Agostini : The flow of air with velocities higher than sound through holes of very small diameter. Experiments were made with holes 0·03–0·5 mm. diameter, and over this range the empirical relation of Emden was found to be verified.

Louis Sackmann : The study of the flow of air in the immediate neighbourhood of a wall. Application to the study of the characteristics of aeroplane wings.

André Labarthe and Alexandre Ponomareff : The internal injection of petrol in an internal combustion motor.

D. G. Dervichian and Maurice Joly : The viscosity of monomolecular surface layers.

Pierre Jacquet : The value of the microscopic method for the study of electrolytic deposits. It is claimed that by using the method described the whole surface of the cathode can be explored, and this cannot be realized by the electron diffraction method.

Alexandre Dufour and Fernand Prunier : The observation of Sagnac's phenomenon with a source of light not forming part of the rotating system.

Boris Vodar : The absorption spectrum of nitrous oxide in the liquid state.

H. Ollivier : Contrast between the laws of thermal variation of the magnetic rotatory power in the case of the nitrates of manganese and gadolinium on one hand and the nitrates of cerium, neodymium, praseodymium on the other.

Mlle. Catherine Chamié : Rapid identification by the γ-radiation of actinium, radiothorium and mesothorium.

Jean Perreu : The heats of saturation and of hydration of sodium sulphate.

Jean Cournot and Mlle. Louise Halm : The methods of testing by corrosion of magnesium and non-protected ultra-light alloys. A description of two methods, one based on loss of weight, the other on gas evolved, which have been proved to give satisfactory comparative results.

Mlle. Jeanne Foret : The action of soda in solution on hydrated tetracalcium aluminate.

Edouard Rencker and Pierre Vallet : The thermal decomposition of ammoniacal copper sulphates. The compound $CuSO_4$, $5NH_3$ when decomposed by heat gives as intermediate products $CuSO_4,2NH_3$, $CuSO_4.NH_3$, and finally the anhydrous $CuSO_4$. The hydrated compound $CuSO_4.4NH_3.H_2O$ gives the same intermediate products.

Emile Carrière and Henri Guiter : The precipitation and determination of vanadates. Study of the completeness of precipitation in solutions of varying *p*H by precipitation with barium chloride, silver nitrate and lead acetate.

Christian Aall : The influence of magnesia on the working of a carbide furnace. Experiments explaining the anomalies and inconveniences resulting from the introduction of magnesia into a carbide furnace.

Mlle. France Bloch : Contribution to the study of the thioacids. The preparation and properties of the acid $C_6H_5CS.SH$.

René Heilmann : Isoamylidene-acetone.

Roger Pajeau : Beryllium bromide in some synthetical reactions. Beryllium bromide does not always give the Friedel and Crafts reaction, but can be used in certain cases.

R. Truhaut : The action of mercuric oxide in alkaline solution on glycocol.

Pierre Bedos and Adrien Rüyer : The stable dibromide of 1,3.cyclohexadiene.

Pierre Chatelain : Is the double refraction of liquid crystals independent of the action of the walls or of the action of the magnetic field ?

André Demay : The connexion between the Dinantian granite, microgranite and rhyolite in the eastern part of the Guéret massif.

M. and Mme. Fernand Moreau : The toxicity and antagonism of certain anions in cultures of *Saprolegnia*.

Maurice Marie Janot : The phenomena of growth produced in plants following injections of hetero-auxin (β-indolacetic acid).

Albert Berthelot and Mlle. Germaine Amoureux : Remarks on the utilization of aseptic seedlings for the study of the formation of tumours.

Fernand Willaume and Osias Binder : The absorption spectra by reflection in the ultra-violet of some basic copper salts and other fungicidal and insecticidal products.

Jean Louis Perrot : The activity of the spermatozoids at the level of the hermaphrodite canal of *Helix pomatia*.

Maurice Fontaine : The amount of flavine in various organs of the eel.

Jehan Vellard : Geographical variations of the poison of *Bothrops atrox*.

Henri Simonnet : Contribution to the study of the fate of morphine in the animal organism.

Léopold Nègre, Albert Berthelot and Jean Bretey : The action of the ethyl esters of certain saturated fatty acids on the evolution of experimental tuberculosis in the guinea pig.

Moscow

Academy of Sciences (*C.R.*, 14, No. 4 ; 1937).

A. Alexandrov : New inequalities for volumes of convex bodies.

B. Gnedenko : Unity of a system of orthogonal functions invariant with regard to the derivation.

M. Kourensky : A method of integration of equations with partial functions of the first order, linear with reference to the Jacobians, and with several unknown functions.

V. S. Ignatovskij : The Laplacean transformation (4).

N. S. Košljakov : Developments into Fourier-Bessel series.

S. Mikeladze : (1) The numerical solution of the differential equation :

$$\frac{d^2u}{dx^2} + \frac{d^2u}{dy^2} + \frac{d^2u}{dz^2} = \Phi(x, y, z).$$

(2) The numerical integration of the Laplacean and Poisson's equations.

N. J. Seljakov : Nature of ordinary ice. The existence of two modifications of ice belonging to different classes of symmetry is proved.

M. Konstantinova-Schlesinger: Percentage of atmospheric ozone at the altitude of 9,620 m. determined by fluorometric procedure.

W. A. Plotnikov: Isotopes.

E. E. Babkin: Vapour tension of a mixture of phosphoric and nitric acids.

M. A. Kločko: Conductivity of electrolytic systems.

I. Lobanov and A. Jungerman: The age of old rocks at Isahkovski Hill.

T. T. Demidenko and E. F. Timofeieva: (1) *Azotobacter* as a source of nitrogenous foodstuff for the higher plants. (2) The role of straw as a source of carbohydrates for nodule bacteria.

D Kostoff: (1) Interspecific hybrids in *Secale* (Rye). (2) Studies on polyploid plants (17). *Nicotiana multivalvis* ($2n = 48$) × *Nicotiana suaveolens* ($2n = 32$) amphidiploid ($2n = 80$).

M. Kliučnikova: Physiological characteristics of vernalized and non-vernalized *Perilla*.

N. I. Efimova: Influence of different substances, artificially introduced into leaves of tobacco, on the development of the disease called 'riaboukha'.

A. A. Kuzmenko: Experiments on the illumination of grains by light of different wave-length.

T. T. Demidenko and E. F. Timofeieva: Influence of nodule bacteria and *Azotobacter* on the yield of leguminous and cereal plants sown together.

M. I. Saltykovskij: Causes of intermediate cold resistance in wheat hybrids of the first generation.

Forthcoming Events

Tuesday, June 22

Institution of Heating and Ventilating Engineers, at 7.—A. F. Dufton: "The Air we Breathe".

Thursday, June 24

London School of Economics and Political Science, at 5.30. Oration Day.

Sir William Beveridge: "The Place of the Social Sciences in Human Knowledge".

Saturday, June 26

Royal Meteorological Society.—Summer meeting to be held at the Solar Physics Observatory, Cambridge.

Association of Technical Institutions, June 25–26.—Annual Summer Meeting to be held at Blackpool.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Lecturer in Mechanical Engineering in the Hull Municipal Technical College—The Director of Education, Education Offices, Guildhall, Hull (June 21).

Head of the Department of Hygiene and Public Health in the Battersea Polytechnic, S.W 11—The Principal (June 26).

Lecturer in Geography in the Portsmouth Municipal Technical College—The Registrar (June 26).

Lecturer in Chemistry in the Battersea Polytechnic, London, S.W.11—The Principal (June 26)

Lecturer in Physics and Methods of Teaching Science in the Borough Road College, Isleworth, Middlesex—The Principal (June 26).

Assistant Masters to teach Engineering and Science and Mathematics in the Bolton Municipal Technical College—The Director of Education, Education Offices, Nelson Square, Bolton (June 30).

Lecturer in Production Engineering and Lecturer in Electrical Engineering in the Central Technical College, Birmingham—The Principal (June 30).

Assistant for Computational Work, etc., in the Mathematics Department, Imperial College of Science and Technology, South Kensington, S.W.7—The Secretary (June 30).

Senior Physicist, Chemist and Research Assistant in Biochemistry on the staff of the Wool Industries Research Association—The Secretary, Torridon, Headingley, Leeds, 6 (June 30).

Lecturer in Biology and School Gardening in the Swanley Horticultural College for Women, Swanley, Kent—The Principal (July 1).

Biochemist in the Rowett Research Institute, Aberdeen—The Secretary (July 1).

Demonstrator in the Physics Department, Guy's Hospital Medical School, London Bridge, S.E.1—The Dean (July 2).

Psychologist (woman. part-time) in the Maudsley Hospital, Denmark Hill, S E 5—The Medical Superintendent (July 3).

Principal and Head Master of the Sheerness Technical Institute and Junior Technical School—Mr V. C. Stupples, 46 High Street, Sheerness (July 3).

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research Report of Test by the Director of Fuel Research on the Carbonising Plant of Coal and Allied Industries, Ltd., at Seaham Harbour, County Durham—Test carried out 10th to 17th September 1936. Pp. iv+33. (London: H M. Stationery Office.) 9*d.* net [245

Ministry of Health. Costing Returns, Year ending 31st March 1936. Part 2: Poor Law Institutions, Separate Casual Wards. Pp. 27. (London: H.M. Stationery Office) 1*s.* 3*d* net. [245

Twenty-five Years of the London Museum: an Album of Photographs illustrating the Range of the Collections. Pp 142+130 plates (London: London Museum.) 2*s.* 6*d.* [265

Other Countries

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 205: Cartography. By Charles H. Deetz. Pp. vi+83+29 plates (Washington, D.C.. Government Printing Office.) 60 cents. [215

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 19: Functional Planning of Elementary School Buildings. By Alice Barrows. Pp. viii+88 (Washington, D C.. Government Printing Office.) 25 cents. [215

Achema Jahrbuch, Jahrgang 1937: Berichte über Stand und Entwicklung des Chemischen Apparatewesens. Begründet von Dr Max Buchner. Herausgegeben unter Mitwirkung von Fachgenossen aus Wissenschaft und Technik der Achema. Pp. 296+xlviii+96 (Berlin: Verlag Chemie, G.m.b.H.) [245

U.S. Department of the Interior. Geological Survey. Bulletin 868–D: The Kaiyuh Hills, Alaska. By J. B. Mertie. (Mineral Resources of Alaska, 1934.) Pp. ii+145–178+plate 9. 10 cents. Bulletin 878: Analysis of Rocks and Minerals from the Laboratory of the United States Geological Survey, 1914–36. Tabulated by Roger C. Wells. Pp. x+134 15 cents. Bulletin 880–A: Mineral Industry of Alaska in 1935. By Philip S. Smith. (Mineral Resources of Alaska, 1935.) Pp ii+95+plate 1. 20 cents. Professional Paper 186-C: Fossil Plants from the Stanley Shale and Jackfork Sandstone in Southeastern Oklahoma and Western Arkansas. By David White. (Shorter Contributions to General Geology, 1936.) Pp. ii+43–67+plates 10–14. 10 cents. Professional Paper 186–D: Some Organic Constituents of a Recent Sediment from Chincoteague Bay, Virginia. By Roger C. Wells and E. Theodore Erickson. (Shorter Contributions to General Geology, 1936) Pp. ii+69–79+plate 15. 10 cents. Professional Paper 186–G: Stratigraphic Relations of the Austin, Taylor and Equivalent Formations in Texas. By Lloyd William Stephenson (Shorter Contributions to General Geology, 1936.) Pp. ii+133–146+plate 44. 10 cents. Professional Paper 186–I: Some Deep Wells near the Atlantic Coast in Virginia and the Carolinas. By W. C. Mansfield. (Shorter Contributions to General Geology, 1936) Pp. ii+159–161. 5 cents. Water-Supply Paper 786: Surface Water Supply of the United States, 1935. Part 6: Missouri River Basin. Pp. 358. 40 cents. (Washington, D.C.: Government Printing Office.) [245

Koninklijke Vereeniging "Koloniaal Instituut", Amsterdam. Zes en twintigste Jaarverslag, 1936. Pp. 185 (Amsterdam: Koloniaal Instituut.) [245

Proceedings of the U S. National Museum. Vol. 84, No. 3016: Two New Beetles of the Family Mordellidae from Orchids. By Eugene Ray. Pp. 239–242. (Washington, D.C.: Government Printing Office.) [245

Catalogues, etc.

Catalogue of Books and Journals on Zoology, Biology and Geology. (No. 507.) Pp 66. (Cambridge: W Heffer and Sons, Ltd.)

A Collection of Old Medical Books: Bacteriology, Circulation of the Blood, Electrotherapy, Ophthalmology, Pharmacology, etc (List No. 25.) Pp. 36. (London. E. P. Goldschmidt and Co., Ltd.)

Scientific Instruments. Pp. 100. (Delft. P. J. Kipp and Zonen; London: W. Edwards and Co)

Vergleichende Anatomie. Histologie, Ontogenie, Anthropologie. (Antiquariatskatalog Nr. 712). Pp. 202. (Leipzig: Gustav Fock, G m.b.H.)

Cambridge Pressure and Draught Indicators and Recorders (Folder No. 47a.) Pp. 6. (London. Cambridge Instrument Co., Ltd.)

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Native Policy in the Empire

LORD NOEL-BUXTON, in bringing forward a motion in the House of Lords on June 9 that native policy in the Empire should be considered in the present session of the Imperial Conference, raised a question of wide and far-reaching implication, involving the status and well-being of vast populations of backward peoples who, whatever their present grade of civilization and condition of tutelage, are nevertheless members of the Empire, and, presumably, will hand on that privilege with its rights and duties to their descendants.

The wording of the motion was as follows:

> That this House, in view of the divergences in native policy now developing in different parts of his Majesty's Dominions and Dependencies, believes that the time has arrived for the Imperial Conference to formulate such policy in broad outline, with a view to protecting the rights and promoting the advancement of all races of the Empire, whatever may be their religion and colour, and that such policy should be based upon the principle of trusteeship.

It was, by leave, withdrawn; but its exact and comprehensive phraseology will not be forgotten when, as is inevitable, the question is raised again and further discussed.

The motion forced not one, but several cards. In the debate which followed, discussion tended decidedly to criticize, defend or extenuate existing policies in native administration, rather than to discuss the merits of the substantive proposal. This is not entirely to be regretted. It afforded an opportunity for expression of opinion on the principle of 'trusteeship', upon which the motion had asked for a direction from their Lordships. An important exchange of views emerged, which might have been stifled at its inception by an official intimation that at this late date it was impossible to entertain the proposal.

In supporting his motion, Lord Noel-Buxton had little difficulty in making out a case. It is probable that most will agree that the Imperial Conference affords the best, perhaps the only, effective machinery for the full and free discussion of the position, which is not only fast becoming anomalous, but also may—indeed in Africa inevitably will—become dangerous, unless handled with foresight and statesmanship. It is not without significance that Mr. Ormsby-Gore, in his review of the affairs of the Colonial Office during recent years before the Imperial Conference on May 31, stated that he considered that the main political problem which confronts the Colonial Office is still "the relationship between natives and non-natives, both European and Asiatic, in many territories, following the growth of education and the awakening of political consciousness". It cannot be doubted that a colonial administrator of his experience must also have had at the back of his mind the problem as it is manifested in instances which were not under review. In a matter of so delicate a character as this question has become under the provisions of the Statute of Westminster, the initiative demands a strong force of informed opinion as a stimulus to any action which will ensure discussion on an Empire-wide basis.

The anomalies which were adduced by Lord Noel-Buxton in support of his argument might be multiplied manifold; but it was sufficient for him to contrast the position in West Africa and in New Guinea with the conditions of the pass system and under-colour bar legislation to demonstrate the gulf that lies between what are, broadly speaking, two schools of thought in approach to the problem of the backward races of the Empire. On one side, as in West Africa, the native is afforded full opportunity for educational and economic development, as well as a measure of co-operation in the administration of affairs. In New Guinea, among peoples who a brief time past were head-hunters, living in the stone age, education in the purpose of administrative measures and some participation in their working have been productive of even an enthusiasm for paying taxes. On the other hand, in South Africa, where racial feelings run high, the prevailing policy is one of repression and domination.

On the main principle, so far as it affects the natives of territories directly under the control of the British Parliament, their Lordships' expression of opinion is virtually unanimously on the side of the benefit of the native being the paramount interest of administration. A word of caution was put forward by the Marquess of Lothian, who in sympathy with the patent difficulties of the Colonial Office, stressed the obligation to white settler as well as native; but the feeling of the House was such as to justify the view that the aim of the Government as stated by the Marquess of Dufferin, Under Secretary of the Colonial Office, "to govern the indigenous races in their own interests and with a view to their elevation in the scale of civilization", will not be allowed, in this 'place' at least, an interpretation which would permit, for example, the natives of the South African Protectorates to be exposed to such regulation as it has been proposed to apply to the indigenous inhabitants of the mandated territory of South-West Africa.

It is possible that some may feel with Lord Bledisloe that at the present moment the needs of the situation will best be met by "the Government on the spot" rather than by any attempt to secure uniformity in a policy formulated by the Imperial Conference. Such a policy would have to apply to different races in different parts of the world, and this, it was maintained by Lord Dufferin in his reply on behalf of the Government, precluded the possibility of dealing with the varied conditions as a unitary whole. There is indeed much to be said for this point of view. Obviously the problem differs from one territory to another. In Canada and Australia, for example, it varies in essential features from the problem of West Africa—the difference in the relative proportion of native and white alone places the latter in another category; but notwithstanding innumerable and important variations in detail, which necessitate elasticity in organization and machinery as between one part of the Empire and another, the inspiring principle may and should be the same, if trusteeship be adopted as the valid basis of relationship between ourselves and the less advanced races.

The eye of the practical administrator must necessarily be directed in affairs to the next step; but even so, it is well to be sure of the general direction in which that step should lead. The state of affairs which has arisen in regard to the indigenous population of Nyasaland is largely the outcome of well-intentioned but misdirected effort in the past. The measures which are being taken to cope with the situation there, as reported by Mr. Ormsby-Gore in his annual survey of colonial affairs in the House of Commons on June 2, indicate the desirability of a unity of outlook in dealing with certain aspects of the native question in East and South Africa as a whole.

The aim of the Union of South Africa is to ensure the stability of a great and prosperous white man's country; but the native population outnumbers the white by something like four to one. Now, when Black Africa as a whole is awakening to an intense desire for development in one direction or another, South Africa is sitting on the safety valve. Over against the Union's policy of segregation stands as an alternative 'trusteeship'. But trusteeship is no more than a means to an end. Unless its function is interpreted constructively and in the light of scientific study of native institutions and the effect on them of the cultural impacts which must follow from the assumption of the obligation which trusteeship entails, premature inculcation of European ideals, social, ethical and economic, may prove no more beneficial and no less dangerous in the long run than segregation. It cannot be repeated too often, nor too insistently emphasized, that the time has now come when the ultimate aim of such measures as 'indirect rule' and 'trusteeship' should be defined in precise terms. In the formulation of this aim the prior necessity of anthropological study should not be ignored. The anthropologist alone is competent to determine and bring together the data upon which it will be possible to define the direction and rate of change least likely to bring disintegration and disaster in its train.

Hydrography of the Atlantic Oceans

Schichtung und Zirkulation des Atlantischen Ozeans

Lieferung 3: Die Troposphäre. Von Albert Defant. (Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition auf dem Forschungs- und Vermessungsschiff *Meteor* 1925–1927, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft von A. Defant, Band 6, Teil 1.) Pp. iii+289–411. (Berlin und Leipzig: Walter de Gruyter und Co., 1936.)

THE oceanic troposphere, like the corresponding section of the atmosphere, is a relatively shallow layer marked by steep temperature gradients which contrast strongly with the more even conditions of the stratosphere. Prof. Defant and his colleagues have employed these terms consistently since 1929. The waters of the arctic and antarctic regions belong entirely to the stratosphere, and in the Atlantic Ocean the troposphere extends from 45° S. to 55° N., to a depth of 600 metres and 950 metres in the southern and northern subtropical regions, and to 300 metres near the equator.

Prof Defant's account is based largely on the observations made at 242 stations by the *Meteor*, but with the thoroughness which characterizes all the work published from the Institut für Meereskunde, no source of information has been overlooked, and, in all, the data obtained by twenty-three expeditions have been used.

The main tropospherical currents are horizontal and are confined to the upper strata, but there is also a vertical circulation with widespread influence on the structure of the layer. In the southern and northern subtropical regions, where anticyclonic current systems lead to accumulations of highly saline surface water, there are sinking movements; and in the equatorial zone, which is mainly a divergence region, there are ascending currents.

Owing to two counteracting influences, the powerful warming of the surface water by radiation from sun and atmosphere, and the cooling of the sub-surface water by horizontal advection, the troposphere becomes resolved into three strata: an almost uniform surface stratum, a discontinuity stratum in which temperature and density change rapidly with depth, and a more extensive underlayer which has been called the sub-troposphere.

The surface stratum belongs mainly to the region of the trade wind drifts (the north and south equatorial currents), but it can be distinguished, though not so clearly, as far as 30°–35° S. and 25°–30° N. Its depth is 140 metres in 20° S., 85 m. in 5° N., and 195 m. in 25° N.; but at the equator and in 10° N. the surfaces of equal density sweep upwards until, on either side of the depression in 5° N., the depth of the uniform stratum is only 70 m. and 53 m. The depth also varies from east to west, being greater in the west, and there are minor variations that are best studied from the author's charts.

The upward sweep of the density surfaces at the equator and in 10° N. is worthy of particular notice. As Sverdrup showed for the Pacific Ocean, the convexity in 10° N. exists because this latitude is the thermal equator of the ocean, and the second upwelling, at the equator, because the effect of the earth's rotation is symmetrical about the equator. The south equatorial current extends into the northern hemisphere as far as 5° N., and the influence of the earth's rotation makes its density surfaces slope downwards to the south in the southern hemisphere and downwards to the north in the northern hemisphere.

In the region of the equatorial counter-current, between 5° N and 10° N., the density surfaces slope upwards to the north, and since such a slope is dynamically stable only if the surface current flows eastwards, it follows that the counter-current is not entirely a compensation current as hitherto supposed.

The discontinuity stratum of the troposphere, marked by a sharp decrease of temperature and increase of density with depth, has an average thickness of 50–100 m. It is traversed by far-reaching undercurrents which have their origin in the subtropical accumulations of surface water, and are made conspicuous by their high salinity. One of the most striking is the *southern hemisphere undercurrent*, which leaves the southern subtropical region and flows northwards along the coast of South America to join the large volume of subtropical water carried by the Gulf Stream.

The sub-troposphere is the least characteristic of the three strata. The temperature and salinity decrease with depth but more slowly than in the discontinuity stratum, and the activity of the water circulation diminishes. The lower boundary of the layer is marked by slightly greater changes, but since the water in the boundary region escapes the aerating influence of both tropospherical and stratospherical currents, its most distinguishing feature is a very low oxygen content.

The value of the report under notice is greatly increased by tables, sections and charts; all the plates are magnificently produced in colour, and they are very easy to understand. The report is a very worthy addition to the accounts of the hydrography of the deep and bottom waters already published in the same series.

G. E. R. DEACON.

Cancer and Diet

Cancer and Diet:
with Facts and Observations on Related Subjects. By Dr. Frederick L. Hoffman. Pp. xx+767. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1937.) 5 dollars.

ABOUT one half of this book consists of reviews of work concerned with questions of diet or cancer and the possible relationship of these to each other, so far as can be found in publications in the author's own library. Most references to original work are obtained from abstracts in the *Cancer Review* and *American Journal of Cancer*. Many extracts are given from the *Cancer Review*, which came to an end in 1932, though the extracts show how valuable a review it was.

Of the work published on diet and cancer, "so much is contradictory that no balance can be drawn between the advocates of one theory or another". Certain foods which have in the past been suggested as the cause of cancer are almost certainly innocuous. Thus potatoes have been indicated as a cause of cancer, apparently because potatoes are themselves subject to disease, but Dr. Hoffman points out that the cancer mortality in Ireland, where potatoes are widely consumed, is lower than in the rest of the British Isles. It has been claimed that injection of tomato juice into animals produces cancer, but there is absolutely no evidence that the eating of tomatoes can induce malignant changes in the body. This book shows that no one food can be considered a cause of cancer.

The second half of the book deals with Dr. Hoffman's own contribution to the subject. He has composed a questionnaire which has been answered by 2,234 people suffering from cancer and by 1,149 controls. The questionnaire deals with age, religion, race, physique, food preferences and medical history. The answers to the questions are tabulated in the appendixes according to sex and occurrence of cancer. In most of the answers there is no significant difference between normal and cancer cases. One of the most striking differences, however, is in the religious categories. Of the cancer cases 57 per cent were Protestant and 32 per cent Catholic, while of the normal cases 45 per cent were Protestant and 42 per cent Catholic. Dr. Hoffman does not discuss the significance of these differences, which may be due to an error in sampling. Examination of food preferences suggest that the vitamin and total food consumption of cancer cases is excessive, and Dr. Hoffman's main principle is that a diminished food intake would reduce the incidence of cancer. He admits, however, that this is not yet definitely proved and is himself seeking further evidence along the lines which he has already used.

The idea that the average man consumes more food than is good for him is fairly common, particularly among American biologists. Chittenden recommended a protein intake which was about half that present in a normal Western diet, and Raymond Pearl considered that smoking lengthened life because it reduced appetite.

The closing sentence of this book is: "I consider my own duty discharged in presenting the facts as I have found them, which lead to the conclusion that overnutrition is common in the case of cancer patients to a remarkable and exceptional degree, and that overabundant food consumption unquestionably is the underlying cause of the root condition of cancer in modern life." This conclusion is difficult to reconcile with the fact that cancer is not rare among peoples who are not considered to be overnourished, such as Japanese, Chinese, Malays and Filipinos. Further evidence which is contrary to Dr. Hoffman's thesis is given by figures in the Registrar-General's Decennial Supplement for England and Wales (1921), showing that cancer is more common in the lower social classes, which are usually assumed to live on a less liberal diet than the upper classes.

The possibility of error in the method of examining questionnaires is obviously very great as the personal element is predominant in the answers obtained. It is common to meet very fat people who say that they eat practically nothing. Apart from the erroneous answers that may be obtained, the interpretation is extremely difficult to put on a quantitative basis. Finally, assuming that there is a correlation between the incidence of cancer and high food intake, a large appetite might conceivably be due to some inherited factor linked to another factor predisposing the individual to cancer. The relationship of cancer and diet is of interest and may be of importance, but the true nature of this relationship is difficult to determine

Radio-Frequency Technique

Lehrbuch der Hochfrequenztechnik
Von Dr. Fritz Vilbig. Pp. xx+775. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937). 32.80 gold marks.

TO attempt an up-to-date survey of radiotechnics, a subject in which the progress daily astonishes us by its variety as well as its rapidity, might daunt anyone. Yet, in this textbook of high-frequency technique, Dr. Vilbig has not only attempted such a task but also has executed it most commendably. Writing with the outlook of a student of what is nowadays often called 'light ,engineering', rather than that of a physicist, he has given an extraordinary lucid account of both the science and art of modern radiocommunication, with just sufficient in the way of backward glances at the older-fashioned methods to satisfy the mildly conservative. In short, he tells us all about the new with just as much about the old as is worth remembering.

The book contains twenty-six chapters, of which the first six are devoted to high-frequency phenomena in open and closed circuits and to the propagation of electric waves either along wires or through space and the ionosphere. Thirteen chapters are devoted to thermionic valves and their multifarious uses. For the English or American reader there is here one disadvantage to be noted, for the somewhat lengthy columns of valve data all refer to German tubes (Telefunken or Loewe). If the volume is ever translated into English, this will have to be changed.

Four more chapters deal with the application of apparatus and methods in the maintenance of communication, while the last two chapters deal respectively with television and with the thermal and physiological actions of radio-frequency currents. In the chapter on television we note perhaps most markedly the influence of the author's nationality, but from it we can scarcely fail to conclude that Germany lags considerably behind Great Britain in the matter of broadcast television.

Special mention should be made of the informative diagrams and illustrations. There are also a hundred pages of reference to books and original papers arranged under the chapter headings and subdivided chronologically. This list is like the subject matter of the book itself, up-to-date to the end of last year.

E. V. A.

The Case for Racial Crossing

Half-Caste
By Cedric Dover. Pp. 324. (London: Martin Secker and Warburg, Ltd., 1937.) 10*s*. 6*d*. net.

THERE is need for a scientific work on the subject of race and racial crossing; but the present book can scarcely lay claim to fulfil that need. It considers mainly the social and historical aspects of racial crossing, with some references of a less critical kind to its biological and anthropological bearings. It contains a chapter on the condition of the Eurasians, of whom the author is one, and another on the life of a Eurasian poet. The chapter on "Miniature Melting Pots" gives short accounts of mixed groups in many parts of the world. Another chapter is concerned with racial crossing and its results in South Africa, Chapter x is devoted to the American "Negro" (Afroamericans), followed by another on the racial mixtures of South America.

One can appreciate the author's point of view without sharing it. He looks forward to universal miscegenation as a cure for the world's ills, and favours policies for the "judicious encouragement of interbreeding and the development of mixed groups". But he admits that there is at present "distressingly little evidence of this spirit". It is worth pointing out that even if intercrossing between, for example, whites and blacks were universally regarded as desirable, Europe would still necessarily remain for millennia essentially white and Africa essentially black. Mr. Dover himself quotes the conclusion of Williams on the Maya-Spanish crosses in Yucatan, that after nearly four centuries they "can still be more or less separated into sub-types corresponding to the ethnic elements concerned in the ancestry".

This fact of genetic segregation in racial crosses, together with the great disparities in culture (in the widest sense) between the more divergent human types is, for many, sufficient reason against creating insoluble problems by advocating the further intermingling of mankind's already sufficiently mixed types. Such advocates usually forget that the diversity of climates alone makes it impossible to build the same kind of civilization everywhere, and that there is already a certain amount of racial adaptation to different environments. Intermixture with a distant race breaks apart and redistributes these adaptational differences, to the detriment of the races concerned. No degree of civilization can do away with the need for such adaptations in the more extreme climates, arctic and equatorial. But every biological rule has its exceptions, and certain racial mixtures, such as Indian-white crosses in the wilder parts of Northern Canada, may be justified in their results.

The author has "made the interesting discovery that peoples similar to the Eurasians may be observed everywhere" (p. 277), but it is obvious that such "similarities" are too superficial to count for much against the disparities which exist among crossed types in different parts of the world. The "brown fringe", which the author hopes to see extended as a "portent of a new humanity" would only increase the number of racial types without contributing materially to the solution of racial problems.

Those who are interested in the more controversial aspects of race crossing will find them sympathetically considered in this book. One of its best features is a rather extensive bibliography.

R. R. G.

Contact Catalysis

The Mechanism of Contact Catalysis
By Dr. R. H. Griffith. Pp. xi+208. (London: Oxford University Press, 1936.) 15*s*. net.

THE importance to-day of catalytic processes in the chemical industry are obvious to everyone who is acquainted with the catalytic production of sulphuric acid, the synthesis of ammonia from its elements, the manufacture of nitric acid by the oxidation of ammonia, and the manufacture of liquid fuel both by the direct and indirect hydrogenation of coal. Each year finds more and more applications of catalysis to industry, but so far the development of catalysts has been mainly empirical in character, entailing a mass of detailed and expensive investigation prior to each new application.

In the introduction to the book under review, the author points out that if the phenomena of catalysis had been explored completely, it should be possible not only to give a logical explanation of every known example, but also to predict the conditions under which new reactions could be carried out. Our present knowledge does not yet permit of this, but there have been in the last few years many important discoveries in relation to the mechanism of heterogeneous catalysis, and Dr. Griffith has referred to and attempted to correlate what he considers to be the more important of the numerous publications relating to the study of surfaces and to other properties of catalysts. The author is himself responsible for a number of original papers in the field of catalysis and is therefore well able to present the subject authoritatively. This he has done in a most adequate manner.

Experimental methods employed in the study of reaction kinetics are briefly described in the first chapter, and throughout the book stress has been laid on methods of experiment as well as on the interpretation of results. The study of adsorption of gases by solids has played an important part in elucidating the nature of catalytic action, and a survey of work in this field is presented in the second chapter. The conception of activated adsorption advanced by H. S. Taylor in 1931 has proved a great stimulus to the progress of surface chemistry. In a later chapter the author predicts that the accumulation of facts about the adsorption of a wider range of gases and vapours on surfaces composed of metals, oxides, sulphides and similar surfaces, will eventually prove extremely useful in the development of new catalysts.

The third and fourth chapters deal with promoters and carriers, and with poisoning and retardation. The examination of the catalyst surfaces and the probable spatial arrangement of the adsorbed molecule in relation to the actual configuration of the solid catalyst next receive treatment. It is interesting to note that, at the end of the chapter devoted to the mechanism of catalysis, the author concludes that all recent experimental work on catalysis is leading back to ideas closely approaching the old intermediate compound theory.

The volume contains numerous tables and figures and is provided with an excellent index.

R. T.

The World of Science

By Dr. F. Sherwood Taylor. Pp. xvi + 1064 + 48 plates. (London: William Heinemann, Ltd., 1936.) 8*s.* 6*d.* net.

To those who are fond of encyclopædic omnibus volumes this book will give pleasure. Its avowed purpose is "to answer in simple terms the questions which the ordinary man and woman ask about living creatures, the world and the mechanical devices daily encountered by all". One must admire the successful conclusion of the immense task that the preparation of this book must have proved to the author and his assistants. Nevertheless, parts of the book seem to indicate that the weariness known to all authors of large volumes must sometimes have unwittingly crept over Dr. Taylor, and one can well imagine him struggling with the gigantic array of knowledge represented by the whole of science.

The style adopted does not, in general, make for easy reading, the sentences being, for the most part, short and jerky. The various divisions of the branches of science are set out in tabular form on p. 12. In such an up-to-date book we are surprised at the omission of biophysics, especially as biochemistry is included. There are a few inconsistencies in the book itself. On p. 295 it is stated: "It was a longish step to show that matter of all kinds was made up of nothing but these electrons and positive charges", but on p. 531 we read that "atoms are composed only of three things, electrons, protons, and neutrons". The statement on p. 421 that "ultrasonic waves are transmitted very much as light" is misleading. True ultrasonics behave to some extent in a similar way to light, but the mode of transmission is fundamentally different.

It is unfortunate that some of the diagrams have been reduced so much as to detract considerably from their value. Chemical substances and reactions are frequently shown diagrammatically as groups of spheres representing atoms, in the manner used to represent crystal structure. The advantage of this over the more usual chemical formulæ is open to question, for it seems liable to lead to misconceptions.

Despite these criticisms, however, this book contains a vast store of knowledge, accurately presented, and will form a useful addition to the "ordinary man's" library, and the index will enhance its value as a reference book.

H. R. LANG.

Battlefield of the Gods:

Aspects of Mexican History, Art and Exploration. By Pál Kelemen. Pp. 212 + 61 plates. (London: George Allen and Unwin, Ltd., 1937.) 10*s.* 6*d.* net.

"BATTLEFIELD OF THE GODS" should not be passed over lightly as a travel book of the usual type. The author, it is true, is neither archæologist nor ethnologist and in his description of such of the archæological sites of Mexico and Yucatan as were visited by him, there is nothing new in the way of fact; but he has the trained eye of an artist, and he has pondered to some effect the place of art as a functional element in culture. Hence he is able to bring out the significance of the art and architecture of the ancient peoples of Central America as an expression of their racial history, developing under the influence of their environment. It must be counted as among the more illuminating features of this book that the author's review of post-Conquest development and his studies of ecclesiastical architecture and the Christian religion, as it was adopted by the native, as well as his incidental glimpses of the native mind as it exists to-day, demonstrate vividly how Maya, Aztec and Spaniard have blended to produce what is most characteristic and distinctive in the modern civilization of Central America. In short, in a series of impressionistic sketches he indicates the trend of that continuity of cultural development from pre-Conquest days, of which the evidence is being collected, more scientifically perhaps, but not more convincingly, by the organized research of the Carnegie Institution of Washington.

It should be added that some remarkable examples of post-Conquest ecclesiastical art are figured and described here, which have not previously been published. This book should do much to convince English readers of the interest of a branch of archæology which, unfortunately, has too few supporters in Great Britain.

The Statesman's Year-Book:

Statistical and Historical Annual of the States of the World for the Year 1937. Edited by Dr. M. Epstein. Seventy-fourth annual publication, revised after Official Returns. Pp. xxxvi + 1502. (London: Macmillan and Co., Ltd., 1937.) 20*s.* net.

FEW volumes cover a more comprehensive field than this annual, which as usual has been revised up to the end of March in the year of issue. Government, area, population, education, finance, production, commerce, communication and many other topics are descriptively and statistically treated for every State in the world. In addition, there is information on currency, weights and measures and even names of diplomatic representatives, and long lists of authoritative books of reference. The British Empire and the United States of America receive the fullest treatment and occupy nearly half the volume, which despite its many pages occupies a remarkably small bulk. An exhaustive index facilitates reference. As usual, two coloured maps are included: this year they show respectively the Sanjak of Alexandretta in relation to Syria, and Abyssinia with surrounding territories. A number of tables give world production of several important commodities and particulars of fleets and merchant shipping.

Builders' Estimates and Pricing Data:

their Preparation and Analysis. By Henry A. Mackmin. (The Directly-Useful Technical Series.) Second edition, revised and enlarged. Pp. xii + 227. (London: Chapman and Hall, Ltd., 1936.) 12*s.* 6*d.* net.

THIS work is the third edition of a book first published in 1926 and incorporates not only new matter on recent developments in building construction, but also the methods of estimating used in the Midlands and the north, as well as in London and the south. It is extremely readable, and can be suggested as well suited to those engaged in the technical side of building generally.

B. H. K.

The Nature of Snow*

By Gerald Seligman

ALL ice and snow forms are crystalline. To demonstrate the crystalline structure of even an apparently non-crystalline body such as a shapeless block of ice, Tyndall passed a beam of light through it. If we repeat this experiment we find that hexagonal cavities are produced and that the process of crystallization is, as it were, reversed, so that we get what are sometimes called 'negative crystals', or as I prefer to call them, 'negative figures', within the body of the ice (Fig. 1). As the action of the beam proceeds, each figure becomes filled with the water which occupied it as ice. In the centre of each figure a bubble forms, which, in reality, is a vacuous sphere due to the water taking up less space than the ice.

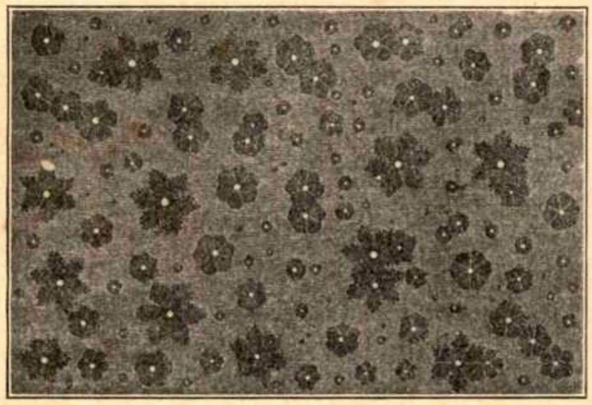

Fig. 1.
NEGATIVE FIGURES IN ICE.
Reproduced from "The Glaciers of the Alps", by J. Tyndall (by courtesy of Sir John Murray).

These 'negative figures' are very useful in telling us the arrangement of the crystals in a mass of them, such as, for example, in glacier ice. They lie at right angles to the principal axes of the ice crystals, and parallel to the original freezing surface. Therefore, in pond ice, as we should expect, the 'negative figures' are found parallel to the surface of the pond, and this confirms that the ice crystals grow with their principal axes perpendicular to the surface. In artificial ice they are often found more irregularly placed, the incidence of the refrigeration having been irregular.

In glacier ice we find that the crystals are orientated without any order, for the reason that the glacier crystals have grown from snow grains, each crystal preserving the haphazard orientation of the original snowflake as it fell on to the surface.

SUBLIMATION

Everyone who wishes to understand snow must understand sublimation. Sublimation is, of course, the transition of a solid into a gas and its immediate reconversion into the solid, without entering the liquid phase. Many substances do this, and ice is one. Under suitable conditions it evaporates direct into water vapour, and, again under suitable conditions, this will reconsolidate, or, in loose parlance, sublime, into ice without any water appearing.

The evaporation of ice into water vapour has probably been seen by every winter visitor to the Alps; on a dry, warm day a patch of snow on a rock will vanish into thin air without leaving a trace of moisture. Among other factors, principally those of wind and the relative humidity of the air, ice evaporation is promoted by a relatively high ice temperature; the reconsolidation of this vapour into ice is brought about by a relatively

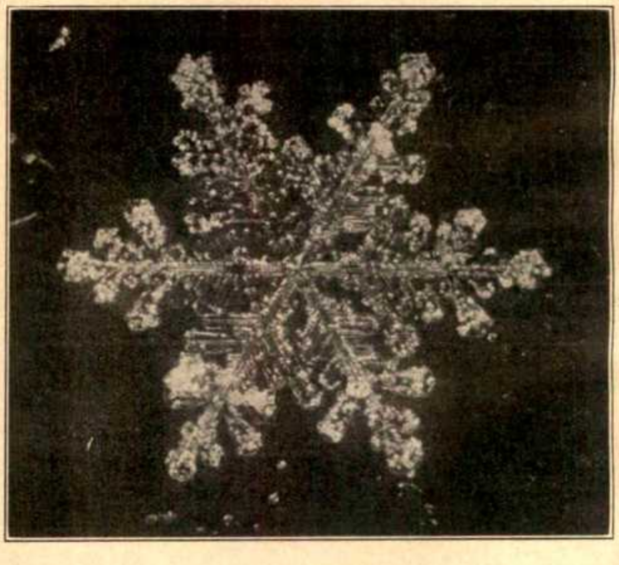

Fig. 2.
A TYPICAL DENDRITIC SNOWFLAKE (× 15).
Photograph by G. Seligman.

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* From the Friday evening discourse at the Royal Institution delivered on January 22.

low temperature. There is scarcely a single snow phenomenon that does not to some extent depend on sublimation. The genesis of snow itself—the growth of the snowflake—is nothing but the sublimation of water vapour out of a supersaturated atmosphere. In this case sublimation starts upon nuclei floating in the air, which may consist of grains of dust, pollen or chemical salts.

SNOWFLAKES

The designs of snowflakes are probably infinite. Bentley, a distinguished American experimenter, photographed some 5,000 types, and believed that he had only attacked the surface of the possibilities.

The simplest form of snowflake is a hexagonal plate about ten times greater in diameter than in thickness. Its diameter might be as large as 1 mm. or 2 mm., or much smaller. More common in the Alps are the dendritic flakes (Fig. 2). When snow falls at a temperature close to freezing point, we get the large cotton-woolly aggregates which are so common in Great Britain, the word 'flake', in fact, denoting its woolly character.

Another form of flake is the prism, and its variant, the needle. Fascicular bundles of needles frequently cross each other at 90°, departing from the usual 60° symmetry of the ice crystal. This is extremely rare in other forms of ice crystal, except in the case of window hoar—the beautiful crystals which form on the inside of window-panes—and in this case also it is of constant occurrence.

The growth of dendritic flakes was explained by Wegener from work done on the crystallization of iodoform by Lehmann in 1888. Using a slightly supersaturated solution, Lehmann stated that first of all a tiny hexagonal crystal formed, and that immediately surrounding it the solution was only saturated, the supersaturated area remaining a little distance away. Consequently, the corners of the hexagon, being closer to the supersaturated part, would grow out, until liquid could penetrate between the rays so formed and build side growths upon them.

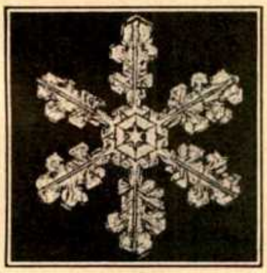

Fig. 3.

Working with iodoform, we have not so far been able to find these two degrees of saturation in the laboratory, but it is a fact that in the sublimed ice crystals which grow on windows, the growing crystal does clear a space all round it. This certainly lends colour to what Wegener has deduced from Lehmann's work. I have observed this space again and again, moving outward as the crystal grows at the expense of the tiny frozen moisture drops covering the pane.

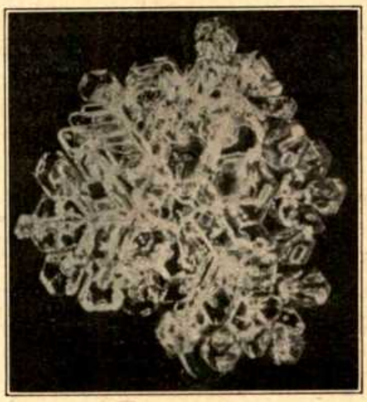

Fig. 4.
A SNOWFLAKE 'ICED-UP' TO FORM A FLAT PLATE OF ICE (× 10).
Photograph by G. Seligman.

Wegener showed, too, that the greater the difference between the vapour pressure of the ice of a flake and that of the surrounding atmosphere —the vapour pressure gradient—the more it favoured the growth of dendritic rays. The lower the vapour pressure gradient, the more the growth of solid plates was encouraged.

With this information it is not very difficult to trace the life-history of a snowflake. Taking the one shown in Fig. 3: at high altitudes, where the vapour pressure gradient was low (owing in this case to temperature and temperature differences being low) the central hexagonal plate was formed. The cold flake then fell to a warmer region, where the vapour pressure gradient increased, and the six rays shot out. Then perhaps it fell out of its snow cloud, when, for another reason (in this case that of lower saturation) the vapour pressure gradient decreased again; a more solid growth resulted and it assumed its final form.

In a converse manner we may be able to obtain a message of the meteorological conditions high up, from the structure of flakes as they reach the earth. This has already been done to some extent, but Nakaya's recent work in making flakes under controlled conditions should enable this, perhaps, valuable addition to meteorological knowledge, to make great strides.

FIRNIFICATION

In any alpine winter snowscape it seems as though Nature has stood still under its winter mantle, and that all is peace. Yet, in truth, the snow cover is a vast and active laboratory in which the flakes are made to undergo incessant and increasing change, until the time when they disappear in spring and commence their long journey to the sea, or, at high altitudes, become converted into glacier ice.

These changes are called 'firnification'. When snow falls, it lies on the ground in the loosest and most impalpable condition. Its specific gravity at this time is about 0·06, that is to say, 1/15 ice, 14/15 air, but under certain conditions of calm and low temperatures, it may be only 0·01, that is 1/92 ice, 91/92 air!

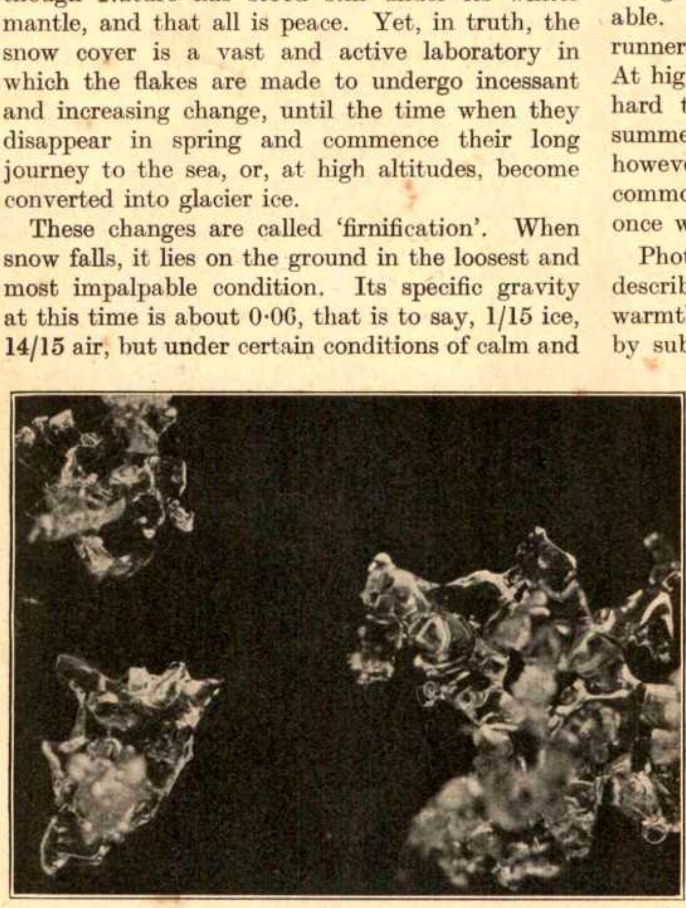

Fig. 5.

ADVANCED FIRN SNOW; SHOWING THE CEMENT BINDING THE GRAINS TOGETHER (× 7).

Photograph by G. Seligman.

The snow immediately begins to settle. The sharp points of the rays evaporate, and the flakes break up, so that the powder of broken flakes sinks together and becomes firmer. Its specific gravity will now have risen to 0·2 or 0·3. At this stage it is called 'powder snow', and is in its most attractive condition for ski-runners, who, as they skim down the mountain-side, can turn in it hither and thither at will.

Then, under the influence of alternate heating and cooling, a crust begins to form on the snow surface which tends first to trip the unskilled skier, and then, as it grows in depth, becomes hard, so that a man climbing the mountain must cut steps in it. In this condition it is known as 'firn snow', from which the whole process derives its name. But when the hot spring sun has thawed the top few inches of hard firn snow at midday, ski are again able to get a grip, and it then forms one of the grandest and fastest ski-ing surfaces imaginable. 'Spring snow' is the name given by ski-runners to this sun-loosened surface of firn snow. At high alpine altitudes the firn snow becomes so hard that, except on south faces and at midsummer, it is almost permanently icy. It is, however, not true ice, which is far rarer than is commonly believed; that stage comes later, the once whitish firn snow becoming blue and glassy.

Photomicrographs provide a key to the changes described above. Commencing with a snowflake: warmth first causes a blunting of the delicate rays by sublimation, some of the water vapour being trapped and resolidified in the centre of the flake, to make a continuous flat plate of ice. The original rays are still visible (Fig. 4). These plates shimmer like diamonds immediately after a snowfall. Seen by moonlight, when the darkness allows the rainbow colours to shine out undimmed, they are a sight never to be forgotten.

At the same time, some of the flakes begin to fracture, and we also see some reconsolidation of the sublimed water vapour in the form of granules. At this stage the snow has settled into the 'powder snow' beloved of ski-runners.

Next we have a light firn stage. The granules are united into aggregates, due to the alternate heating and cooling. This corresponds to the light sun-crust stages. In the earlier stages of firnification, sublimation is probably the chief factor. In the later stages thawing and freezing due to temperature alternations become more common. Regelation probably plays some part, too, throughout the process.

The grains have now grown in size and a cement binding them together is clearly seen. It is this cement which melts first under the influence of heat, turning the hard firn snow into the loose wet grains of 'spring snow'. The thawing of this cement also causes glacier grains to disintegrate when the sun shines strongly on the glacier surface.

There is an interesting similarity here between ice and metals close to their melting points. In the latter the crystal boundaries are also found to be surfaces of weakness. It is believed, but I think not proved, that when ice freezes it rejects any salts from the interior of the crystals and they find their way to the crystal boundaries and into this cement. Certain it is that, as would be expected from an impure ice, this cement has a lower freezing point than the pure ice crystals, and melts first, releasing them to form 'spring snow' or loose collections of glacier grains as the case may be.

It is possible that there is a true analogy between the behaviour of ice and metals in this respect.

Fig. 5 is a photomicrograph of very advanced firn snow and shows the cement. The difference between advanced firn snow and ice is that in the former some air always remains between the crystals. (So long as there is air between the crystals it is, by definition, snow.)

It is surprising that the actual transition of firn snow into glacier ice has never been observed in detail, or recorded more closely than these photographs show in rather incomplete manner. This is to form the subject of a research now in course of preparation.

If we could descend vertically through the firn region of the glacier, as if by a shaft, we should there too find the snow becoming denser and more ice-like; and that is how it is hoped to carry out the research on the transition of snow into ice mentioned above.*

AVALANCHES

The modern study of snow really derives from a need to understand and prevent (or avoid) avalanche accidents. The study of firnification has thrown a powerful light on the most common winter avalanche—that which comes down soon after a fall of fresh snow.

Fig. 6 shows firnification photomicrographs in diagrammatic form: In *A* the very new snow is interlocked by its rays, and is therefore safe on all but very steep hills. In *B* these rays become reduced in size, and the snow particles are therefore mobile. In *C* the flakes break up and form granules, but still lie loose and mobile. In *D* the snow is granular and more compact, and is again safe. *B*, *C* and *D* conditions will occur more quickly if the air is warm. In other words, low temperatures prolong the avalanche danger.

We may summarize the whole lore of this type of avalanche in the following very simple words:

(1) Immediately after a fall slopes are safe, or at least safer than they will become later when the sun shines. (*A* stage.) This has a practical application. If a party of mountaineers is weather-bound in a hut, it should endeavour to make its escape, other things being equal, as soon as a slightest amelioration in the weather has set in, and not wait until the sun has reappeared.

(2) As soon as the air warms up after a snowfall, the snow becomes mobile, first of course on south, and afterwards on north slopes. (*B* and *C* stages.) The practical import of this is that, again other things being equal, escape should be made by north slopes, which are not reached by avalanche danger until later.

(3) Cold conditions prolong the danger.

(4) As soon as the snow has become denser powder or 'settled' it is safe. (*D* stage.)

WIND-PACKING

The effect of wind upon snow is to pack it hard, forming a crust. From such a crust the erosive action of wind-driven grains cuts out fantastic figures, which may form a serious obstacle to the explorer in polar regions, for they may rise in high, so-called sastrugi, covering wide areas. These sastrugi have their steep face to the wind, which has a practical application, especially on a flat plain where the wind may be expected to be constant over wide areas—in a fog they provide the traveller with a constant indication of direction.

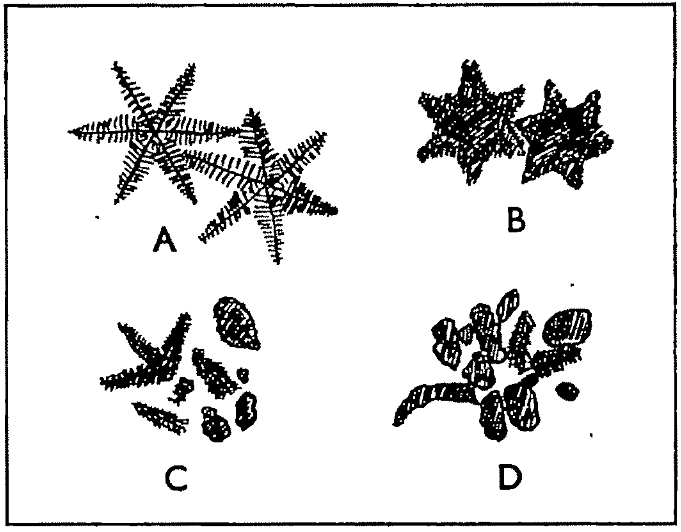

Fig. 6.
DIAGRAM SHOWING THE SAFE AND DANGEROUS STATES OF NEW AND 'SETTLED' SNOW.

Cornices, too, are the result of wind action.

The drifting of snow is a study in itself, and a profound one at that. The deposition of snow in drifts is due to a slackening of the wind speed and consequent deposition of the snow grains it was transporting. If the wind still continues to blow while snowdrifts are forming, that is to say, if the snowdrift is not growing in a complete calm, the hardening, or 'wind-packing' as it is called, will extend right through the drift. If this drifting and packing occur on a steep hillside we get a curious happening. The packed snow, when disturbed by the weight of a man, breaks into blocks which slide down the mountain side, causing what is called a wind-slab avalanche, which may be very destructive.

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* For this research it is intended to adapt the boring tools of the prospector, and, by the construction of a specially made saw-edged drill head, to bring up undamaged cores of firn snow and ice from different levels in the glacier. Such a tool, constructed for me by Messrs. C. Isler and Co., has already yielded promising preliminary results in glacier ice.

It is characteristic of wind slabs that they do not bind themselves to the hillside, but have a hollow space underneath, which renders them all the more unstable.

Photomicrographs of the snow composing one of these wind-packed drifts or slabs showed considerable uniformity in grain size. This indicated a method of approach towards the proof of what had hitherto only been suspected, namely, that the snow had been drifted, since drifting sorts out the grains into uniform sized groups.

A study was made of a whole series of photomicrographs both of natural wind slabs and of wind slabs made under controlled conditions in an out-of-door laboratory. Ultimately it became possible to make this hitherto unexplained phenomenon, which had sent so many brave and wondering mountaineers to their deaths, yield up several of its secrets. Among other things it became possible to tell the mountaineer where on the hillside he can expect the worst wind-slab avalanches, and under what atmospheric conditions they are to be expected.

To put these findings in a nutshell: they are found on slopes to the leeward of the last snow-bearing wind, when the general condition of the air is damp.

This conclusion has already borne fruit. Ever since the fatal avalanche on Mount Everest in 1922, when seven porters met their deaths, leaders of the expeditions have been puzzled by unaccountable avalanches bursting from the North Col with apparently no prime cause. They have now come to realize that these fall under just those conditions which I have pointed out, namely, a wet wind depositing the snow in drifts on lee slopes, and they have been able to link them up with the advent of the monsoon. As soon as the damp monsoon wind blows over the North Col the glacier on its lee side becomes a death-trap. An alternative route has now been reconnoitred and will, no doubt, be used in future, as soon as the conditions begin to favour wind slab development.

Origin of the Papuan Insect Fauna

By L. Evelyn Cheesman

THE island of New Guinea is a centre of distribution for species belonging to the Papuan fauna, which is very distinct and very rich in variety of forms. Yet the bulk of this huge island is part of the Himalayan geanticline, and therefore geologically recent. Since the fauna cannot have evolved upon land recently raised from the sea, there must have been older land from which the new land was populated.

Palæogeologists such as Ortmann, Lapparent, Arldt and others have postulated a land-mass which during the Middle Cretaceous extended from the Asiatic continent south to New Caledonia and eastward to Sumatra and Java. Some time during the Upper Cretaceous, according to the same authorities, New Guinea became separated from Borneo, Celebes and the Philippines, and also from New Caledonia. Later, the entire island is supposed to have been submerged until the Miocene-Pliocene folding movement raised the central ranges and land to the south.

Biological evidence with regard to the distribution of insect species supports these theories of former land-masses up to a certain point. For the Papuan insect fauna appears to be of oriental origin, showing decided affinities with the fauna of the Philippines, New Caledonia and the Moluccas; but is distant from that of Malaysia, with the exception of a few widely dispersed species which may represent a much older fauna.

The Papuan insect fauna has also spread in a south-easterly direction as far as the Society Islands in the mid-Pacific. I think that later we shall find the Papuan element in the Pacific even stronger than it appears, when we are more familiar with true Papuan forms and are in a position to check old records. For I have discovered in many cases that species recorded as Indo-Malayan, Austro-Malayan and Australasian are in reality Papuan; even so-called Australian species are very often those recorded from tropical Queensland and therefore are also Papuan.

The origin of the peculiar endemic fauna and flora of New Guinea, however, is not explained by the work of geologists. Old mountains of continental rock do exist in New Guinea, in the central ranges and to the north; but these have not been investigated, and may have been submerged before the Tertiary. On the north coast, however, where I recently made a collecting expedition on behalf of the British Museum (Natural History), the Cyclops Mountains and

Mt. Bougainville in Dutch Territory (Fig. 1), and the Torricelli Range in the Mandated Territory, are of pre-Cambrian schists and gneisses, and these mountains at least show no sign of submergence. They all belong to the same geological period and have a similar geological formation.

Before leaving England for Dutch New Guinea, I tried to obtain information of the topography of this region but without success. In Netherlands Indies the Dutch authorities showed me Government geological maps (not available in England), from which it is evident that no marine deposits have been recorded from the Cyclops Mountains or Mt. Bougainville. What is also very interesting is that they were evidently islands, the old shores of which can be traced inland. For inland south of the Cyclops Mountains—which are a coastal range thirty miles long—is a Tertiary limestone zone. In this area I discovered an old coral cliff more than 120 feet high. Rock specimens from this cliff which I brought back with me contain Tertiary Foraminifera; and a fossil reef-shell, *Strombus* sp. from the bank of a stream in that neighbourhood, is also Tertiary.

At the foot of the mountains on the south lies Lake Sentani, the southern shores of which are formed of elevated coral limestone—the old coast of the former island—and the bed of the lake has been raised 200 feet. The northern side of the range is high and steep, with cliffs sheer to the sea, and has no inlets or anchorage except the two bays east and west. It appears that the island tilted downwards on that side, but was raised on the south together with its fringing coral reefs. Mt. Bougainville farther east is also surrounded by old coral inland.

With regard to the Torricelli Range in the Mandated Territory, an oil company has been working for eight years in that district, and the mountains with the surrounding area have been thoroughly surveyed. The company does not wish to publish maps at this stage of its work, but I learnt from its members that they had come to the same conclusion regarding the Torricelli Mountains, namely, that this range was formerly an island, and there is no evidence of submergence.

This is extremely significant in the early history of the Papuan fauna. We see that there exist in New Guinea to-day at least three mountain groups —and doubtless there are others—which were formerly islands, and have remained above the sea throughout a very long period. It is interesting,

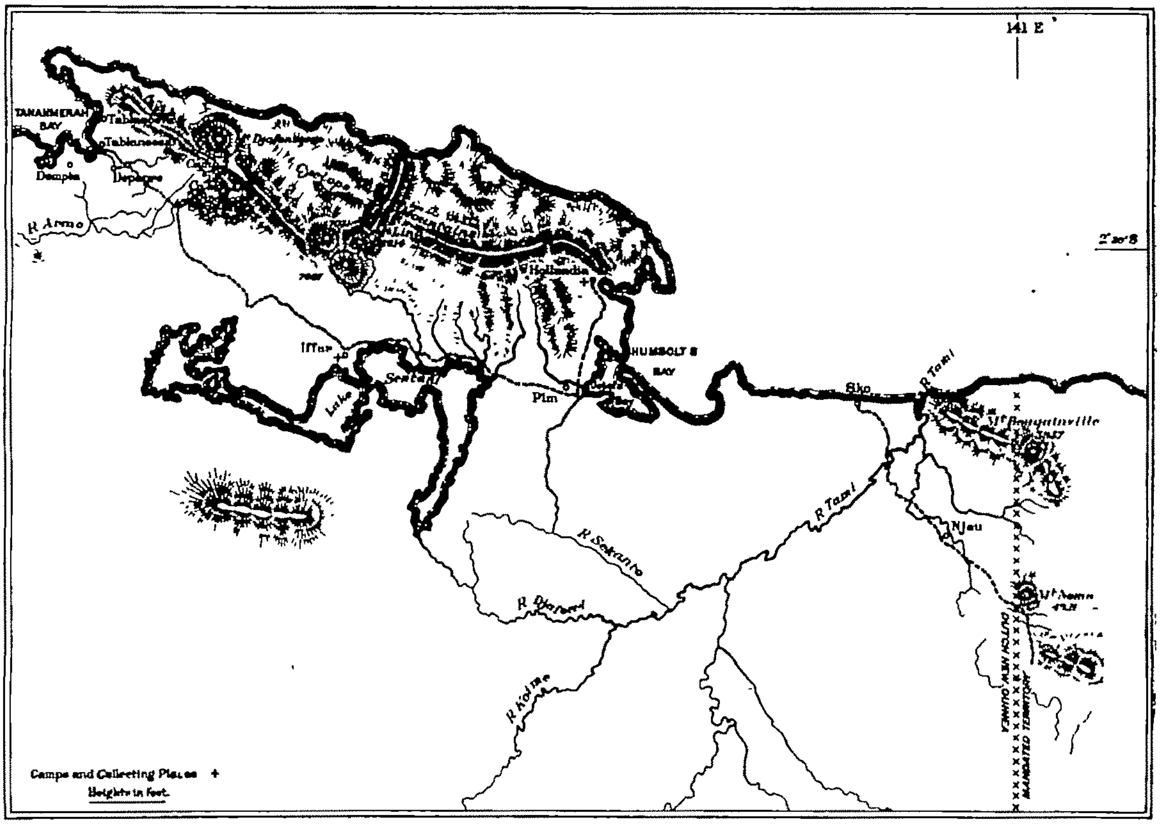

FIG. 1.

MAP OF THE BRITISH MUSEUM (NATURAL HISTORY) EXPEDITION TO THE NORTH OF NEW GUINEA too to note that they all have a similar trend, and that they correspond with the crystalline schists of the island of Japen and with those of a range south of the Arfak Mountains in Vogelkopf.

If we assume that New Guinea has not been entirely submerged since very remote ages, and that remnants of the Middle Cretaceous land-mass exist to-day, this is entirely consistent with geological as well as biological evidence. It is not fantastic to consider that the land which rose from the Eocene Sea would unite these old islands, and their population would spread over the new territory; and isolation upon islands would account for the richness of the Papuan fauna and flora.

The Papuan insect fauna is approximately one third Oriental and two thirds endemic. If we consider that this fauna consists of old forms of Oriental origin together with more recent forms derived from them, that appears to be a very plausible explanation, and provides a most helpful working hypothesis in tracing the affinities and the distribution of species.

Obituary Notices

Dr. S. F. Grace

SAMUEL FORSTER GRACE was born on May 10, 1895, at Huyton, near Liverpool. As a boy he attended St. Francis Xavier's College, Liverpool, where he had a very brilliant career. In 1908, 1910 and 1911 respectively he took the preliminary, junior and senior stages of the Oxford Local Examinations, and was awarded first class honours in all three. In each of the first two of these examinations he was placed "first in all England". In 1912 he entered the Faculty of Science of the University of Liverpool with valuable scholarships; and studied mathematics and physics. In 1914 he passed the examination for the ordinary degree of B.Sc., being the most distinguished student of his year in mathematics. At the outbreak of the Great War, he joined the King's Liverpool Regiment and was in France almost continuously until the summer of 1918. It was on the Somme in June 1918 that he received the wound which ultimately led to his death.

In the spring of 1919, Grace returned to the University of Liverpool and entered the honours school of mathematics. He took the honours degree in 1920 and, in spite of the gap of nearly five years in his studies, his record was one of the best which that particular school has ever had. During the session 1920–21 he worked at the Sorbonne and the Collège de France, holding scholarships which included an 1851 Exhibition Research Scholarship. In 1921 he joined the teaching staff of the Department of Mathematics of the University of Liverpool, and steadily progressed from the lowest to the highest grade of lecturers. He was a born teacher and had a power of getting to know the individual qualities of large numbers of students.

Before going to Paris, Grace began mathematical investigations on the motion of solids in a rotating liquid, the results of which were published in the *Proc. Roy. Soc.* between 1922 and 1926. He then began a series of researches on tides, the results of which were published in the *Geophys. Supp., M.N.R.A.S.* These fall into three groups on the following subjects: (1) The analysis of observational data with the object of finding the laws of internal friction in tidal currents, and the friction at the sea-bottom. (2) The theoretical determination of the distribution of the tides over the Gulf of Mexico and the Bay of Biscay. (3) The dynamical explanation of actual tides in narrow seas.

All Grace's research was marked by excellent workmanship. He had a steady-going persistence and thoroughness and a capacity for sustained hard work which carried him far.

From 1924 his war-wound gave him serious trouble, and he had several long and grave illnesses. During periods of convalescence and before he had recovered sufficiently to give his university lectures, he worked steadily at his researches. He died on April 30, immediately following an operation, and it was characteristic of him that he had taken some proofs into the nursing home, so as to be able to correct them on his recovery. He never married. J. P.

Dr. John Humphreys

By the death of Dr. John Humphreys, which occurred at Edgbaston on May 29, scientific and antiquarian circles in Birmingham have lost one of their most distinguished members. Born so long ago as 1850 at Llanfyllin, Montgomeryshire, he came from a family which in the previous century had given to the Church a bishop of Bangor and Hereford.

Entering the dental profession by apprenticeship—the only method possible at the time—Humphreys began to practise in Bromsgrove, but soon moved to Birmingham. In 1883 he joined the staff of the Birmingham Dental Hospital, and with the introduction of a dental curriculum at Queen's College became lecturer on dental anatomy. After the incorporation of Queen's College and Mason College in the University of Birmingham in 1900, he continued in the lectureship, which he retained until his retirement from active professional work in 1919. During the tenure of this appointment the claims of a large practice allowed little time for research, but in collaboration with his life-long friend Dr. (later Sir) B. C. A. Windle, he contributed several papers to scientific journals, of which one on "Man's Lost Incisors" and another on "Some Cranial and Dental Characters of the Domestic Dog" are particularly noteworthy. At the same time that he was thus engaged, he began to collect specimens to illustrate his lectures, succeeding to such an extent that he ultimately could claim to possess the most complete and valuable private odontological collection in Great Britain—a collection which with characteristic generosity he presented to the University on his retirement.

Although it is safe to say that this gift alone will serve to perpetuate his memory, Humphreys has many other claims for remembrance. By his survey of the glacial boulders in the Birmingham district, he has added appreciably to our knowledge of the ice-movements in that locality during the Pleistocene period, while by his presentation to the Birmingham Natural History Museum of a complete collection of the flora of east Worcestershire he has placed all lovers of that part of our countryside under a deep and permanent debt of gratitude. His work in these two directions was recognized by his election to the fellowships of the Geological and Linnean Societies.

In later years, Humphreys became more and more interested in antiquarian subjects, serving on the council of the Society of Antiquaries and acting as local secretary for Warwickshire and Worcestershire. He took an active and prominent part in the recent excavations at Uriconium and in the exploration of the Anglo-Saxon cemetery at Bidford-on-Avon, which latter was conducted with such care that it has been said "not a bead was lost". He traced, again with a wealth of topographical detail, the movements of the conspirators in the Gunpowder Plot on their dramatic flight from London to their last stand at Holbeach. He succeeded after a search, extending over three years, of the manor houses of the Midlands in finding in the butler's bedroom at Chastleton House near Moreton in Marsh several priceless Elizabethan Sheldon tapestries, two of which are now among the glories of the Victoria and Albert Museum and the Birmingham Art Gallery. Scarcely less dramatic was his discovery of the important "Bowery Papers" in a leather-covered wooden chest in a windowless attic at Cleeve Prior, where they had lain for more than two centuries. In 1924 the University of Birmingham, which had at various times conferred upon him the degrees of master of arts, doctor of philosophy and master of dental surgery, elected him to a readership in mediaeval archæology.

That Humphreys was able to accomplish so much, even granted his length of days, was due to exceptional ability and industry, and perhaps even more to tenacity of purpose. Great as these qualities are, it is for other and rarer qualities that his many friends will chiefly remember him—his wide sympathies, his unaffected friendliness, his complete disinterestedness. No one ever practised with greater persistence and success the gentle art of self-effacement. W. W.

Mr. J. H. Field

THE scientific work of Mr. J. H. Field, whose death on May 19 at the age of sixty-four years is much deplored, was of a type none the less valuable because it was mainly practical rather than theoretical. He had qualified in physics and engineering at Cambridge and London, and was selected in 1904 for the Indian Meteorological Department to initiate upper-air work. He threw himself wholeheartedly into the task: regardless of hardships, such as those of the Northwest Desert in the hot weather, he adapted Western methods of getting data by kites and balloons to Indian conditions; the instrumental and mechanical equipments were largely designed and constructed by himself.

Financial difficulties were at first acute; but in 1912 matters improved and Field started the Agra observatory, which developed into a factory for making and compressing hydrogen, a workshop for making instruments, and a mother-station for a number of pilot-balloon observatories. In 1924 he took on the less congenial post of head of the Department; and for five years there he showed the enthusiasm and the tireless thoroughness that had always marked his activities. On his retirement he was responsible for a complete and able examination of the conditions that led to flying accidents in the lee of the Rock of Gibraltar.

Field's scientific papers consist mostly of data and discussions of the upper-wind system of India. He also carefully studied the exposure of thermometers at the ordinary observing stations. Perhaps his chief discoveries were the thinness of the monsoon currents in north-west India and the great increase of strength in the upper winds in the cold weather. He found also a marked tendency for an unusually vigorous increase to be followed by an unusually vigorous winter rainfall: here he always recognized that he had not data enough to justify reliable conclusions, but since his retirement this criterion has become the most reliable of the five criteria used in the winter forecast.

Field's real monument is the upper-air observing system of India, with about thirty-six observatories, and its well-designed equipment of instruments; but he secured also a new headquarters building at Poona. He will long be remembered by his staff for the inspiration of his indefatigable thoroughness and for the justice of his rule. G. T. W.

WE regret to announce the following deaths:

Prof. J. A. Culler, emeritus professor of physics in Miami University, Ohio, on May 18, aged seventy-nine years.

Sir Squire Sprigge, editor of the *Lancet* and author of "The Life and Times of Thomas Wakley" (1896), "Medicine: Its Practice and Public Relations" (1905), "Some Considerations of Medical Education" (1910) and "Physic and Fiction" (1921), on June 17, aged seventy-six years.

Prof. H. E. Slaught, emeritus professor of mathematics in the University of Chicago, on May 21, aged seventy-six years.

News and Views

Royal Society Elections

AT a meeting of the Royal Society held on June 17, the Right Hon. the Earl of Athlone was elected a fellow of the Society under a special clause in the statutes which provides for the occasional election of "persons who either have rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the Society". At the same meeting the following were elected foreign members of the Society: Prof. August Krogh, of Copenhagen; Prof. Otto Meyerhof, of Heidelberg; and Prof. Henry Norris Russell, of Princeton.

Prof. August Krogh

THE election of Prof. A. Krogh to the Royal Society will give much pleasure to his many friends, who have been following with great admiration his remarkable achievements in different branches of physiology. His early work (1904) in collaboration with Bohr and Hasselbach demonstrated for the first time the effect of carbon dioxide on the affinity of hæmoglobin for oxygen. In 1910 Krogh definitely proved that the absorption of oxygen and the elimination of carbon dioxide in the lungs take place by diffusion only and without the assistance of any secretory activity by the cells. This investigation finally settled the long-standing controversy around this problem. We owe to Krogh a series of important contributions to the study of the respiration of insects and the elaboration of a delicate technique for the accurate analysis of minute bubbles of gas. This technique was applied ultimately to the study of problems in other fields of physiology. Krogh's remarkable work on the capillary circulation, which was soon recognized by the award of the Nobel Prize in Physiology and Medicine, is marked by the same insistence on direct proof, combined with a broad biological outlook. The work of Krogh's laboratory to-day is largely concerned with the problems of respiration, especially at high altitudes, problems of circulation, the mechanism regulating the water and salt exchanges in aquatic animals, and the ecology of aquatic organisms in relation to the nitrogen cycle in water.

Prof. O. Meyerhof

WE owe much of our present knowledge concerning the chemistry and thermodynamics of muscle to Dr. Otto Meyerhof. During twenty years he has published a remarkable series of papers—more than a hundred in all—describing experimental studies of the complicated events involved in the maintenance and activity of the contractile tissue. If our knowledge of these is yet incomplete, a survey of Meyerhof's papers alone will show that progress has been real and that his own work has done much to accelerate it. Twenty-five years ago, Meyerhof, who had been a student of psychiatry and philosophy, influenced by Otto Warburg—who himself became a foreign member of the Royal Society in 1934—turned to biological studies. He first dealt with cell respiration and, among other contributions to knowledge of this, showed that respiration calls for the influence of a soluble agent similar to the cozymase which Harden had shown to be a necessary factor in fermentation. To-day we have come to recognize how significant are these relations. By 1919, Meyerhof had begun to give special attention to muscle, and his earlier chemical and calorimetric studies ran parallel with the myothermic studies of A. V. Hill in Great Britain. This association became very enlightening, especially in bringing to light the time relations of events which occur during and after a contraction. Since then, Meyerhof and his school have described many improvements in technique, and have revealed many significant facts. Of special interest was the proof that the anaerobic breakdown of glycogen to lactic acid which occurs during a contraction is reversed during the aerobic process of recovery; and also the discovery—of much help to himself and to other workers—that many of the significant reactions which occur in the intact muscle proceed in due sequence in a properly prepared aqueous extract of the tissue.

Prof. H. N. Russell

PROF. H. N. RUSSELL, professor of astronomy at Princeton University, U.S.A., is one of the best-known American astronomers. He first became prominent through his theory of stellar evolution, according to which a star, contracting continuously throughout its history, passed successively through a 'giant' stage of rising, and a 'dwarf' state of falling, surface temperature. This theory, regarded somewhat sceptically at first, gained general acceptance through the discovery, by means of Adams and Kohlschutter's spectroscopic method for determining absolute magnitudes, of the reality of the distinction between giant and dwarf stars. The development of the theory of stellar constitution called for some amendment of the original postulates of Russell's theory, and it is characteristic of him that he made no attempt to preserve ideas based on insufficient data, but became a leader in the reformulation which was seen to be necessary. He was among the earliest to realize the importance of Saha's theory of ionization in stellar atmospheres, and took a leading part in working out its implications, always with a keen appreciation of the limitations placed on theoretical possibilities by difficulties inherent in methods of observation. The development of laboratory spectroscopy attracted him strongly, and with the collaboration of Prof. F. A. Saunders he obtained the first evidence of the co-operation of extra-nuclear electrons in producing line spectra: 'Russell-Saunders coupling' is now a well-established, and the most frequently occurring, type of such co-operation. More recently he has made important contributions to the analysis of complex spectra corresponding to various stages of ionization—particularly those of metals prominent in celestial spectra.

PROF. RUSSELL's work is marked throughout by a breadth of interest and a clearness of apprehension of essentials which place him among the greatest men of science of the time. There is scarcely a branch of astronomy (with the possible exception of problems peculiar to the extra-galactic nebulæ) which has not attracted his attention and become elucidated thereby. He has recently advanced some very suggestive ideas relating to the origin of the solar system, and his text-book on astronomy, written in association with his colleagues, Profs. R. S. Dugan and J. Q. Stewart, is unique in its kind. He travels freely among the American observatories, and has for many years been regarded as a kind of unofficial ambassador-at-large, co-ordinating work of various types and often taking an active part in the solution of the problems encountered. His vivid personality is one of the most conspicuous and characteristic features of astronomical conferences, and the well-deserved honour now accorded him of foreign membership of the Royal Society will give universal satisfaction.

The German Expedition to Nanga Parbat

EVERYONE must sympathize with the Germans who have met with disaster, for a second time, in an attempt to climb Nanga Parbat. In 1934 three members, including the leader, lost their lives on the mountain in a blizzard and one died from illness; added to this, six of their faithful porters also lost their lives. Now news has come that the second German expedition has met with an even greater disaster, seven out of nine members, including the leader, Dr. Karl Wein, together with nine porters, having been overwhelmed by an avalanche at Camp IV. Details of what exactly happened are not yet to hand, but almost at the same time as the news of the disaster was telegraphed an article appeared in *The Times* of June 22 from Dr. Karl Wein, professor of geography at the University of Munich, dated June 6 from the Base Camp. From this it seems the present expedition is following the same route as that of 1934. On June 5 it had reached Camp III, which in the former expedition was at a height of 19,400 ft., while the 'trek' to Camp IV, 20,300 ft., had been made on the following day. In this account Dr. Wein describes a great avalanche crashing down the face of Nanga Parbat, but which with the exception of several stray fragments did not reach Camp II, 17,550 ft., which was being pitched at the time. The rush of air caused tents to be "blown over, tent poles snapped and strong canvas torn". All the members of the party seem to have been thoroughly experienced mountaineers. We shall await with interest details of this, probably the greatest, of Himalayan disasters.

Powers of the National Trust

THE Bill by which it is proposed to extend the powers of the National Trust was considered by the Select Committee of the House of Commons on unopposed Bills on June 17, Capt. R. C. Bourne being in the chair. The object of the Bill is to put into operation the scheme of the Trust for the preservation of houses of historic or æsthetic interest in private ownership, which in part was inspired by legislation framed for this purpose in France. It will enable the Trust to take over and save from breaking up large country houses and estates, while allowing the donor and his family and descendants to continue to occupy, provision being made for the public to have access to them. In addition, the Bill provides for enabling the National Trust to acquire and hold small sites of five acres in extent for the purpose of preserving "view-points"; to enter into agreements with owners restricting the use of land, and empowers local authorities to co-operate with the Trust. By this legislation the National Trust will be placed in a much stronger position in regard to what must be regarded as its most useful function—the safe-guarding and ensuring the preservation of sites which on account of their outstanding archæological, historical or æsthetic interest, are of national, or even of international importance. It will be relieved in no small measure of the constant necessity of urgent and hurried 'last-minute' appeals, which recent rapid land development has made unavoidable, but of which in the end there is danger that the public may become a little weary. The Trust will now be enabled by the Bill to concentrate on appealing to the general public for the preservation of sites of which the national importance will be most readily appreciated, or for which no other provision is possible.

Indians of Canada

AN example of the variation in method in dealing with the less advanced races of different parts of the Empire, to which reference is made on another page of this issue of NATURE (see p. 1083), is afforded in a recent survey of conditions among the Indians of Canada by the Hon. T. A. Crerar, M.P., Minister of Mines and Resources of the Dominion of Canada. Indian administration in Canada is dominated by the twofold aim of protection and advancement. The Indians, at one time rapidly decreasing in numbers and regarded as a doomed race, are now on the up-grade. Since 1927, when they had fallen to 104,000, they have increased to 112,000. This increase is attributed largely to the improved medical benefits they now receive and the greater attention given to hygiene. They live on reservations, of which there are two thousand of varying size, running from a few acres up to five hundred square miles, the total area being 5,170,000 acres, of which 220,000 acres is under cultivation. A fund of fourteen million dollars, accruing from the sale of Indian lands, mining rights, etc., is administered by the Government entirely for Indian benefit. The cultural condition of the Indians depends almost entirely on their geographical environment. In the East, they are farmers, and although many are very poor and all suffering from the effects of the economic depression, they differ little in condition from their white agricultural neighbours. In the northern hinterland they are hunters and trappers, and have suffered severely from white competition, and the same applies to some extent to the salmon fishing communities of the North-West coast; but the tribes of the Plains region (Alberta) who lost their livelihood with the extinction of the bison and became farmers and ranchers, have in many instances achieved prosperity in two generations. Finally, it may be added, it is possible for an Indian to become enfranchised on certain conditions, and to cease to rank legally as an Indian.

Statistics of Unemployment

THE report of the Ministry of Labour for 1936 directs attention to the exceptionally sharp rise in the numbers available for employment, which increased by 270,000 between July 1935 and July 1936, due mainly to a rise in the numbers of persons aged sixteen years resulting from the increased birth-rate in the immediate post-War years. Against this there was a large increase in the numbers in employment, which in December 1936 reached the highest level recorded since comparable statistics have been kept—11,132,000 as against 10,629,000 in December 1935. There was also a marked decrease in the numbers unemployed, the number of persons registering as unemployed at employment exchanges in December 1936 being 1,629,000 as against 1,869,000 in December 1935. This total includes 69,000 'casuals', 195,000 'temporarily stopped' and 82,000 'juveniles'. Analysis of the age distribution of unemployed men and women indicates that the problem of finding work for those in the older age groups is predominantly one affecting men, and that age proves a handicap to obtaining employment when younger persons are available. Severe unemployment continued in the coal mining industry, but on a lower level than in 1935. The position improved in all the metal trade groups; in the cotton industry, unemployment over the whole year was 15·7 per cent compared with 20·9 per cent in 1935. The position improved in the wool industry but remained severe in the jute industry and in textile finishing. Most other industries showed improvement.

THERE was a marked increase in the number of persons transferred from the depressed areas compared with previous years, and the proportionate increase in the number of families assisted to re-settle was even more notable. In view of the improved employment position, the whole country was thrown open in instructional centre recruitment, preference in allocation to centres being given to men from areas of heavy and prolonged unemployment. Some expansion in physical training is also reported. Juvenile employment conditions also improved, but there was no indication of a general revival of the apprenticeship system of engaging labour. Shortages of juvenile labour relate particularly to boys and girls in the 14–15 age group, and there was a widespread tendency to raise the starting wage of learners, particularly in unskilled and non-progressive employment. The policy of industrial transference of juveniles was continued in certain areas, as well as arrangements for vocational training and guidance and placing in employment. Reference is also made to progress in the decentralization of the work of the Ministry.

Russian Trans-polar Flight

THREE Soviet airmen, flying a single-engined 960 h.p. monoplane, "Ant 25", left Moscow on June 18 on a non-stop flight to San Francisco via the North Pole. According to the New York correspondent of *The Times*, they were compelled by poor visibility to land at Pierson Field, Vancouver Barracks, in the State of Washington, on June 20, when within six hundred miles of their goal. They had been in the air for 63 hours 17 minutes, and are stated to have passed near the Pole at an altitude of 14,000 ft. The three airmen, MM. Byelyakoff, Chkaloff and Baidukoff, have been decorated with the Soviet Order of Merit, and Mr. Roosevelt, in a congratulatory message to the Soviet Ambassador in the United States, referred to the flight as a "historic feat".

Palæolithic Implements from Bombay

PALÆOLITHIC implements from the island of Salsette, north of Bombay, of considerable importance as demonstrating for the first time the presence of a palæolithic culture in this region of India, have been placed on exhibition in the British Museum (Bloomsbury). This series of implements is the result of three years' excavations carried out by Lieut.-Commander Todd in Pleistocene deposits of alternating gravel and clay. The implements are of indurated shale and come from various levels of stratification. They include Lower, Middle and Upper Palæolithic types, which, however, differ considerably from previous palæolithic finds in India. The principal site is a quarry at Khandivli, situated some 100 ft. above sea-level near the foothills running up to the mountainous interior. Mesolithic implements occur as surface finds and also in the caves of Padan not far away, where they are associated with rock engravings. Diagrams of the geological conditions and photographs of the sites are also exhibited with the implements.

Research on Diseases of Farm Animals

AN extensive programme of investigation into the cause and prevention of disease in farm animals is being undertaken by the Animal Diseases Research Association at Moredun, near Edinburgh, under the direction of Dr. J. Russell Greig. It has for some time become apparent that the existing laboratories and animal accommodation at Moredun were insufficient for the Research Association's rapidly extending work, and Treasury sanction has recently been given to the recommendation of the Agricultural Research Council and the Department of Agriculture for Scotland that a grant not exceeding £9,800 should be made available (after taking into account any receipts from other sources) from the Development Fund to enable necessary building extensions to be undertaken. In view of the economic importance of grass sickness, it became clear to the Department of Agriculture for Scotland and the Agricultural Research Council that further extension and intensification of the research into the cause and prevention of this disease are necessary, and the Treasury has sanctioned an appropriation from the Development Fund to the Department of Agriculture for Scotland of a sum not exceeding £3,200 to meet the expenditure for extended work on this disease during the current financial year. Several contributions towards the cost of grass sickness investigation have been received from outside sources, notably that from the Racecourse Betting Control Board, which has granted £1,000 for the work at Moredun during 1937. While the cause of this fatal disease, which is reported to have killed 1,200–1,500 horses last summer and is by no means confined to Scotland, is suspected to be due to poisoning developed in the intestine by certain bacteria, taken in on grass or in some other way during feeding, this theory, though promising, is not yet proved. A large-scale vaccination trial, which is being made after careful preliminary experiments, is intended as a further test of this theory.

General Science and Education for Citizenship

PROF. LANCELOT HOGBEN's address on "The Teaching of Science in the Education of the Citizen" delivered at a conference of higher education members of the National Union of Teachers on December 30 has now been made available in pamphlet form (London: National Union of Teachers). There is much that is controversial in the address, and the Union is careful to disclaim responsibility for its views and opinions; but its provocativeness is stimulating. It starts from the position that the social task of modern education is "to implement the age of plenty. To do it we have to make the record of scientific discovery an open Bible". In the teaching of science should be epitomized the drama of human achievement, and at each stage the question "Did this or that principle, this or that theory, help mankind to lift this or that stone in the building of the temple of plenty?" will serve to discriminate between the essential and the non-essential constituents of any proposed curriculum and to reconcile the competing claims of specialists. But how about preparation for passing examinations designed by specialists without regard to the requirements of intelligent citizenship? Will students taught on these principles be able to cope with them? Will not those who are themselves destined to become specialists suffer?

To these questions, Prof. Hogben gives answers based on his own teaching experience. The keen interest aroused by the approach to science as a social venture, and the framework of important facts and comprehensive principles provided by it make the memorizing of the less vital facts needed for passing examinations an easy matter and make a sound basis for later specialization. A fatal error in the teaching of science is the presentation of principles without regard to a sufficient background of relevant information. Prof. Hogben finds an illustration of this in present methods of teaching electricity and magnetism. He advocates a greatly extended use of films in the teaching of science. The cinema, he says, can bridge the gulf which now separates people who have a good visual imagination from those who have not.

New Power Station on the Rhine

IN the *Escher-Wyss News* of December, published by the well-known engineering works at Zurich, a complete description is given of the Albbruck-Dogern Power Station on the Rhine. The Rhine, which historically has played an outstanding part among the rivers of Europe, has gained appreciably in commercial importance during the last ten years. Formerly its importance depended on navigation, which gradually spread up the river from the Niederrhein to Basle, now a port handling more than 2·2 million tons annually. During the last ten years the utilization of the water-power has proceeded in the opposite direction from the Upper Rhine down the Rhine valley. The part of the river of greatest interest as regards power generation is that lying between the Lake of Constance and Strasbourg. This stretch extends about a hundred miles, and if we exclude the sudden drop at the Rhine Falls, the gradient is about 1 in a 1,000. There are now eight, including the latest, the Albbruck-Dogern, low head water-power stations erected along this stretch of the Rhine.

FOR the complete utilization of the Rhine six further stations are projected. The installed output of all the stations together will amount to approximately one million horse power, and the average yearly generation of electricity will be about 5,000 million kilowatt hours. With the exception of the French station at Kembs, all the stations have Escher-Wyss water turbines. The new station at Albbruck-Dogern utilizes the flow from the head of the Rhine to the lower course of the Aare as far as the Klingnau power station. The water supplied by the head race has an average flow of 900 cubic metres per second. It is utilized in three vertical shaft turbines each of which is capable of developing 37,600 h.p. under a head of 11·5 metres and with a maximum flow of 290 cubic metres per second. The power station is at Albbruck and has a length of 87 metres and a breadth of 29·3 metres. The three sets, each consisting of a water turbine and an electric generator, are arranged in a row at right angles to the canal and 27 metres apart. After passing through a transformer the electric energy is transmitted at 104 kilovolts.

Prepayment Electricity Metres

THE prepayment meter is, in general, suitable for the user of electricity whose means are small. The advantages are that he pays in small amounts and that he has an incentive to check and control running costs. The disadvantages are that he pays slightly more per unit consumed, and the supply is apt to be interrupted at inconvenient times. To the supply company, the advantages are that there is less accounting as there are no bills, there is a reduction in bad debts, and special applications can be used in hotels and boarding houses. On the other hand, the reading and collecting cost is increased and so also is the maintenance. Mention of coin mechanisms in connexion with measuring holy water began about A.D. 200. A history and criticism of various types of 'coin mechanisms' in connexion with electric meters are given in a paper by J. Prince and M. Whitehead read to the Institution of Electrical Engineers on April 2. Most of the difficulties in connexion with these meters, including the prevention of fraudulently tampering with them, have now been overcome. One of the outstanding points which affect the use of coin mechanisms is the psychological reaction of the peoples concerned. According to the authors, there is a definite objection to prepayment in both Canada and the United States. They are not used in Denmark, France and Portugal. A few are in use in Holland, Austria, Switzerland, New Zealand and Italy. Great Britain seems to be the only country in which there is a great demand for prepayment meters; probably because it provides the best means of promoting the use of electricity among people of small means.

Journal of the University of Manchester

FROM the University of Manchester we have received a copy of the University's *Journal*, No. 1, vol. 1, published by the Manchester University Press. In an inaugural message from the chairman of Council, Sir Christopher Needham, the *Journal* is described as a new venture designed by the Council to meet what it feels to be a responsibility in regard to graduates, to provide news of University interest and information of developments in University policy as well as personal matters. Conversely, an article by Mr. David Cardwell, chairman of Convocation, reminds graduates that active membership of Convocation (which has, since 1915, followed automatically on graduation) affords a means of service whereby the life-long debt they owe to their University may, in some measure, be repaid. The realization of this ideal has been facilitated by the formation of Groups of Convocation formed in Manchester, London, Leeds and Sheffield and contemplated at Oxford, for discussing matters of University interest and such social and other activities as their members may desire. Sir Ernest Simon contributes an article, "A Time for Expansion: the New Buildings and the Future", describing buildings just completed at a cost of £100,000, others (including a new dental school and hospital and physical chemical research laboratory, swimming bath, etc.) which it is hoped to complete by the end of 1938, and a project, illustrated by an architect's drawing, for further urgently needed developments destined to form with the buildings already mentioned a dignified and impressive quadrangle. Among other contributors to the journal are: Prof. A. H. Gibson (on the Department of Engineering), Prof. Edward Fiddes (on "Some Teachers of Owens College"), Dr. Tyson (on "The Library and its Uses") and Prof. G. H. Thompson (his Ludwig Mond lecture on "Intelligence and Civilisation"). Copies of the *Journal* will be supplied without charge and on application, to graduates and friends of the University.

Dr. H. L. Richardson

DR. H. L. RICHARDSON, of the Chemistry Department, Rothamsted Experimental Station, has been appointed adviser in soils and fertilizers to the National Agricultural Research Bureau, Shaolingwei, Nanking, China. This institution, which was founded in 1931, possesses extensive laboratories and a farm of 400 acres, and has already made great progress in the investigation of crop production, plant diseases, animal production, and crop recording. In addition to conducting experiments at Nanking, it works in close collaboration with the numerous provincial research stations in China. Dr. Richardson received his training at Victoria University College, New Zealand, and the University of London, and joined the Rothamsted staff in 1927. He has been particularly associated with the developments in soils and fertilizers.

Indian Institute of Science

IT is reported from Bangalore that, at a meeting of the Governing Council of the Indian Institute of Science held on June 1, Sir C. V. Raman decided to sever his connexion with the Institute. The Council proposed that he should continue in the Institute as professor of physics without administrative powers, and suggested the appointment of an interim director to administer the affairs of the Institute pending the appointment of a new director. Sir C. V. Raman declined the offer of the Council and was unwilling to continue as a subordinate to any other director. It was recommended by the Irvine Committee that a registrar should be appointed to relieve the director of administrative duties and to be directly responsible to the Governing Council. Early this year, it was reported that Mr. R. H. Beckett had been appointed registrar of the Institute, but we understand that, though he was offered the post, he did not accept it. We are now informed that the registrar will be Mr. C. E. W. Jones, C.I.E., lately director of public instruction, Central Provinces.

Chemical Engineering Exhibition in Germany

ANNOUNCEMENTS have been issued of the meeting in Frankfort-on-Main during the week July 2–11 of the various bodies in Germany concerned with chemical engineering and the holding at the same time of the Eighth Chemical Engineering Exhibition, widely known as the "Achema". At the last Achema Exhibition, held in Cologne in 1934, an impressive picture was given of the high standard of production of chemical engineering plant and apparatus in Germany and the exhibition attracted 49,000 visitors.

In the interim, the importance of this branch of industry has increased all over the world and in addition there has been an unprecedented industrial development in Germany brought about by the planned transformation of the national economic system. It is expected, therefore, that the Exhibition next July will offer unusual opportunities and that it will attract a large number of expert visitors from all parts. The Achema Bureau is located in Berlin, W.35, Potsdamerstrasse 103a.

Proton-Neutron Exchange Interaction

REFERRING to his letter in NATURE of June 12 (p. 1021), Mr. H. J. Bhabha states that he omitted to insert the following at the beginning of the final paragraph: "The above experiment may be done with cosmic rays, but it must be emphasized that we do not know that the penetrating group consists of protons, even though we know it cannot consist of electrons obeying the theory."

The Night Sky in July

THE duration of darkness is too short this month to scan a number of interesting objects. Mars, Jupiter and Saturn are to be seen, followed by Venus, which is a bright morning star. On July 17 at 21^h U.T. ($= 22^h$ summer time), Mars is in conjunction with the moon, and an occultation is visible from Great Britain. The disappearance of Mars behind the moon as seen from Greenwich takes place at $21^h\ 17{\cdot}7^m$ and the reappearance at $22^h\ 19{\cdot}8^m$. Jupiter is in opposition on July 15; its equatorial diameter is $47\frac{1}{2}''$ and its polar diameter $3''$ less, the oblateness of the disk being apparent in quite a small telescope. On July $22^d\ 21^h$, Jupiter is in conjunction with the moon. The configurations of the four inner satellites of the planet are given for $23^h\ 45^m$ in the Nautical Almanac of 1937, p. 625. Saturn with its ring system is, of course, nearly always an attractive object for observation with a refractor of 3 inches aperture or larger. The planet is stationary amongst the stars on July 18. The moon is new on July 8 at $4{\cdot}2^h$ and full on July 23 at $12{\cdot}8^h$. The occultation with Mars when the moon is $9{\cdot}7^d$ old has been mentioned above. On July 31 a conjunction of Mercury with the bright star Regulus may be noted. The planet is only 0·4° north of the star (geocentric positions). About midnight (23^h U.T.) in the middle of the month, a bright and interesting stretch of the Milky Way is passing the meridian of London. The Constellations Scorpio, Sagittarius, Aquila, Cygnus (south of the zenith) and Cassiopeia, Perseus and Auriga (to the north) mark its span. In latitudes somewhat farther south than that of London, the galactic star clouds in Scorpio and Sagittarius are an unforgettable sight which may be guessed at on clear moonless nights in Great Britain. Though less spectacular, the low eastern sky at midnight contains the constellation Andromeda, and by locating the great nebula, which can be done with the unaided eye, we are seeing out to the depths of space beyond our galactic system. A number of meteor radiants are active during July, among which may be noted the $\alpha\beta$ Perseids with radiant at R.A. $3^h\ 12^m$: Dec. 43° N.; γ Draconids (radiant, R.A. $17^h\ 56^m$: Dec. 48° N.) and the δ Aquarids (radiant R.A. $22^h\ 36^m$: Dec. 11° S.). Some swift meteors may be seen from the radiant at R.A. $21^h\ 0^m$; Dec. 48° N.—the α Cygnids.

Announcements

H.M. THE KING has nominated Sir Arthur MacNalty to be for five years a member of the General Council of Medical Education in the United Kingdom in succession to Sir Henry Dale.

THE following awards from the Lady Tata Memorial Fund for research in blood diseases, with special reference to leukæmia, have recently been made: *Grants for research expenses*, Dr. Julius Engelbreth-Holm (Copenhagen), Prof. Karl Jármai (Budapest), Prof. James McIntosh (London), Prof. Charles Oberling (Paris), Prof. Eugene Opie and Dr. Jacob Furth (New York), Dr. Georg Weitzmann (Leipzig) and Dr. Lucy Wills (London); *Scholarships*, Dr. Jørgen Bichel (Aarhus, Denmark) and Dr. Edoardo Storti (Pavia, Italy).

A CONFERENCE on the "Challenge to Democracy" will be held at Ashridge College, Berkhamsted, by the Association for Education in Citizenship, on July 8–14. Further information can be obtained from the Secretary, Association for Education in Citizenship, 10 Victoria Street, S.W.1.

AN earthquake of moderate intensity was recorded at Kew Observatory on June 21. The first impulses were registered at 15 hr. 26 min. 2 sec. G.M.T. The records indicate that the shock was located about 6,000 miles away, probably in Peru.

PROF. HUGO SPATZ has been appointed director of the Kaiser Wilhelm Institute for Cerebral Investigations.

AN international congress of public health consisting of ten sections will be held in Paris on July 1–10. Further information can be obtained from the Secrétariat Général, Laboratorie d'Hygiène, Faculté de Médecine, rue de l'Ecole de Médecine, Paris, 5^e.

THE Belgian Government has decided to organize a campaign of health with the title of the National Crusade of Health under the direction of the Red Cross.

DR. MAX WIEN, professor of physics at Jena, and Prof. Oskar Seyffert at Dresden, have been awarded the Goethe Medal for art and science by the German Chancellor.

THE first World Congress on the Voice, organized by *Euphonia*, will be held at La Maison de la Chimie, Paris, on September 19–28. Further information can be obtained from Dr. Wicart, 92 Avenue de Wagram, Paris.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1113.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Growth Substances, Root Production, and Cambial Activity in Woody Cuttings

IT is now well established that α-naphthalene acetic acid and β-indolyl acetic acid (heteroauxin) are among the most active chemicals which stimulate the production of roots[1]. In fact, these substances are put to practical use in accelerating the production of roots from cuttings, herbaceous or woody[2].

Whilst testing numerous horticultural plants, including species well known to root readily and others more reluctant to do so, examples have been encountered of the stimulation to marked activity of the cambium. The following illustrate this phenomenon seen at various seasons of the year:

(1) Cuttings of *Viburnum Carlesii* were taken in mid-July and placed with their basal ends in a solution of α-naphthalene acetic acid, and others in β-indolyl acetic acid, of a concentration of 1 part in 10,000 of distilled water for twenty-four hours; controls were placed in distilled water. The period of uptake of the solution, due to transpiration in part at least, was terminated by washing in water. Insertion into sand in a propagating frame immediately followed the treatments. Within fourteen days the bark of the treated cuttings was seen to split owing to the rapid formation of new tissues inside. Many roots emerged in twenty-one days; frequently these were formed in rows.

(2) Similarly, cuttings of *Ceanothus dentatus* taken on November 28 and treated as already outlined, responded by the rapid production of a new cylinder of tissue of a thickness of some twenty cells, counted radially. These were formed in less than five weeks. Medullary rays in this tissue, stained deeply, are readily seen in the transverse section (Fig. 1).

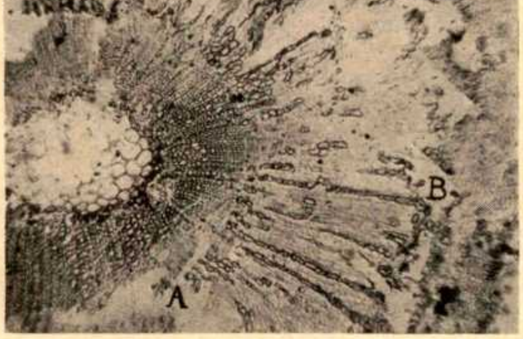

Fig. 1.

TRANSVERSE SECTION OF THE STEM OF *Ceanothus dentatus* AFTER STIMULATION BY ALPHA NAPHTHALENE ACETIC ACID (NOV. 28, 1936). SECTION CUT JAN. 22, 1937. THE REGION *A* TO *B* SHOWS THE NEW PARENCHYMA WITH MEDULLARY RAYS. ×60 DIAMETERS.

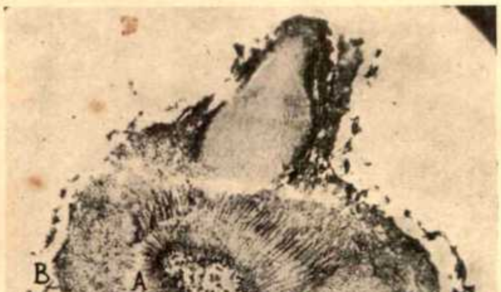

Fig. 2.

TRANSVERSE SECTION OF *Myrtus communis*, STEM SHOWING THE DEVELOPMENT OF ROOTS. IN THE REGION *A* TO *B* PARENCHYMA HAS DEVELOPED OUTSIDE THE XYLEM, AFTER STIMULATION BY ALPHA NAPHTHALENE ACETIC ACID (JAN. 12, 1937). SECTION CUT FEB. 19, 1937. ×30 DIAMETERS.

(3) With *Myrtus communis* a concentration of two parts in 10,000 of α-naphthalene acetic acid for twenty-four hours was used with cuttings taken on January 11. Rapid cell division afterwards took place resulting in new tissue of a thickness of fifteen to twenty cells, counted radially. Where roots developed, and they were freely formed, as may be seen from Fig. 2, the number of new cells produced radially far exceeded that number.

(4) With *Tricuspidaria dependens* taken in late January, the rate of cell division in the treated series has been observed to be remarkably rapid—a cylinder of a radial thickness of eighteen cells has been formed in twenty-five days.

The control cuttings did not show this activity. In them the production of callus tissue was localized, and limited to the base of the cutting. Generally, in the treated cuttings the rate of cell differentiation and lignification of the new tissue did not keep pace with that of cell formation, resulting in tissue of a parenchymatous nature almost entirely undifferentiated, as is well shown by longitudinal sections. The region of stimulation varied in position and length, but frequently was limited to 1·5–2 cm. and did not usually extend to the base of the cutting. An 'internal tube of callus' of cambial origin was produced. Thus it was not only a question of the development of root initials previously laid down.

Full anatomical details are not yet available, but the possibility is not precluded that repeated cell divisions took place to form cells in an irregular and intercalary manner as distinct from the more regular centripetal and/or centrifugal abscission usually associated with cambial activity.

The new roots frequently emerged in rows, showing a relationship between their point of emergence and the leaf traces. How far is the position of the root, its form and shape, governed by the constraining resistance of the older lignified tissue experienced by the rapidly expanding tube of internal callus? Can the adventitious root so formed be regarded as parenchyma, moulded into cylindrical shape?

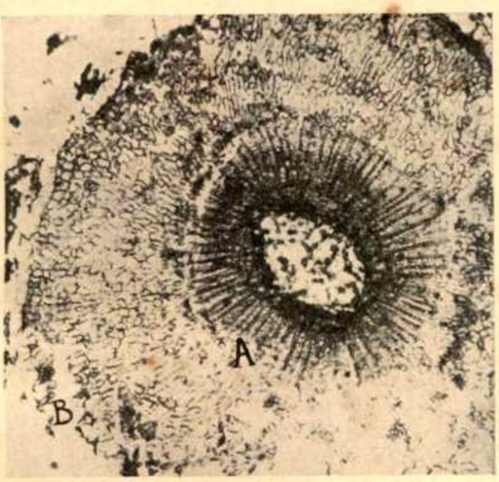

Fig. 3.

Myrtus communis. *A* TO *B* SHOWING THE DEVELOPMENT OF PARENCHYMA IN A REGION WITHOUT ROOTS. ×40 DIAMETERS. OTHER DETAILS AS FIG. 2.

Whilst the cambium may be stimulated at different seasons, including the period of natural quiescence, and whilst root formation may also be induced at various times of the year, the response obtained from one species differs in quality and degree with the season at which treatment is applied and with the co-related nature of the material so selected.

It is difficult to refrain from the attractive speculation that the natural seasonal excitation of the cambium results from the downward translocation of similar substances, formed from young leaves the veins of which are directly connected to the outer portion of the wood. Diffusion to, and excitation of, the cambium could readily take place, as shown by the morphological studies made by Priestley[3] using the 'strip method'.

I thank Miss W. Hopwood for cutting and preparing sections and Messrs. N. K. Gould and F. C. Brown for the photomicrographic illustrations.

M. A. H. TINCKER.

Royal Horticultural Society,
Wisley, Surrey.
April 27.

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[1] Zimmerman, P. W., and Wilcoxon, F., *Contrib. Boyce Thompson Institute*, **7**, 209 and 439 (1935).

[2] Tincker, M. A. H., *J. Roy. Hort. Soc.*, **61**, 380 and 510 (1936).

[3] Priestley, J. H., Pres. Address, Sect. K, Brit. Assoc., York, 1932; *J. Forestry*, **6**, 105 (1932).

Isolation of Carotene from a Wood-Oil

THE intensive studies of the past few years have illustrated the wide distribution of the carotenoids in Nature, but so far as we are aware, the occurrence of this group of pigments in the oils extractable from timber has not been recorded.

Acacia acuminata, which possesses an extraordinarily hard and heavy stem, is indigenous to Western Australia where, owing to its marked resistivity to termites, it has been extensively used for fencing and similar purposes where this property is of importance. The timber, locally known as 'jam' wood, has a pronounced odour, reminiscent of the common raspberry, *Rubus indæus*, and this persists in the timber for years, and in the wood-oil obtained by extraction with light petroleum. A suggestion that carotene might be present in the dark red oil was made by Hill[1]. It is now confirmed by our isolation of the pigment by chromatographic fractionation on alumina.

The adsorption experiment was carried out on the oil, as preliminary analyses had indicated a very small content of saponifiable matter. A number of coloured zones, indicating the presence of at least six carotenoid pigments, were observed. From one of these an extract was obtained which gave 21 mgm. of crystalline β-carotene, m.p. 178°. The amount present in the oil is probably considerably greater than this yield of 0·21 per cent. Dr. R. A. Morton very kindly carried out a spectroscopic examination of the other carotenoid fractions, but reported that they were not pure enough for spectrographic differentiation and identification. Fifty per cent of a non-odoriferous highly fluorescing oil is unadsorbed by the alumina. This is probably hydrocarbon in character. It is likely that the odour of the timber results from a breakdown of carotenoids to β-ionone, of which it is reminiscent.

No opinion can yet be offered as to whether the high carotenoid content is in any way related to the resistance of the wood towards termites.

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[1] Hill, H. E., *J. Roy. Soc. West. Aust.*, **18**, 55 (1931–1932).

Phospholipid Synthesis during Fat Absorption

WE have recently reported some experiments on the distribution and on the rate of 'organification' of phosphorus in rat's tissues[1]. With the same radioactive technique we have now investigated the synthesis of phospholipids during the absorption of large quantities of fat.

A rat weighing about 250 gm. was fed on 5 gm. of olive oil and 7·5 mgm. of radioactive sodium phosphate having an activity of 1,600 of our radioactive units (R.U.). Nine hours later the rat was bled. The absorption of the ingested phosphate was very complete, as no more than 42 R.U. was found in the gastro-intestinal tube and in the fæces.

The tissues were extracted with alcohol and alcohol plus ether and the extracts purified with anhydrous chloroform. The phospholipids of the liver and gut were further precipitated by acetone plus magnesium chloride. The acetone precipitate of the liver has been finally fractionated with cold alcohol. We call the soluble fraction 'lecithin' and the insoluble one 'cephalin', though we are well aware that the separation is by no means a complete one.

The phosphorus of the extracts and their fractions was mineralized and titrated by the Neumann-Machebœuf procedure. Finally, the phosphorus was reprecipitated as phosphomolybdate and the radioactivity measured. The results are reported in the accompanying table.

Tissue		Weight of moist tissue (gm.)	Lipidic P (mgm.)	Radioactive P (R.U.)			Specific activity
				in the whole tissue	per gram of moist tissue	per cent of the ingested P	
Liver	'Lecithin'	7·41	8·62	58·2 ± 1·0	7·9 ± 0·1	3·64	(7·1) 6·7 (6·4)
	'Cephalin'	,,	2·58	14·8 ± 0·9	2·0 ± 0·1	0·92	(5·1) 4·3 (3·6)
	Total Phospholipids	,,	11·20	73·0 ± 1·0	9·9 ± 0·1	4·56	(6·4) 6·0 (5·7)
Intestine		4·22	3·86	40·3 ± 0·5	9·6 ± 0·1	2·52	(10·7) 10·4 (10·1)
Kidney		2·39	2·80	8·2 ± 0·5	3·4 ± 0·2	0·51	(3·4) 2·9 (2·4)
Spleen		0·92	0·75	0·5 ± 0·6	0·6 ± 0·7	—	(3·0) 0·7 (−1·7)
Heart		0·89	0·92	0·0 ± 0·5	0·0 ± 0·6	—	(1·7) 0 (−1·7)
Skeletal muscle		5·49	2·72	0·3 ± 0·5	0·1 ± 0·1	—	(0·7) 0·1 (−0·4)
Blood corpuscles		2·39	0·25	0·0 ± 0·5	0·0 ± 0·2	—	(6) 0 (−6)
Blood plasma		2·61	0·07	0·5 ± 0·5	0·2 ± 0·2	—	(30) 7·5 (−15)

We give the weight of moist tissue, the weight of phosphorus, its radioactivity (in the whole lipidic extract and per gram of moist tissue, with the statistical error of the measurements) and its specific activity (with possible errors assuming a maximum and minimum value given by the mean value plus or minus three times the statistical error). Dividing the radioactivity by the total radioactivity of the sodium phosphate (1,600 units) one has the fraction of the ingested phosphorus which was found in each organ.

From the table it is apparent that, some hours after the ingestion of the fat and radioactive phosphorus, comparatively large quantities of ^{32}P were already found in the phospholipids of the liver ('lecithin' as well as 'cephalin') and of the gut. The absolute amount was larger in the liver, the content per gram of moist tissue being about the same in the two organs: 'specific activity' was higher in the intestine. Kidneys showed a small, but definite, activity. Heart, spleen and skeletal muscle showed practically no activity. The results for plasma and blood corpuscles are inconsistent, probably owing to the small content of phosphorus.

These findings should be compared with those communicated in our previous letter. Indeed in the experiment, in which ^{32}P was injected parenterally, the rate of phospholipid synthesis was found to be larger in liver, gut and kidney than in other tissues. Further, the rapid formation of phospholipids in liver and intestine during fat absorption is in agreement with many results reached by other methods. Our experiments show that the kidney is also involved in this process, which must be regarded not as a simple substitution of fatty acid radicals into the phospholipid molecule, but as a complete synthesis starting, at least partially, from inorganic phosphorus. We thank Prof. E. O. Lawrence and the Radiation Laboratory of the University of California for their most generous gift of ^{32}P.

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[1] NATURE, 139, 836 (1937).

Relation of the Adrenal Cortex to Cyclical Changes in the Female Accessory Reproductive Organs

IN a recent communication[1] one of us recorded the fact that periodic uterine bleeding still occurred in a spayed monkey that was being injected daily with a constant threshold dose of œstrone. It was suggested that this phenomenon is due either to the periodic liberation of some other hormone that raises the uterine threshold to œstrogenic stimulation, or to some undefined inherent periodicity in the responsiveness of the uterus to œstrone. Further consideration of the problem leads us to believe that the adrenal cortex may be responsible both for the persistence of uterine cycles under these conditions and for variations in uterine sensitivity. Our reasons for this suggestion are as follows:

(1) The hormones of the ovary and the adrenal cortex are related in chemical structure, and both organs are controlled by the anterior lobe of the pituitary. It has been shown in many species of vertebrate that the weight of the adrenal cortex fluctuates in accordance with changes in reproductive condition. Thus Anderson and Kennedy[2] found that the adrenal cortex of the rat undergoes alterations in size and lipoid staining response during the œstrous cycle. The weight increases until œstrus occurs, when ovulation takes place, and then decreases to the initial level, these changes being repeated in each successive œstrous cycle. A similar increase in the weight of the adrenal cortex at the time of ovulation has been shown to occur in frogs[3] and pigeons[4].

(2) It is well established that at least one of the principles of the adrenal cortex is intimately concerned with the regulation of the water and salt balance of the organism. This is shown by the fact that removal of the adrenals is followed by considerable excretion of sodium chloride and by diuresis. Conversely, Thorn *et al.*[5] have found that the injection of cortical extract into normal individuals causes a temporary retention of intravenously injected sodium chloride.

(3) The menstrual cycle in monkeys is related to well-marked changes in water-metabolism. Krohn and Zuckerman[6] and Fisher and Zuckerman[7] have observed that water is retained in the sexual skin of the macaque and baboon during the first half of the menstrual cycle, and that considerable diuresis occurs when the sexual skin swelling subsides.

(4) Œstrous cycles generally cease after adrenalectomy. It has, however, been found by Kutz *et al.*[8] that œstrus occurs at normal intervals in adrenalectomized rats if the life and health of the animals are maintained by the administration of salt.

This last observation suggests that the regular occurrence of cyclical changes in the uterus is dependent on a normal water-metabolism. It would also seem that at least part of the mechanism underlying the fluctuations in water and salt metabolism of the female macaque and baboon during the menstrual cycle is the coincident cycle in the activity of the adrenal cortex, the secretion of which fluctuates as does that of the ovary in response to cyclical alterations in the activity of the anterior lobe of the pituitary. It is probable that cyclical alterations in adrenal cortical activity still persist in spayed monkeys, and that the consequent hydration and dehydration of the accessory reproductive organs is the factor that is responsible for variations in the responsiveness of these organs to a constant dose-level of œstrone.

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Effect of Progesterone on Lactation in the Rat

DRUMMOND-ROBINSON and Asdell[1] showed that ablation of the corpora lutea in the pregnant goat caused milk secretion provided the operation was done after the development of the mammary lobule-alveolar system. This suggests that the corpus luteum inhibits lactation prior to parturition, though the work of Anselmino *et al.*[2,3] indicates that the inhibitor is different from the hormone which causes proliferation of the uterine endometrium. On the other hand, Frei and Grüter[4] reported that injections of suspensions of corpus luteum tissue exerted a favourable effect on lactation in the cow. The experiments reported briefly below confirm the contention of Anselmino *et al.*, since we have found that administration of relatively high doses of pure progesterone to the lactating rat does not inhibit lactation as judged by the rate of growth of sucklings.

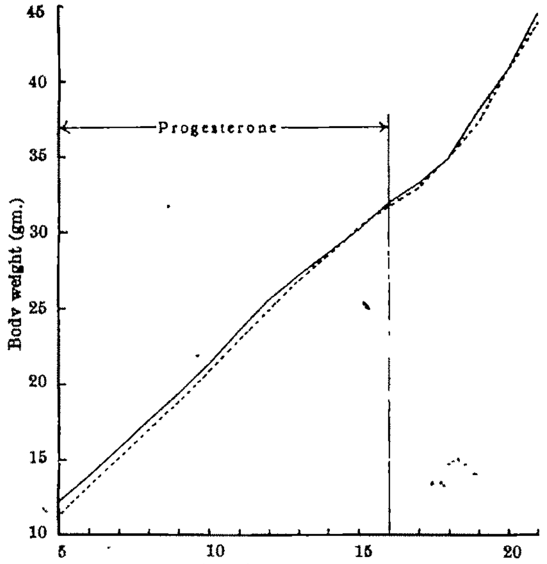

Fig. 1.

AVERAGE GROWTH-RATE OF POOLED LITTERS. FULL LINE, MOTHERS INJECTED DAILY WITH 1 MGM. PROGESTERONE IN 0·2 ML. ARACHIS OIL. DOTTED LINE, MOTHERS INJECTED DAILY WITH 0·2 ML. SESAME OIL.

Two groups of four lactating rats were used, one experimental and one control. Litters larger than eight were reduced to that number, as is the standard practice in this laboratory. In the case of two of the control rats, the litters numbered seven and six respectively. One litter in each group suffered reduction by the death of a female during the experiment. Each experimental rat was given twelve daily intramuscular injections of 1 mgm. crystalline semi-synthetic progesterone dissolved in 0·2 ml. arachis oil beginning on the fifth day *post partum*. Total number of young in litters was 17 males and 15 females; average gain in weight of mothers from parturition to weaning, 21 gm. Owing to an error, the controls were given similar injections, not of arachis oil but of sesame oil, but it is extremely unlikely that this would affect the outcome. Total number of young in litters was 14 males and 15 females; average gain in weight of mothers from parturition to weaning, 23 gm. We are greatly indebted to Dr. A. N. Macbeth and Messrs. Organon Laboratories Ltd. for the gift of the progesterone used in this work.

The average growth-rates, from the fifth day *post partum* to weaning, of all the young of each of the two groups of rats are plotted in Fig. 1. It will be seen that there is no difference between the mean growth-rates for the two groups of sucklings, which shows that progesterone, at the relatively high dosage given, neither inhibits established lactation in the rat, nor causes any increase in milk secretion.

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Wettability of the Cellulose Walls of the Mesophyll in the Leaf

THE moisture regain curves (sorption isotherms) of cellulose show a steep rise at high relative humidity, but the water content at saturation (about 18 per cent of the dry weight of raw cotton) is definite both for natural and for regenerated celluloses[1]. To explain why no loosely adhering liquid condenses even when ample time is allowed for dispersal of the heat generated, it is sometimes suggested that the vapour, even under the best controlled experimental conditions, is never fully saturated. This view is, however, difficult to reconcile with the definiteness and reproducibility of the saturation maxima, especially as the regain curves are here so very steep. That these curves have a finite and not an infinite slope at saturation suggests another explanation, namely, that a clean cellulose surface may be incompletely wettable by water.

The unwettability of natural cotton is generally ascribed to the existence of a film of wax or oil covering its outer surface. Masson[2], who directed attention to the marked rise of temperature which the dried material shows on immersion in water, attributed this thermal effect to the condensation of water which has diffused as *vapour* across an air film which remains clinging to the waxy surface. In passing, we may remark that this view appears to us to require some slight modification, for it has been found that the bulk of the water neither gains nor loses heat until conduction from the cotton comes into play[3].

It seemed to us worth while to study the wettability of other natural cellulose surfaces, such as those which surround the cells in the mesophyll of plant leaves. Strips of leaf, cut so as to permit free exit of air at the top and entry of liquid at the bottom, were placed vertically with their lower edges in contact with water. Capillary rise was in no case observed, and it was found impossible to produce the entry of water into the mesophyll air-space system without either a pressure gradient or prolonged immersion. On the other hand, organic liquids such as benzene, chloroform, ether and essential oils, infiltrate rapidly into the mesophyll air-space by capillarity; vertical strips several centimetres long become completely filled in a very short time although the surface tensions of all these liquids are much less than that of water. Medicinal paraffin shows the same result and on account of its non-toxic character is suitable for comparative experiments with water. The results of many similar experiments show that, whilst all the other liquids named enter the capillary air-space system against gravity, water will not do so.

Leaves infiltrated with water by pressure gradient were found, on exposure to bright sunlight, to clear the mesophyll interspaces of liquid in a period of about two hours. Observed by transmitted sunlight under slight magnification, the retreat of the water appears to be a markedly discontinuous process, the water receding suddenly from areas several millimetres broad, and then halting for a time.

All the above experiments have been carried out with the leaves of *Ficus elastica*, which on account of their architecture are very suitable for this purpose. Moreover, by tearing the blade of this leaf it is possible to expose the mesophyll over an area of several centimetres, and the action of different liquids when placed on the exposed surface can then be followed under the microscope. A drop of water so placed remains supported on the summits of the mesophyll cells and does not flow down and fill the air-spaces. If now a drop of oil be placed at the end of the strip, the oil can be seen to enter the capillary system instantly and advance through the interspaces. Arriving at the drop of water, the oil enters the mesophyll spaces lying under the water, displacing the air, and presently emerging on the far side until the whole strip appears oily. Watched under a magnification of 100 (without a cover glass), the oil when applied can be seen to rush into the capillary spaces in an advancing wave which is followed at a short distance by the main wave of oil, so that in less than a minute a strip 2 cm. long becomes completely covered. When a drop of water is allowed to remain on the surface of the mesophyll, any part of the drop in contact with the surface of the fine vascular bundles flows out along the bundles, but does not spread laterally over the mesophyll cell-walls.

It is clear from these observations that the surfaces of the mesophyll have but the smallest adhesion to water, but that the outer tissues of the fine lateral veins have a much higher adhesion energy. It then becomes necessary to reconsider the conditions obtaining at the interface where transpiration takes place, for the above observations entirely negative the view that transpiration occurs from a liquid film of water on the cell walls of the mesophyll.

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Determination of Aneurin (= Vitamin B$_1$) in Urine by the Thiochrome Method

WE have now worked out Jansen's method[1] for the determination of aneurin for the estimation of this vitamin in urine. Most difficulties were overcome by diluting the urine by about three times its volume of water, by working entirely in a nitrogen atmosphere and by substracting the fluorescence of a franconite eluate to which no potassium ferricyanide had been added from the fluorescences of some eluates which

<table>
<tr><th rowspan="2">Subject</th><th rowspan="2">Diet</th><th rowspan="2">Date (April 1937)</th><th colspan="4">μ gm aneurin excreted</th></tr>
<tr><th colspan="2">9 a.m.–9 p.m.</th><th>9 p.m.–9 a.m.</th><th>Total in 24 hours</th></tr>
<tr><td>G.</td><td>Normal</td><td>18–19</td><td colspan="2">40</td><td>30</td><td>70</td></tr>
<tr><td></td><td>Aneurin-free*</td><td>19–20</td><td colspan="2">50</td><td>10</td><td>60</td></tr>
<tr><td></td><td>,,</td><td>20–21</td><td colspan="2">40</td><td>10</td><td>50</td></tr>
<tr><td></td><td>,,</td><td>21–22</td><td colspan="2">30</td><td>10</td><td>40</td></tr>
<tr><td></td><td>Normal + 3 × 1 mgm. aneurin†</td><td>22–23</td><td colspan="2">60</td><td>190</td><td>250</td></tr>
<tr><td></td><td>,,</td><td>23–24</td><td colspan="2">260</td><td>250</td><td>510</td></tr>
<tr><td>Z</td><td>Normal</td><td>23–24</td><td colspan="2">80</td><td>70</td><td>150</td></tr>
<tr><td>W.</td><td>Normal + 3 × 1 mgm aneurin†</td><td>20–21</td><td colspan="2">290</td><td>170</td><td>460</td></tr>
<tr><td></td><td>,,</td><td>21–22</td><td colspan="2">390</td><td>160</td><td>550</td></tr>
<tr><td></td><td>Aneurin-free</td><td>22–23</td><td colspan="2">80</td><td>40</td><td>120</td></tr>
<tr><td></td><td>,,</td><td>23–24</td><td colspan="2">30</td><td>10</td><td>40</td></tr>
<tr><td></td><td></td><td></td><td>9 a.m.–3 p.m.</td><td>3 p.m.–9 p.m.</td><td>9 p.m.–9 a.m.</td><td></td></tr>
<tr><td></td><td>Same diet + 3 × 1 mgm. aneurin‡</td><td>24–25</td><td>60</td><td>100</td><td>160</td><td>320</td></tr>
</table>

* Washed polished rice, crackers, egg-white, butter, sugar.
† At 9 a.m., 1 p.m., 6 p.m.
‡ At 9 a.m., 3 p.m., 9 p.m.

had been treated with different amounts of this oxidizing agent.

The accompanying table shows the results of the first applications of this method to human urine; they are in excellent agreement with the results of Harris and Leong[2], who used the bradycardia method.

A more detailed account of these and further experiments will be published shortly in one of the Dutch periodicals. We wish to thank Prof. B. C. P. Jansen for his kind interest and Mr. H. N. Zwalf for his skilful assistance.

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A Method for Determining Ice-Water Relationships by Measurements of Dielectric Constant Changes

A NEW method for studying freezing points of soils has been developed by us[1]. Freezing point depressions of soils with water contents covering almost the entire growth range of plants have been measured.

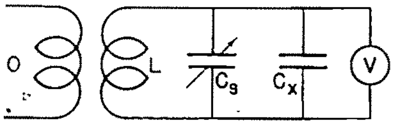


Fig. 1.

The method depends upon the measurement of capacitance changes of an electrical condenser, the metallic conducting plates of which are permanently attached to the walls of a glass vessel containing the material to be studied. The capacitance of such a condenser is a function of the dielectric constant of the water contained in the material. In the liquid state, water has a dielectric constant of approximately 80. After freezing, the dielectric constant of the ice formed is approximately 4. This magnitude of difference obtains if alternating current of sufficiently high frequency is used in making the capacitance measurements. Frequencies of the order of those used in the radio broadcast range are desirable; in these experiments 1,800 kilocycles per second was used.

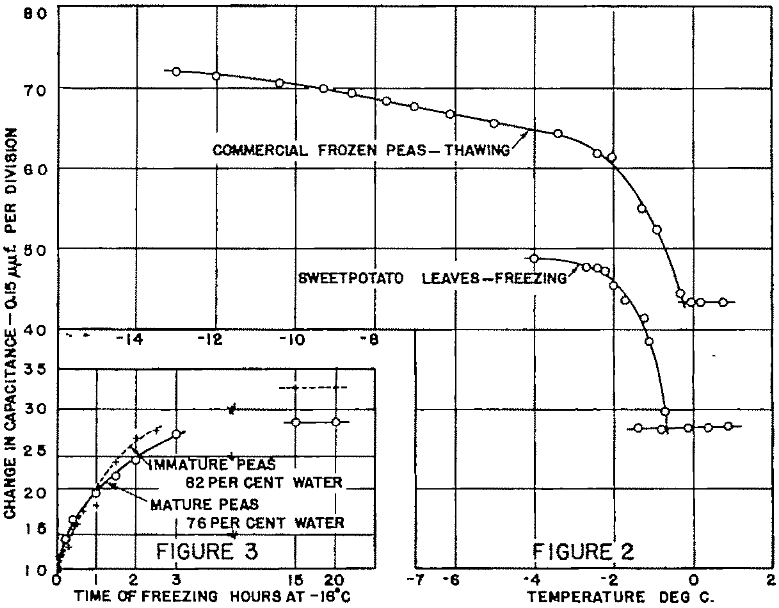
Fig. 1 is a schematic diagram of the circuit used in measuring the capacitance of the condenser containing the material; *O* is an oscillator which emits radio frequency waves at a frequency of 1,800 k.c./sec.; *L*, C_s, and C_x form a receiving circuit which may be tuned to the oscillator frequency. V is a vacuum tube voltmeter which indicates a maximum when the receiving circuit is tuned to resonance with the oscillator. C_x is the condenser containing the material and C_s is a calibrated variable condenser.

Resonance between the two circuits is obtained for a definite value of capacitance supplied by C_s and C_x. Any decrease occurring in the capacitance C_x, such as takes place if the water in the material freezes, may be compensated by an increase in the capacitance C_s. Thus, by determining the capacitance of C_s necessary to tune the circuit to resonance with the oscillator, one can determine any change in capacitance of the condenser containing the material (C_x).

Due to the great change in dielectric constant of water when it freezes, a curve of capacitance versus temperature of the condenser containing the material shows a marked change in direction at the temperature where ice begins to form. Thus, it is possible to determine the freezing or melting point of materials, containing, other than water, only constituents the dielectric constants of which show no sharp change with variation in temperature.

The temperature of the material studied may be maintained at a given value as long as is necessary for establishing thermal equilibrium. If this is done, the curve obtained consists of a number of equilibrium values. Hence the freezing-point which is obtained from such a curve should be an equilibrium value. It has been recognized that freezing point determinations on colloidal materials by the widely used Beckmann technique are not equilibrium values, and hence their use is questionable where equilibrium conditions are assumed, such as in the calculation of vapour pressures.

This method for determining freezing points has been applied to some plant materials. An example of the kind of data obtained is shown in Fig. 2. The curve for sweet potato leaves is for freezing, while that for frozen-pack commercial green peas is for melting. Supercooling is clearly shown on the sweet potato leaf curve. It is, however, possible to obtain the freezing point accurately, since by the graphic method it is not necessary to obtain data exactly at the point of initial ice formation.



If one assumes that the dielectric constants of the materials present in the condenser, other than water, do not change significantly over the temperature range studied, the following interpretations may be made. When the curve is parallel to the temperature axis, no water is being frozen or melted with change in temperature. When the curve is vertical with respect to the temperature axis, pure water is being frozen or melted. When the curve is inclined to the temperature axis, ice is being separated from or melted into a solution, as in the concentration or dilution of a sugar solution. This latter effect may also be brought about by capillary forces or by colloidal substances the avidity of which for water varies with their concentration.

Fig. 3 shows the results obtained upon freezing fresh green peas using time as a variable instead of temperature. 19 gm. of green peas at room temperature were placed in the condenser and immersed in a thermostat held at −16° C. At the time of immersion and at intervals thereafter capacitance measurements were made. The time required for complete freezing is the time elapsed before the capacitance reaches a constant value. The curves shown are for mature and immature peas taken from the same lot. Since the condenser containing the peas was surrounded by an air jacket, it is possible that the rate of heat transfer was the limiting factor in the earlier part of the freezing time. The method offers the opportunity of determining when such substances are completely frozen throughout. It should be noted that the peas with the higher moisture content showed a greater capacitance change upon freezing. Possibly with improved technique, quantitative interpretation of the relation between capacitance change and the amount of ice formed may be made.

This method is being presented here in the hope that it may prove useful in fields outside those with which we are concerned. The data presented in this paper were obtained with the first apparatus built and are to be regarded only as representative of the type of results obtainable. The functions of the laboratory do not permit the following up of this problem from any except the soil point of view. It seems very probable that the method would be useful in studying the winter hardiness of plants, the freezing injury to fruits and vegetables, and storage temperature for meats. It may also be useful in preparation of frozen-pack foods.

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Radioactive Isotopes of Copper

In view of the fact that copper has only two stable isotopes $^{63}_{29}$Cu and $^{65}_{29}$Cu, it is difficult to account for the large number of different half-life periods reported for radioactive copper isotopes. Of the two short periods of 6 min. and 10·5 min., the latter has been satisfactorily attributed to $^{62}_{29}$Cu[1,3,4]. Periods of 6h. and 10h. have been obtained by neutron bombardment[1,5] and a 12·8h. period given by deuteron bombardment[2,8]. Since this latter product emits both positrons and electrons, there is good evidence for labelling it $^{64}_{29}$Cu. A radioactive copper has been chemically separated from zinc bombarded by fast neutrons, of half-life variously reported at 6h. and 10h.[1,5,6]. Madsen has directed attention to the confusion over these periods and gives the half-life period of the copper obtained from zinc as 17h.[7].

Leo Szilard, of the Clarendon Laboratory, Oxford, informed us that the decay curve of the copper bombarded by fast neutrons from radon-beryllium contained a period of a few hours which was absent when slow neutrons were used, or if the radioactive copper was obtained from zinc by fast neutron bombardment. It was arranged with him that further investigations and chemical separation should be made in this laboratory.

We irradiated 2 gm. mols of pure cupric oxide with fast neutrons from a 200 mc. radium-beryllium source. After irradiation, we dissolved the oxide, added 500 mgm. of nickel salt and precipitated the copper as cuprous iodide. The separated nickel after purification and conversion to nickel sulphide, showed an activity of 80 impulses/min., 1½ hours after irradiation had ceased, decaying with a half-life of 160 ± 10 min. We found the same half-life period in nickel irradiated by slow neutrons, in agreement with Rotblat, Naidu and Heyn[9]. It must be due to a radioactive isotope $^{63}_{28}$Ni or $^{65}_{28}$Ni, and may be produced either from $^{63}_{29}$Cu or $^{65}_{29}$Cu by capture of a neutron and expulsion of a proton.

We found that copper irradiated with slow neutrons in the absence of fast neutrons showed an activity of half-life 13 ± 0·5h. and that the same half-life period was obtained by separating radioactive copper from zinc bombarded by fast neutrons. In these experiments the initial activities were about 300 impulses/min. with a background of 20 impulses/min.

This radioactive copper may well be identical with that produced by bombarding copper by deuterons and is accordingly likely to be $^{64}_{29}$Cu. The 6 min. period of copper obtained by slow neutron capture would then be due to $^{66}_{29}$Cu.

No indication of a 6h., 10h. or 17h. period was obtained in our experiments.

Thanks are due to the Department of Scientific and Industrial Research for a grant and to Imperial Chemical Industries, Ltd., for the purchase of apparatus.

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Artificial Radioactivity produced by Fast Neutrons and their Inelastic Collisions

Several investigators have reported that fast neutrons give rise to a transformation of an irradiated element in which the newly formed nucleus results from the original nucleus through the loss of a neutron[1,2].

I have made some experiments on the activation of copper, zinc and silver by fast neutrons. As the efficiency in these cases is small, I used the following arrangement: A foil of the metal under investigation, measuring 8 cm. × 5 cm., was wrapped around the source (50 mc. radon + beryllium) in the form of a spiral, so that the effective solid angle was equal to $4 \times 4\pi$. After activation, the foil was given the form of cylinder of 24 mm. diameter, which fitted the Geiger counter. In this way I obtained an activity which was four times larger than with the usual arrangement. In the case of copper, I found in accordance with Heyn[2] a radio-element of 11 min. half-period, produced by fast neutrons only. An element of this period was found by Bothe and Gentner[3] by irradiation of copper with very hard γ-rays, so that our product must be ^{62}Cu derived from ^{63}Cu by loss of a neutron. The initial activity due to the 11 min. body is about one half the initial activity due to the 5 min. body.

In the case of zinc, I was able to confirm the existence of the 60 min. half-period product. Miss Nuswald, working in this laboratory, has found that this element is an isotope of nickel and not of zinc as stated by Heyn.

In the case of silver, Guében[4] has reported the formation of a 50 sec. activity which possibly could be attributed to fast neutrons only. I have investigated the activitation of silver and found no trace of the 50 sec. product. In the course of these experiments, however, I obtained a definite proof of the existence of a product of 25±3 min. half-period which does not appear after irradiation with slow neutrons. It seems very likely that this product is identical which the 24 min. element obtained by Bothe and Gentner, so that we have almost certainly the reaction

$$^{107}Ag + n^1 = {}^{106}Ag + 2n^1$$

The efficiency of this reaction is about 0·03 of the total efficiency of fast neutrons in producing radioactivity in silver.

In the type of activation studied in this communication, the kinetic energy of the colliding neutron is nearly completely converted into the excess of mass of the system formed, so that after the collision both the colliding and the extracted neutron must have a very small kinetic energy, and therefore be much more efficient than the fast neutrons in producing activation of the 'capture' type. This phenomenon may account, at least partially, for the increase of artificial activity observed when fast neutrons pass through relatively small thicknesses of certain absorbing substances, and attributed hitherto to inelastic collisions[5]. Some rough calculations based on the values of cross-sections of fast neutrons for different types of activation lead to results which are in agreement with the experiments.

I am very much indebted to Dr. H. Herszfinkiel for many valuable suggestions in the course of this work.

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Raman Spectrum of Monodeuteroethylene

MONODEUTEROETHYLENE has been prepared (J.C.J.) in two different ways. Starting from vinylbromide and deuterium bromide, obtained by the action of deuterium oxide on redistilled phosphorus pentabromide, the monodeuteroethylenebromide was prepared. This compound was submitted to the action of zinc and yielded monodeuteroethylene. Several spectra of the liquid compound were taken at a temperature of − 140° C.; the lines are listed in the accompanying table. The strongest lines of ethylene also appeared.

The monodeutero compound has also been obtained mixed with more highly substituted ethylenes by exchange of deuterium oxide and ethylene on a nickel catalyst at 80° C. (Polanyi).

Using a potential function for the ethylene molecule determined by Manneback and Verleysen[1] in their work on di- and tetradeuteroethylenes, the nine plane vibration frequencies of the unsymmetrical monodeuteroethylene have been computed (G.L. and Y.L.T.). The difficulty of expanding a determinant equation of the ninth degree and finding its roots was reduced materially by using suitable methods of calculation.

	C_2H_4 (calc.)	C_2H_3D (calc.)	C_2H_3D (obs.)	C_2D_4 (calc.)
1	949·7	789·2	—	678·1
2	950·0	947·5	—	758·3
3	1343·9	1268·2	(6) 1284·2	1008·9
4	1444·0	1387·3	(5) 1395·7	1072·8
5	1621·3	1578·7	(10) 1599·1	1428·8
6	2988·0	2266·2	(1·5) 2266·3	2152·5
7	3019·0	3001·8	(2) 2963·2	2288·9
8	3069·0	3045·9	(9) 3015·0	2308·0
9	3107·0	3092·5	(0·5) 3104·8	2325·0

The intensities are derived from photometric measurements. These results are expressed in cm.$^{-1}$. They show that the differences between calculated and observed data are less than 1·5 per cent. For comparison, the frequencies of C_2H_4 and C_2D_4 are given as calculated[1] by means of the same potential function. The difference between the calculated values for C_2H_4 and the experimental values from which the potential function was obtained are always less than 0·15 per cent.

The modes of vibration have also been computed. They suggest interesting qualitative remarks concerning the intensities and polarizations that may be expected in the Raman and in the infra-red spectrum. All vibration frequencies of C_2H_3D should, of course, be active in both spectra. Roughly speaking, a mode of vibration of the molecule C_2H_3D resembles very much the one or two modes of the symmetrical molecule C_2H_4 or C_2D_4 the frequencies of which lie nearest its own. For example, ν_8 in C_2H_3D is very weak in the Raman effect and nearly antisymmetrical with respect to the carbon axis, as would be inferred from its position between ν_8, antisymmetrical, Raman active but weak, and ν_9, inactive in the Raman spectrum of C_2H_4. The motion of ν_5 of C_2H_3D is almost perfectly symmetrical with respect to the carbon axis; hence that line is found to be very strong and should be polarized in the Raman spectrum. On the other hand, the modes 1 and 2 in the symmetrical molecule are respectively inactive and extremely weak in the Raman effect; this explains why the two lines of lowest frequency could not be observed. The mode 6 is an averaging of the four modes 6, 7, 8, 9 of C_2D_4.

In the case of C_2H_3D, three more lines should appear in the Raman spectrum below 900 cm.$^{-1}$; they are due to motions out of the plane of the molecule. For the symmetrical molecule C_2H_4, two of these modes are Raman inactive; the third one has not yet been observed.

A more extended account of the work is in course of publication in the *Annales de la Société Scientifique de Bruxelles*. The experimental work has been carried out in the laboratory of Prof. M. de Hemptinne.

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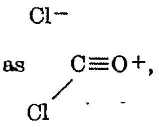
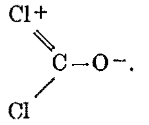
[1] Manneback, C., and Verleysen, A., NATURE, 138, 367 (1936). id., *Annales Soc. Scient. Bruxelles*, B, 56, 349 (1936); 57, 31 (1937).

Force Constants and Molecular Structures

WE have examined the infra-red absorption spectrum of phosgene vapour. The following fundamental modes have been assigned: $A_1 : \omega_1 = 1827$, $\omega_2 = 578$, $\omega_3 = 300$; $B_1 : \omega_4 = 845$, $\omega_5 = c.300$; $B_2 : \omega_6 = 444$ cm.$^{-1}$., the allocation being in agreement with the recent polarization measurement of Ananthakrishnan[1].

The persistence of molecular constants throughout various radicals has been remarked many times: Linnett and Thompson[2] have proposed using values of the force constants in C_2Cl_4 when compared with those of CCl_4 and C_2H_4 to determine the extent of contribution from resonating structures in the first molecule. The difficulty in obtaining even semi-quantitative measurements in such cases lies in the uncertainty as to what any particular force constant implies: thus for CCl_4 the values for the CCl force constant in the literature range from 1·74 to 3·85 ($\times 10^5$ dynes/cm.) according to the force field used, while Linnett and Thompson introduce another estimate of 4·38. One must hesitate in utilizing force constants derived from not necessarily comparable force fields, especially when the molecules have different symmetry.

The force constants for the ethylenic linkage in C_2H_4 and C_2Cl_4 given by these authors are respectively 9·0 and 5·8: if a correction is applied to the Badger relation so that it may hold for a carbon-carbon link, the first represents the true ethylenic distance of 1·37 A., while the second gives 1·45 A. or a 75 per cent single bond effect! Actually, even the refined methods of electron diffraction can scarcely distinguish between the supposed interatomic distances of 1·37 A. and 1.38 A.; consequently any great difference between the two force constants is illusory. The divergence may arise from the use of too artificial a force field, and also because the calculations employed are rigorously applicable only to infinitesimal amplitude frequencies.

We have met with rather more success in the treatment of the similar molecules phosgene, formaldehyde and urea. The carbonyl force constants are of the order of 12·3, 11·5 and 10·2 respectively: and we may safely regard the carbonyl frequency, ω_1, for HCHO (1,744 cm.$^{-1}$) as the normal value. Hence the latter arises from a pure double bond; urea ($\omega_1 = 1{,}655$ cm.$^{-1}$) has a considerable single bond contribution, but phosgene in accordance with the very high value $\omega_1 = 1{,}827$ cm.$^{-1}$ has a marked triple bond effect arising from such structures as  rather than the single bond nature postulated by Pauling, Brockway, and Beach[3] and deriving from  The interatomic distances obtained by these authors for $COCl_2$ are CO = normal (?) = 1·28, and CCl = 1·68 < normal = 1·76; the original results of Dornte[4] (CO = 1·15 < normal, CCl = 1·80 A. > normal) are qualitatively more in agreement with the spectroscopic observations, while the chemical evidence is altogether in favour of the interpretation of phosgene as an acid chloride and not as a halogenated ethylene.

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[1] *Proc. Ind. Acad. Sci.*, 5, 285 (1937).
[2] NATURE, 139, 509 (1937).
[3] *J. Amer. Chem. Soc.*, 57, 2705 (1935).
[4] *J. Amer. Chem. Soc.*, 55, 4128 (1933).

Measurement of Pressures in the Upper Atmosphere

IN the course of a series of photographs of the spectrum of the auroral afterglow in pure nitrogen at pressures varying from about 1 mm. to 0·01 mm., it was observed that the ratio of the intensity of the first-negative system of bands to that of the second-positive system changed gradually as the pressure changed. The first negative bands, which are emitted by the molecule ion, increased in intensity until, at the lowest pressure at which it was possible to photograph the afterglow, the spectrum consisted almost entirely of bands due to the ionized molecule.

This result suggests the possibility of measuring accurately pressures in the upper atmosphere of the earth, by simultaneous observations of the ratio of these two band systems in an auroral display and of the height of the aurora. A comparison of these results with those obtained in the laboratory should then give the pressure. A series of careful experiments is now in progress to determine the effect of a small quantity of oxygen on the intensity ratio of these two band systems and also to study the effect of tube size on this ratio. In view of the present results, auroral observers may be led to make observations of the intensity ratio of these band systems as well as of the heights of the displays.

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Permeability of Metals to Hydrogen

IT is well known that all the common metals are permeable to hydrogen at high temperatures. The accompanying table brings out the rather remarkable fact that, at 1,000° C., the permeability of the metals for which data are available only varies by a factor of about 10.

RATE OF DIFFUSION OF HYDROGEN IN C.C. PER CM^2. PER. SEC. AT 760 MM. PRESSURE FOR 1 MM. THICKNESS OF METAL.

Metal	1,000° C	500° C	0° C.
Iron	1×10^{-3}	1×10^{-4}	6×10^{-8}
Nickel	2×10^{-3}	3×10^{-6}	1×10^{-11}
Molybdenum	4×10^{-3}	5×10^{-6}	2×10^{-10}
Platinum	1×10^{-4}	1×10^{-8}	5×10^{-15}
Copper	1×10^{-4}	1×10^{-8}	4×10^{-15}
Aluminium	—	2×10^{-7}	2×10^{-22}

Since, however, the temperature coefficient of diffusion varies considerably for the different metals, the rates of diffusion at low temperatures are very different. In the table the rates of diffusion at 0° C. have been calculated by means of the usual diffusion equation, and it will be seen that the rates for copper and platinum, for example, are now 10^9 times less than that for iron.

Iron is, in fact, by far the most permeable of these metals at room temperature. Apparatus for work at high pressures is usually made of steel to provide the necessary strength. The diffusion of hydrogen cannot be greatly reduced by increasing the thickness, since the rate of diffusion only varies directly as the thickness. A far more effective method of avoiding trouble from this cause would appear to be to line the steel vessel with a thin layer of one of the less permeable metals, such as copper or nickel. Provided this is free from porosity, 1 mm. of copper would be as effective as 5 miles of steel, and 1 mm. of aluminium would be better than 10^{13} miles of palladium!

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Points from Foregoing Letters

PHOTOMICROGRAPHS of transverse sections of *Ceanothus dentatus* and *Myrthus communis*, showing the formation of cambium after treatment of cuttings with growth substance (alpha-naphthalene acetic acid) are submitted by Dr. M. A. H. Tincker. Similar stimulation of growth and formation of roots was observed in cuttings of *Viburnum Carlesii* after treatment with beta-indolyl acetic acid. The author suggests that the natural seasonal excitation of the cambium may result from the downward movement of similar substances formed in young leaves.

The presence of beta-carotene (a substance related to vitamin A) in the wood oil extracted from *Acacia acuminata*, a tree of Western Australia, is reported by Dr. V. M. Trikojus and Prof. J. C. Drummond.

By feeding a rat with olive oil to which radioactive phosphate had been added, and afterwards analysing its tissues, a group of investigators from the University of Palermo have found a large percentage of the radioactive phosphorus in the phospholipids (both the 'lecithin' and the 'cephalin' type) of the liver and of the gut. Kidneys also showed a small but definite activity, while the heart, spleen and skeletal muscle showed practically none.

Prof. C. N. H. Long and Dr. S. Zuckerman bring forward various considerations which lead them to the view that cyclical alterations in adrenal cortical activity still persist in spayed monkeys and are responsible for the periodic bleeding that can be induced by a constant threshold dose of œstrone injected daily.

Dr. S. J. Folley and Dr. S. K. Kon find that relatively high doses of the sex hormone, progesterone, when given to the lactating rat, do not inhibit lactation as judged by the rate of growth of sucklings. This, they consider, supports Anselmino's view that the inhibitor of lactation is a different hormone.

Prof. D. H. Bangham and Prof. F. J. Lewis show that whilst water adheres but weakly to the mesophyll cell walls in the leaf, organic liquids adhere strongly and rapidly fill the interspaces, under the influence of capillarity. On the other hand, water wets comparatively easily the outer surfaces of the fine vascular bundles of the leaf. It is concluded that the water vapour of transpiration is not evaporated from a film of liquid water, however thin, on the outer surface of the mesophyll cells.

A new method of studying the freezing points of soil and plant material is described by L. P. Alexander and T. M. Shaw and exemplified by results obtained with peas and sweet potatoes. It depends upon the great change in dielectric constant of water when it freezes, and is applicable whenever the dielectric constants of the materials present, other than water, do not change significantly over the temperature range studied.

By irradiating cupric oxide with fast neutrons from radium-beryllium, Dr. E. A. Oeser and J. L. Tuck have obtained a radioactive body of half-life 160 min. This precipitates with nickel and the authors consider it to be radioactive nickel of mass 63 or 65, produced from copper by capture of a neutron and expulsion of a proton. The authors direct attention to the large number of different half-life periods reported for radioactive copper isotopes and suggest their probable origin.

J. Rotblat has confirmed the existence of the 11 min. radio-isotope of copper, the production of which by fast neutrons was reported by Heyn. He has also found that fast neutrons give in silver the isotope of 25±3 min., probably ^{106}Ag. In both cases the new product is formed with emission of a nuclear neutron. An elementary process of this type leads to the appearance of two relatively slow neutrons which are more efficient than the primary neutrons in producing artificial radioactivity. This effect may account for the increase of radioactivity produced by fast neutrons after passage through some absorbing substances.

It is suggested by Prof. J. Kaplan that the variation in the relative intensity of bands emitted by the neutral molecule ion and those emitted by the neutral molecule in the auroral afterglow, might be used as the basis for a method of obtaining pressures in the earth's upper atmosphere, by comparing this ratio in actual auroras and in the auroral afterglow.

Research Items

Human Skeletal Material from British Honduras

Owing to the humidity of the soil, little human skeletal material has been recovered from Mayan sites in British Honduras. Skulls, jaws and long bones excavated by J. Eric Thompson at San José in 1931 and 1934 have been measured and described by Mr. Wilfrid D. Hambly, who also compares them with measurements of the living Maya of Yucatan and skeletal material from Baking Pot (*Anthropological Series*, Field Museum, Chicago, 25, 1). Study of the head-form is based on three skulls and three calvaria, each of which yielded some reliable measurements, though only in two were they numerous. The first is that of a child with a cranial capacity of 1,128 c.c. and a cephalic index of 91. A slight ante-mortem occipital flattening has led to some distortion. The second skull, in the strongly developed occipital protuberances and development of the glabella and supra-orbital ridges, shows male characteristics. There is slight occipital flattening, though it is doubtful whether this is artificial. The third is a male less rounded than other specimens. Considerable ante-mortem loss of teeth had taken place; there is caries with much signs of wear. In this specimen the facial index can be calculated as 79·1, comparable with a mean index on fifty living Maya males (Steggerda) of 82·46. The fourth skull is the only one which gives the measurements necessary for the dental index, 45·2, bringing the specimen just within the macrodont class. The calvarium, of an aged male, yields an index of 95·2, but there is some distortion. A second calvarium, which shows considerable occipital flattening, has an index of 91·0. The left half of a calvarium has a very pronounced occipital protuberance and its length of 183 mm. is so far in excess of other length measurements as to indicate that it is an aberrant form. Comparative measurements are as follows:

		Length	Breadth	Index	Capacity in c.c.
San José	♂	156·0	139·2	87·6	1260
Baking Pot	♂	173·6	146·0	84·3	1375
	♀	163·2	144·0	88·4	1225
Maya (living)	♂	180·41	153·71	85·01	
	♀	170·57	148·79	87·11	

Snowshoes

A study of snowshoes, which is the outgrowth of an interest in crude bearpaw snowshoes used on occasion by the Grand Lake Victoria Indians of western Quebec, has led Mr. Daniel Sutherland Davidson to some interesting and somewhat surprising conclusions, which have a bearing on general principles of ethnographical observation and the interpretation of geographical distributions (*Mem. Amer. Phil. Soc.*, Philadelphia, 6; 1937). The snowshoe, one of the most important aboriginal inventions in the northern hemisphere, apparently has contributed directly or indirectly to the great expansion of northern peoples and has encouraged man to invade and to reside permanently in regions inland which previously had discouraged occupation. The snowshoe, in concept, appears only to have been invented once. Its distribution is contiguous, but various peoples have changed and elaborated the original form. The wooden snowshoe, in plank form originally, possibly was brought into America by a proto-Algonkian migration and afterwards diffused to the Caribou Eskimo, who still retain it in its original form. In the Old World the frame shoe appears not to have modified the wooden shoe at all, but rather the reverse. In the New World the wooden shoe never evolved, its modifications being due to adoption from the frame shoe; but in the Old World the wooden shoe changed by modifications inherent in the shoe itself. The bearpaw shoe appears to have originated in Asia, and to have diffused westward to Europe and to have been brought to America by migrating Athabascans, it may be making possible their great expansion.

Migration of Sea-Trout

A marking experiment, in which 196 sea-trout smolts were marked in 1933, and 1,798 in 1934, has been carried out in the Wisloka, a tributary of the Vistula, and the results are now described by St. Żarnecki (*Bull. Intern. Acad. Polon. Sci. Lett.*, 8, 449; 1936). The place of liberation was a long distance from the sea and it was hoped that this would give more definite information about several features of the migration. The number of recaptures was low compared with Scottish recoveries in similar experiments, 3 of the first lot and 47 of the second; but it showed that the mean of the periods occupied in the migration from spawning places to the sea was about 5 months and 3 weeks (173·3 days), and that the rate of travel averaged 5·8 km. in the 24 hours. Most interesting perhaps was the fact that the recaptures in the sea showed that the initial direction of the migration of young sea-trout was eastward of the Vistula estuary. This direction corresponds with the flow of the Vistula waters, which where they debouch in the Baltic Sea, run eastward almost parallel to the coast. Whether this be simply due to the fact that the sea-trout having followed the current for so long continue to do so, or to some kind of selection, it affords the migrants a short period of accommodation for the change from fresh-water to sea-water environment.

Respiration in Locusts

Recent field experiments on the destruction of flights of locusts by the discharge of toxic dusts from an aeroplane raise various problems in connexion with respiration in these creatures. Dr. A. G. Hamilton now discusses (*Bull. Entom. Res.*, March 1937) the mechanism of respiration of locusts and its bearing upon the inhalation of poisonous dusts. Experiments made with flying locusts, suspended from threads in a wind tunnel and immersed in a cloud of finely particulate cuprous cyanide, are described. Several investigators have brought forward evidence showing that the first four spiracles are inspiratory in function and the remaining six are expiratory. There is, however, lack of adequate evidence whether the anterior spiracles also function in an expiratory manner and whether the remaining spiracles, or any of them, act as inspiratory apertures. In the present paper, confirmation is given to the belief that the first four spiracles are inspiratory organs, but their possible expiratory function has not been subject to investigation. As regards the remaining six pairs of spiracles, only the last or tenth spiracles were found to perform a double function, namely, expiratory in flying locusts and inspiratory when the insects are not in flight. The functions of the different spiracles were determined by the presence or absence of cupric cyanide in the associated tracheæ. By killing the locusts with hydrogen sulphide, the cuprous cyanide is converted into copper sulphide, and since this latter is black it is readily seen in the white tracheal tubes. Its presence implied that a particular pair of spiracles was inspiratory in function.

Interpretation of the Flower

UNDER this general title, Dr. Agnes Arber recently discussed some even more general questions of plant morphology (*Biol. Rev.*, 12, 1937). Goethe's conception that the flower is equivalent to an abbreviated vegetative shoot is handled very sympathetically, and in particular a very good case is made for the thesis that was thoroughly worked out by de Candolle, that the carpel has its equivalence with an infolded foliar organ. A recent opponent of this theory (Grégoire) has complained that nowhere can be found a full and reasoned statement of this thesis, and Mrs. Arber supplies a most convincing brief exposition of the salient features of this analogy between leaf and carpel. She does much more, however, for she points out the result of the impact upon morphological discussions of the evolutionary and phylogenetic atmosphere in which this discussion has continued since the publication of the "Origin". As the result, 'equivalence' has had a new meaning read into it; in the course of phylogenetic history a leaf is assumed to have become a carpel, and Grégoire would reject the foliar theory because in development a carpel does not arise from a foliar primordium. This restatement of the Candollean hypothesis and its separation from the phylogenetic atmosphere, in which it cannot have its original meaning, is a valuable service to morphology, but perhaps even more valuable for the English reader is the clear statement of the aim of the *Gestalt* morphology of Troll, which is introducing yet a new concept into pure morphological speculation and refuses either to base itself on phylogeny or upon teleological 'adaptive' interpretation. This new morphology is not less interesting because it sees the flower, or the inflorescence that simulates the flower, as the expression of a 'flower type', the significance of which is, as yet, quite elusive.

Hybrid Vigour in *Sorghum*

THE cultivated sorghums all belong to the species *Sorghum vulgare* and are classified into four types, grain, forage, grass and broomcorn types, which have the same chromosome number and are fully interfertile. Messrs. R. E. Karper and J. R. Quinby (*J. Hered.*, 28, No. 3) find that the F_1 hybrids between different types show a degree of hybrid vigour which in some cases is quite remarkable and differs for each cross. The cross between Hegari sorghum and dwarf broomcorn yielded an F_1 more than two and one half times as tall as the parents and producing nearly three times as much forage and grain. In certain crosses the plants were 15 feet tall and yielded 150 bushels of grain per acre. Milo and Hegari always produced extreme vigour and lateness in their hybrids, other varieties producing vigour without lateness. Heterosis is also shown by increased size of endosperm, which is correlated with the vigour of the plant. The extreme vigour of hybrids of Milo and Hegari is attributed to the presence in them of many dominant genes for growth, other varieties having some of the corresponding recessives. In certain crosses there is an increase of yield unaccompanied by increased height or change in time of maturity. Bulk emasculation of the flowers was carried out by means of hot water.

Erysiphaceæ of Japan

YASU HOMMA has recently published a very extensive monograph on the powdery mildew fungi (Erysiphaceæ) of Japan (*J. Fac. Agr. Hokkaido Imp. Univ., Sapporo, Japan*, 38, Pt. 3, 183–461, Feb. 1937). The treatment is exhaustive, and there are two divisions, a general part and a systematic part. The general part deals with the structure, formation and germination of conidia, and the occurrence of fibrosin bodies therein, with the perithecia, their asci and ascospores, with hibernation, host-parasite relations, immunity and resistance. Much experimental work is reported in this section, and very extensive inoculations of the fungus *Erysiphe graminis* f. sp. *Tritici* upon a wide variety of wheat species are described. Germinating conidia of the fungus penetrated the epidermis of both immune and susceptible kinds of wheat, but no further development of the germ tube took place within an immune plant. Infection by conidia was effected most easily during the period of greatest vigour of growth of the host. The systematic part records nine species new to science, and Japan possesses one endemic genus in *Typhulochæta*. This is distinguished from all other genera of the Erysiphaceæ by the clavate appendages to the perithecium. Eight plates illustrate structural and taxonomic details, and the paper is fully indexed. It contains more than 180 citations of published work, and should provide a valuable book of reference for mycologists outside the territorial limits implied by its title.

Deafness and the Use of Hearing-Aids

A COMMITTEE of the Medical Research Council has issued a report upon the physiology of hearing, giving the results of investigations into the utility of hearing-aids to deaf people ("The Use of Hearing Aids", A. W. G. Ewing, L. R. Ewing and T. S. Littler, M.R.C. Special Rep. Series, No. 219. H.M.S.O. 9*d.* net). In recent years the assistance that can be given to the deaf has been greatly increased because the extent to which a patient is in need of a hearing-aid, and the kind of aid most suitable, can be ascertained by audiometer tests to a degree previously impossible. The general increase in intensity of sound is only one aspect of the problem, as deaf persons vary in the extent to which they are deaf to different pitches of the auditory range, the object of a hearing-aid being so to modify the sound as to bring it within the range of hearing which the individual retains. The threshold of audibility for speech may be reliably deduced from the thresholds for pure tones obtained with a pure-tone audiometer or beat-tone oscillator. In general, it is within 5–10 decibels of the patient's lowest reading for pure tones over the frequency range 250–4,000 vib. per sec.

Of 158 adults tested, 94 obtained considerable help from a portable valve aid, 18 from non-valve battery aids, 2 from bone-conduction battery aids, 16 from speaking tubes only, and 28 were too deaf to derive help from any aid. Even when the most efficient type of aid is used, proficiency in lip-reading is also required if deafness is to be alleviated to the fullest extent. For teaching groups of deaf children, the class amplifier, into the microphone of which the teacher speaks, has advantages over individual aids.

Ultra-violet Light in the Upper Atmosphere

The spectrum of the sun, observed through the lower atmosphere, is cut off at about λ 2900 by an ozone layer which probably lies between 20 km. and 50 km. from the earth's surfaces. Phenomena which take place above this layer, such as the night-sky luminosity and the production of ionized layers, depend largely on the ultra-violet rays of shorter wave-length than this. M. N. Saha (*Proc. Roy. Soc.*, A, **160**, 155) reviews the action of such light on oxygen and nitrogen. The 'negative' bands of nitrogen, due to N_2^+, have been found in the light of the sky for a short time at sunrise and sunset, and these bands are supposed to be excited by light of wave-length less than λ 660. The intensity of this process indicates that the sunlight intensity at this wave-length is far larger than could be expected from a black body at 6,500° K.—a model which has often been used to represent the sun. The absorption of short wave-length ultra-violet light by oxygen and nitrogen has not yet been sufficiently investigated in the laboratory, but a number of possible processes are examined in the paper.

Nuclear Reactions in the Stars

The old suggestion of Eddington, that the building up of heavier elements from hydrogen goes on in the stars with continuous production of energy, has several times been examined in the light of modern information about nuclear reactions. C. F. v. Weizsäcker (*Phys. Z.*, 38, 176) has developed this idea in some detail. The nuclear velocities resulting from temperature in the interior of a star are high enough for nuclear reactions of the lightest elements to take place with fairly high probability. These reactions involve both the building-up and breaking-down of nuclei, so that the light nuclei undergo cycles of transformation. Neutrons are produced and are held responsible for the building of the heavy elements. The reactions between light nuclei take place in very deep regions where the density is low on account of radiation pressure. A small part only of the star's mass takes place in rapid cyclic processes, but fresh supplies of light atoms are brought into the active region by convection. The stability of a star against radial pulsations is due, it is suggested, to the damping effect of a time-delayed β-transformation which is a link in the cycle. This effect fails for very slow pulsations, and in fact Cepheid variables of period larger than a certain value are not known. The life-history of a typical star is sketched. In a pure hydrogen star, the first process is the reaction of a proton and an electron to form a neutron: this is endothermic and requires a very high temperature. The cyclic charges begin and the star expands explosively. The star then settles down to a career of slow expansion, which lasts until its hydrogen supply is used up.

Axial Flow Fans and Pumps

In the preparation of "Data for the Design of Axial Flow Fans and Pumps" (London: The Draughtsman Publishing Co., Ltd. 2*s*.), Mr. R. Poole has taken as granted the principles and theory of his subject and has confined himself to an exposition of the means and methods by which the actual determination of the design is effected. In the space at his disposal it is possible to deal with only one aerofoil shape—he has chosen Glauert's extended Joukowski aerofoil—but it must be understood that the method is not inappropriate in other cases. This impeller is shaped like aeroplane wings and, therefore, the aerodynamical characteristics of the blades being known, the total pressure and torque on them can be ascertained taking into account their helicoidal path in relation to the fluid. For the theory and research on which the work is based references are made to papers and to Reports and Memoranda of the Aeronautical Research Committee, so that any reader who finds the notes insufficient for his purpose may refer to the usual sources. In design of this nature, the work largely depends on the determination of the appropriate constants and coefficients, and on the application of the relations between such characteristics as lift and drag, velocity, torque, thrust, interference, etc., which have been evolved and ascertained in the course of extended research, and can be expressed and arranged for use most conveniently in the form of diagrams and tables. Almost wholly, then, this pamphlet consists of the curves from which, stage by stage, the required design can be worked out. Only in so far as it is necessary to explain these curves and their purpose does the author employ letterpress, except at the end, where an example of the design of an axial flow fan in conformity with given requirements is fully worked out.

Filter Attachment to Portable Air Velocity Meter

Reference was made in Nature of June 27, 1936 (p. 1078) to a convenient portable air velocity meter, the 'Alnor velometer', put on the market by Messrs. Air Conditioning and Engineering, Ltd., 4–12 Palmer Street, London, S.W.1. New filter attachments have now been developed for use with this instrument when taking direct air velocity measurements in an atmosphere heavily laden with dust. By the use of a conversion chart, it is possible to use the same instrument with the filter removed.

Measurement of Photographic Plates by Projection

Mr. G. F. Kellaway has published a paper with this title (*J. Brit. Astro. Assoc.*, 47, 5, April 1937), in which he describes a method for projecting an enlarged image of the negative of a celestial body, by means of a projection lantern lens, on to a graduated screen, such as graph paper. Mr. Kellaway uses a Zeiss triplet of about 28 inches focal length to secure the negative, which is then projected on a screen. Two examples are given, one to determine the position of a star and the other of Whipple's Comet, both results being very satisfactory when compared with the catalogued position of the star or with visual observation of the comet. It is suggested that the method should be used when the object is faint and diffused, and those who possess small-scale cameras could increase their scope of work by spending a few shillings on a projection lens.

after-shocks; all these features pointing to a complicated origin covering a large area.

(5) Burma, divided into three main structural units—the Shan plateau (A, Fig. 2), consisting of rocks of Mesozoic and older ages, the Tertiary basin of the Irrawaddy valley (B), and the range of the Arakan Yoma of late Mesozoic and early Tertiary times (C). They are separated by zones of faulting, with which many of the epicentres of Burmese earthquakes are associated, especially those of the destructive earthquakes of 1839 and 1858, the former near Mandalay and the latter near Thayetmyo and Prome. During the years 1929-31, there was a remarkable series of eight earthquakes, the epicentres of which, numbered in the order of occurrence in Fig. 2, are marked by a linear arrangement close to the eastern fault.

Most of the Indian earthquakes of the last forty years have been investigated by officers of the Geological Survey of India, yet it must be admitted that the state of seismological research in the country is behind that in some other lands. In Japan there are a hundred and five seismological observatories, in the United States forty-two, but in India only six, and not one official devoted entirely to seismological subjects. Mr. West suggests that the work done more or less independently by the Geological Survey, the Meteorological Department and the Survey of India should be co-ordinated and expanded by founding what would practically be an Earthquake Research Institute with its headquarters, say, at Shillong, provided with many new instruments for stations new and old, and with officers who, after a great earthquake, should at once proceed to the central area and establish round it a network of temporary stations in order to determine the epicentres and focal depths of the after-shocks. C. D.

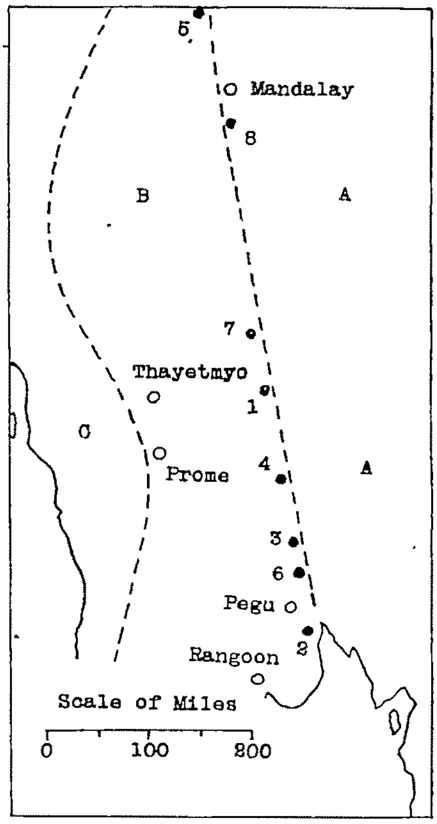

Fig. 2.
DISTRIBUTION OF EARTHQUAKES IN BURMA.

Incidence and Causes of Stammering

STAMMERING is one of those abnormalities sufferers from which fall between two stools. It is scarcely the concern of the family doctor, and yet is outside the scope of ordinary educational methods. Of recent years, psychological treatment has helped many individuals to cope with speech disabilities, but it commonly happens that more time and expense are called for in the achievement of a cure on these lines than stammerers are able to give, and so for one reason or another it usually falls to the lot of the individual stammerer to cure himself.

It is with special reference to some interesting figures supplied by the Stammerers' Club of New South Wales* that this short commentary on an important subject is given; as the result of questionnaires sent out to the members this Club has elicited most interesting information.

Whilst in most instances of stammering there is actual physical disability of some kind, nevertheless, for the most part the trouble is to be found in a constitutional nervousness or sense of inferiority. From the statistics from New South Wales, it is noteworthy that although serious illness is actually credited with nine per cent in the list of causes, no definite physical disease is said to have any serious influence. The cause of stammering generally is attributed to such psychological causes as shock, imitation, fright and being bullied or laughed at. In all these, it is evident that individual nerve sensitiveness or feeling of inferiority is the chief underlying trouble. That this nerve weakness is often inborn seems to be emphasized by the fact that in no less that fifty-one per cent of the instances dealt with the stammerer began before the age of five years, and no less than ninety-three per cent experienced the onset before the age of ten. Granted that unfortunate conditions in upbringing produced such psychological disturbance as to impair capacity for normal speech, it certainly cannot be held that all these stammerers were born with strong nerves or the capacity for developing sound defences against the stresses of life.

As regards position in family, it does not seem to matter whether one is born early or late if one is to experience the disadvantage of stammering; it is true that there is the difference between thirty-eight per cent as regards 'elder' children and twenty-five per cent as to 'youngest', but as the 'intermediate'

* Stammering: its Cause and Cure. (The Handbook of the Stammerers' Club of New South Wales.) Pp. 72. (Sydney Stammerers' Club of N.S.W., n.d.)

members are put down as thirty-seven per cent there is really not much in it. In regard to reaction to school conditions this is said to have been 'good' in eighty-one per cent and in nineteen per cent 'bad', whereas it might well have been expected to be the other way round.

A further point of interest which comes out of these statistics of the N.S.W. Stammerers' Club is that seventy-six per cent stammerers were boys and twenty-four per cent girls; moreover, the serious influence of this disability in the case of the latter as regards life as a whole is suggested by the figures which tell us that at thirty years of age approximately seventy-three per cent of the boys had got married whilst only thirty-seven per cent of the girls had been equally successful.

Usually relief of stammering depends on the determination of the individual sufferer who will make use of certain rules of elocution and self-help such as are readily accessible from teachers and handbooks on the subject. Certainly the stammerer who sets out to cure his difficulty must attain three objects; namely, (1) confidence; (2) attainment of a new habit; (3) the maintenance of a restful state of mind and body. He must learn to relax. He mus learn to use a new voice with a timing slightly br definitely different from that which he habituall uses when stammering. He can look forward cor fidently, if he determines to practice and to rely c himself, in any case he can perhaps take som comfort from remembering that he is one of a com pany of very famous men. Amongst kings one may remember that Louis II and Louis XIII of France are said to have stammered badly. Whilst at least one Queen of England (Mary II) was also troubled in the same way. I have always understood that Charles Lamb abandoned an intended career in the Church because of his speech disability, although stammering has not always been incompatible with a reputation as a famous speaker. Charles Kingsley, Phillips Brooks and Father Hugh Benson, all distinguished in the pulpit, are said to have stammered at times.

E. L. HOPEWELL-ASH

South-Eastern Union of Scientific Societies

ANNUAL CONGRESS AT HASTINGS

THE forty-second Congress of the South-Eastern Union of Scientific Societies was held at Hastings on June 8–12. The Mayor of Hastings, Alderman A. Blackman, welcomed a large gathering of representatives of affiliated societies and other members of the Union at the opening ceremony on June 8, when Prof. F. E. Weiss was installed as president of the Union for the ensuing year, and delivered his presidential address on "Competition and Co-operation in Nature".

In the past, competition in commerce and industry was regarded as beneficial to the community, but competition among industrialists is no longer in such great favour, and even in agriculture efforts are being made to restrict it. On the other hand, co-operation, which is the basis of communal organization, is not generally called in question. Prof. Weiss pointed out that these forces also exist in Nature. Darwin had pointed out that, owing to the enormous reproductive capacity of most plants and animals, a weeding out process is inevitable; there is a struggle for existence under which only the fit survive. Many plants produce hundreds of thousands of seeds, but do not appreciably increase in numbers on an area already covered with vegetation. In the case of plants, the struggle for light is often the dominant factor. There is also competition for the necessary food among animals, and the larger and stronger animals have an advantage over the smaller and weaker ones. In the case of carnivorous animals, however, the race is not always to the strong, but also largely to the swift and agile. Though the dictum "Nature red in tooth and claw" causes some people to regard evolution as a continuous competitive warfare in which might is always triumphant, Darwin pointed out that there are certain instinctive characters in many animals which make for the preservation of the race as a whole and as apart from the individuals, and that probably in these the basis of our moral nature had its beginnings. Parental instincts play a very important part in the survival of the more highly developed animals; there is here no competition fo food between parents and offspring, but, on th contrary, parents will often starve themselves for th benefit of their young. Prof. Weiss then dealt wit numerous cases of symbiosis, the classical examp in plants being found in lichens. He took two amples to illustrate competition and co-operat among plants, the rosette-forming plants of g lands illustrating competition, and plants of Leguminoseæ with their nodules carrying nitrify bacteria exemplifying co-operation.

"Our Changing Flora" was the theme of an addr delivered by Dr. R. W. Butcher to the Botanic Section of the Union. Man has brought abo remarkable changes in the flora of Great Britai The draining of fens, the turning of heathland int forest, rivulets made into canals, the digging of rai way cuttings and making embankments have al played an important part in bringing about changes There never has been, and probably never will be anything static about the flora. The ecologis recognizes a continual change of vegetation as basic principle in plant succession. Captain Dive has directed attention to rapid topographical changes in the South Haven peninsula of Dorset since 1700. Large masses of *Isoetes echinospora* are now found on the bed of Littlesea, yet this plant was unknown there a few years ago. Pearsall has recorded many changes in the vegetation of the English Lakes these changes being in accord with changes in th nature of the lake bottoms.

Mr. L. F. Salzman gave a paper on "The Writi of Local History" to members of the Archæologic

Section. He likened a local history to a large-scale map, for, he said, it is possible to indicate on such a map features which cannot be shown on a map portraying a whole country. In a local history it is thus possible to emphasize the human side of history.

To the same section Alderman T. S. Dymond read a paper on "The Cinque Ports Barons returned to Parliament, 1366 to 1722". Though the "Return of Members of Parliament", ordered by the House of Commons to be printed in 1878, began with the year 1290, the names of representatives from the Cinque Ports date from 1366 only. From that year until 1844, two members sat for Hastings. Before Queen Elizabeth's time, a representative from the free barons of the Port was chosen. Down to the great Reform Bill, freemen, elected by the bailiff (mayor) and jurats, alone had the franchise; by 1831 their number had fallen to twenty-three. At the election following the Reform Bill, Mr. North (father of Miss North, famous for the collection of Nature paintings in the North Gallery in Kew Gardens) was elected by 356 votes. In contrast with this number, 20,955 votes were cast for the successful candidate at the last election.

"Fossils in their Original Environment" was the subject of a lecture given by Dr. H. Dighton Thomas to the Geological Section. Dealing first with Trilobites, Dr. Dighton Thomas said that the loss of eyes in these organisms was co-related with their burrowing habits; the Welsh beds were deposited in deep water, and in them the Trilobites show a reduction in the development of eyes, and one of them was blind. Brachiopods were common in shallow water after the Devonian period. Changes in the fauna of deposits were brought about by changing conditions of salinity in the water. He does not regard chalk as a foraminiferal limestone, but as a Foraminifera-bearing limestone. The bulk of the chalk is of shallow water origin, and its fauna is not a deep water one. He suggested the collection of fossils from differing horizons in the chalk and the determination of the fauna of the separate zones, as there is a lack of knowledge of the succession of the fauna in chalk in England. The flora and fauna of the London Clay are those of a tropical sea, and plants similar to those in it are still found in lowland tropical countries, Nipa swamps being cited.

Many interesting excursions to places of interest [illegible] d Hastings were made. At Ashburnham Place, [illegible] herine Ashburnham kindly allowed the King [illegible] relics to be inspected, and on the same [illegible] the sites of Sussex ironworks were visited. [illegible] ing of iron ore and the forging of wrought [illegible] these sites date from very early times, and [illegible] arried on at the site visited until about 1813, [illegible] ast of the ironworkers dying in a cottage close [illegible] n 1883. The geologists paid a visit to Crowhurst [illegible] arry, where faulting is very clearly seen, and one of the visitors picked up a scale, apparently from a turtle, with the markings on the back clearly defined. The natural gas bore at Heathfield Station was inspected. Visits were also paid to local churches and to Pett Level, where, owing to exceptionally low tide, the remains of the submerged forest were plainly visible.

At the annual representative assembly, it was [illegible] nounced that the 1938 Congress would be held at [illegible] rthing, under the presidency of Dr. Julian Huxley. [illegible] A. W. Farquharson, of Le Play House, 33 Gordon [illegible] re, London, was elected honorary general [illegible] tary.

Science News a Century Ago

A Spanish Manuscript on Tahiti

AMONG the donations presented to the Royal Geographical Society at its meeting on June 26, 1837, was a Spanish manuscript, being the "Diary of an Expedition to, and Residence upon the Island of Tahiti", by Maximo Rodriguez, written in 1774. Rodriguez had accompanied an expedition from Lima to Tahiti, and with three other persons had spent about thirteen months in the island. Cook had heard of the visit of the Spaniards and had written: "Will anything ever become known to the world of the proceedings of the Spaniards at this island?" After a lapse of sixty years the diary was placed in the hands of a captain in the Royal Navy and by him presented to the daughter of Rodriguez, who having heard that Captain FitzRoy was making inquiries for manuscripts sent it to him begging his acceptance of it, saying that "she felt sure it would be better placed in the hands of an Englishman, and more valued in England, than it ever could be, concealed from the world, and uncared for, in her library at Lima".

The Institution of Civil Engineers

IN a memorandum issued on July 1, 1837, from 1 Cannon Row, Westminster, the Council of the Institution of Civil Engineers directed attention to the following subjects for communications and for premiums, during the session of 1838: the nature and properties of steam; the warming and ventilation of public buildings; accounts and drawings of the Plymouth Breakwater; the rates, from actual experiments, of the velocity, load and power of locomotive engines on railways, first upon levels, second upon inclined planes; description and account of the principles of Huddart's rope-making machinery at Limehouse; the sewerage of Westminster, and drawings and accounts of the shield used at the Thames Tunnel.

A Peat-Compressing Press

THE *Mechanics' Magazine* of July 1, 1837, contained a description of an improved machine for compressing peat invented by the Right Hon. Lord Willoughby d'Eresby. The machine was an upright press at the bottom of which was a rectangular cast-iron box into which a rectangular piston could be forced downwards by means of a rack and pinion. The interior of the box was lined with vertical iron bars between which small spaces were left so that the water could escape as the peat was compressed. "I find", wrote the inventor, "that the machine answers perfectly on about half the sorts of peat usually consumed, that is to say, on those of a fibrous quality; and I am still carrying on the experiment on a large scale. The peat when compressed, has been used with perfect success, instead of coal, for the purpose of calcining lime, for the smith's forge as well as for ordinary fuel."

The Museums of Copenhagen

ON July 2, 1837, Lyell wrote from Copenhagen to one of his sisters: "In the time of Linnæus this city contained finer collections of shells, and finer works were published here by Chemnitz (12 vols.) and others, than in any country in Europe. It is not wonderful, therefore, that even now some of the Danes should be far ahead, and that as Prince Christian had a taste for natural history, he should have a splendid private collection, and that the curator of his museum (containing above 8,000 specimens of living shells), Dr. Beck, should be one of the two or three best conchologists in the world. But besides this, Copenhagen possesses in its different museums most of the identical shells which Linnæus described in the edition of his 'Systema Naturæ' published during his life; and here therefore alone, we can verify incontestably the species which he really described and named. As Lamarck and others have in very many cases mistaken the shells which Linnæus meant, great confusion has arisen, and it is here alone that this confusion can most readily be cleared up.

"I am going over with Beck an examination of all the fossil species identified by Deshayes with living shells, and it will probably lead to many modifications of my views, at least many of my details, also to many new views which I shall perhaps have to test at Paris before I return."

Edge's Pendulum for Ships

In 1837, the Society of Arts awarded a silver medal to Adolphus George Edge, a mate in the Royal Navy, for his invention of a pendulum for showing the inclination of a ship when under sail, which could be used for regulating the elevation or depression of the guns. It was tried with favourable results in the *Inconstant* and *Pique*, and at the end of June 1837 Rear-Admiral F. J. Maitland wrote to the Secretary of the Admiralty, from the *Victory* at Portsmouth, saying that as Edge's pendulum had shown its great superiority "to two other pendulums tried against it in the Portsmouth Yacht, I am desirous that my intended flag-ship the *Wellesley* should be supplied with it; and I request you to be pleased to obtain permission for one to be made for me in Portsmouth Yard". A example of the pendulum was placed in the repository of the Society of Arts.

The Endless Ladder

Under this title the *Gentleman's Magazine* for June 1837 gives the following description of what appears to be a prototype of the moving staircase. "A patent has recently been obtained for a most ingenious and useful machine adapted to mining and many other purposes, where the main object is to raise or lower weights or packages in constant succession. This simple but very effectual contrivance consists of an endless ladder, made either of chain or rope, which passes under and over two revolving drums or cylinders, mounted upon horizontal axes; one placed at the bottom, and the other at the top of a shaft or plane, to and from which the ladder is intended to reach. A continuous motion being given to either of the cylinders by the power of steam or animal force, the endless ropes or chains furnished with horizontal stairs like those of a common ladder are made to circulate over the revolving cylinders by which they are distended, so that one part of this endless ladder is continually ascending with a slow but uniform motion from the lowermost of the cylinders to the uppermost, whilst vice versa the other part of the ladder is descending to the lowermost in an uninterrupted circulation."

University Events

Birmingham.—The new A. E. Hills chemistry building is to be opened formally by the donor on July 7. The opening address is being given by Sir Frederick Gowland Hopkins.

Glasgow.—Prof. G. G. Henderson has presented to the University a valuable collection of books and reprints on chemistry, and also an interesting series of engravings and photographs.

The following candidates were awarded the degree of D.Sc. at the graduation ceremony held on June 16: J. Bell (thesis: "Heavy Water and the Structure of Crystalline Hydrates", with additional paper); J. D. Loudon (thesis: "The Cationoid Reactivity of Nitrodiphenylsulphones", with additional papers); Anne H. McAllister (thesis: "Clinical Studies in Speech Therapy").

Honorary degrees were conferred on the following, among others: *LL.D.*, Prof. J. Boeke, professor of histology and embryology, University of Utrecht; J. M. Cowan, physician, Glasgow; Prof. T. K. Monro, emeritus professor of medicine, University of Glasgow; Sir Robert Muir, emeritus professor of pathology, University of Glasgow; Sir Albert Seward, emeritus professor of botany, University of Cambridge; Prof. R. Stockman, emeritus professor of materia medica, University of Glasgow.

Liverpool.—On June 4, honorary degrees were conferred on the following, among others: *LL.D.*, Lord Leverhulme, formerly pro-chancellor of the University; Sir Hector Hetherington, principal and vice-chancellor of the University of Glasgow, formerly vice-chancellor of the University of Liverpool; *D.Sc.*, Prof. C. T. R. Wilson, formerly Jacksonian professor of natural philosophy, Cambridge; *D.Eng.*, Mr. A. P. M. Fleming, director and manager of the research and education departments of the Metropolitan-Vickers Electrical Co., Ltd.; *Litt. D.*, M. René Dussaud, Department of Syrian and Palestinian Antiquities, Louvre Museum.

Manchester.—In addition to the grant of £5,000, recently announced, in aid of the biochemical research directed by Prof. I. M. Heilbron, the Chemistry Department has now received from the Rockefeller Foundation a further grant of £300 a year for tw [illegible] years in aid of the application, under Prof [illegible] Polanyi, of physico-chemical methods to the [illegible] tion of problems of biological interest.

A chair of theoretical physics has been [illegible] in the University to which Prof. D. R. H [illegible] present Beyer professor of applied mathema [illegible] been appointed.

Dr. J. G. Woolham has been appointed hon [illegible] assistant lecturer in physiology. Dr. J. M. Jack [illegible] and Dr. J. A. Todd have resigned their posts in t [illegible] Department of Mathematics on appointment a [illegible] lecturers in Westfield College, University of London, and the University of Cambridge respectively.

Oxford.—At Encænia on June 23, honorary degrees were conferred upon the following, among others:—*D.C.L.*: The Right Hon. W. G. A. Ormsby-Gore, Hon. R. H. Brand and Sir Herbert Baker. *D.Sc.*: Prof. Walter Nernst. *D.Litt.*: Dr G. P. Gooch.

Prof. J. H. Hutton, of Cambridge, has b [illegible] appointed Frazer lecturer in social anthropo [illegible] for 1938.

Societies and Academies

London

Royal Society, June 17.

LORD RAYLEIGH : The surface layer of polished lica and glass, with further studies on optical con- ct. The reflecting power of a polished silica surface amined at normal incidence in a liquid having the me refractive index as the body of the material, ries widely according to the treatment. Surfaces lished by a process which removes material rapidly surfaces washed in dilute hydrofluoric acid, do t reflect appreciably in the liquid. Surfaces polished methods which do not quickly remove the material y reflect as much as 0·28 per cent of the incident ht. A kind of burnishing seems to take place, hich modifies the surface, and may bring up its fractive index from 1·461, the ordinary value, to much as 1·61, quite as high as light flint glass, d much higher than any known variety of silica. ese effects are found in a less degree in ordinary ass, and in a much less degree in crystal quartz. normal cases the reflected light changes in tint m red to blue as the refractive index of the mersion fluid is increased through the critical value r minimum reflexion. The modified silica surface anomalous in this respect, the reflexion being red either side of the minimum value. The explanation f this is discussed.

F. P. BOWDEN and T. P. HUGHES : Physical roperties of surfaces. (4) Polishing, surface flow, d the formation of the Beilby layer. The process f polishing is greatly influenced by the relative elting point of the polisher and the solid. If the lisher melts at a higher temperature than the solid, rface flow and polish of the solid will readily occur. the melting point of the polisher is below that of e specimen, surface flow takes place very slowly not at all. In general, the amount of surface flow governed, not by the properties of the polisher and ecimen at room temperature, but by their relative echanical properties at the high temperature of the ding surfaces. Experiment suggests that polish is ought about by an intense local heating of the rface irregularities to the melting or softening point. he molten or softened solid flows or is smeared over e surface, and rapidly solidifies to form the polished ilby layer.

D. J. MALAN and H. COLLENS : Progressive htning. (3) The fine structure of return lightning okes. The fine structure of return lightning strokes s been studied from the photographs of 120 flashes ken with Boys and other cameras. There are two pes of structure exhibited by branched and by branched strokes respectively. In the case of a anched stroke the time-luminosity curve at the base the stroke shows that when the first upward oving luminosity (component 1) reaches a branch- g point, the channel again increases in luminosity mponent 2), the luminosity falling off when the end the branch has been reached. Later components using a new increase in channel luminosity may our when further branching points are reached. These mponents are thus intimately connected with the anching processes. The components of unbranched rokes are never observed to start before the stroke s reached the cloud. All components associated ith branches are found to progress with velocities excess of 10^{10} cm./sec. Their direction is indeterminate. Components not associated with branches but with the cloud charge itself, progress either upwards or downwards, their velocities varying from 2×10^{8} cm./sec. to more than 10^{10} cm./sec. The low-velocity components are observed to progress downwards only. The total number of components observed at any point along the channel decreases after passing branching points, the highest number being observed at the base of the stroke. The time-intensity curve at the base of a stroke shows that the first two components are the most important. No evidence of components which can be ascribed to self-oscillation of the channel has been found.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 2 ; 1937).

L. GODEAUX : An algebraic variety of three dimensions of bigenus one.

TH. DE DONDER and Y. DUPONT : New theory of the dynamics of continuous systems (5).

E. DE WILDEMAN : The number of carpels of the flowers of *Rubus caesius* L. and the number of the druplets of its fruits.

TH. DE DONDER : The uniqueness of the adjoint system of De Donder's linear partial differential equations.

D. FREYDENBERG : Note on numerical combinations with a constant sum.

P. BURNIAT : Projective models of canonical surfaces.

A. APPERT : Transitive topologies.

G. DUFRANE : A birational transformation of space having a given fundamental curve.

J. VAN MIEGHEM : Fundamental relation between the variations of pressure and temperature in the atmosphere.

J. L. DESTOUCHES : Minimal conditions which a physical theory must satisfy.

J. FAUTREZ : The athrocytosis of acid colouring matters. Stable and labile athrocytosis.

P. DENIS : A new alkaloid of the Rubiaceæ : rubradinine.

M. HOMÈS and G. VAN SCHOOR : The presence of certain growth-promoting substances in *Elodea canadensis*.

(*Bull. Classe Sci.*, 23, No. 3 ; 1937).

L. GODEAUX : Some algebraic varieties in three dimensions having canonical and pluricanonical surfaces of order zero.

G. HIRSCH : A generalization of a theorem of Borsuk, concerning certain transformations of the *analysis situs*.

O. ROZET : The nets of integral invariants.

S. DE BACKER : Viscous fluids and propagable waves (3).

P. SWINGS and A. GATHOYE : Note on the absolute magnitudes of *Be* and *B* type stars.

M. NICOLET : Theoretical determination of the effects of absolute magnitude of the molecular bands in stellar spectra.

J. EECKHOUT : Polarographic reduction potential of dinitro compounds.

D. CRESPIN and M. DESIRANT : New empirical formula for the spectroscopic determination of the internuclear distance of diatomic molecules.

L. LISON : Structure of the cryptosoleniated region in the Coleoptera *Tenebrio molitor* L. and *Dermestes lardarius* L.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, June 29

Warburg Institute, at 5.30.—K. de B. Codrington: "Play and Ritual".*

Royal Anthropological Institute, at 8.30.—Annual General Meeting.

Dr. H. S. Harrison: "Ethnology under Glass" (Presidential Address).

University of Manchester, July 1–2.—Conference on "Magnetism" to be held in the Physics Department.*

Achema VIII.—Chemical Engineering Exhibition to be held at Frankfort-on-Main on July 2–11.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned.

Lecturer in Librarianship in the Municipal College, Romford Road, E 15—The Principal (June 28).

Lecturer in Geography in the Normal College, Bangor—The Principal (June 28).

Assistant Lecturer in Mathematics in University College, Cardiff—The Registrar (June 30).

Assistant Lecturer in Zoology in University College, Gower Street, London, W.C.1—The Secretary (July 1).

Research Biochemist at the Runwell Hospital, Nr. Wickford, Essex—The Physician Superintendent, envelope marked "Biochemist" (July 1).

Assistant Lecturer in Zoology (woman) in University College, Leicester—The Registrar (July 3).

Lecturer in Refractory Materials in the Royal College of Science—The Secretary, Imperial College of Science, Prince Consort Road, London, S.W.7 (July 3).

Lecturer in Mathematics in King Alfred's Training College, Winchester—The Principal (July 3).

Junior Scientific Officers in the Admiralty Scientific Pool (July 9: quote C.E. 4472/37) and Assistants (grade III) in the Admiralty Technical Pool (July 3. quote C.E. 4473/37)—The Secretary to the Admiralty (C E. Branch).

Assistant Lecturer in Agricultural Chemistry, Assistant Lecturer in Agricultural Zoology, Instructor in Poultry Husbandry and Instructors in Horticulture in the University of Leeds—The Registrar (July 5).

Demonstrator in Botany at University College, Southampton—The Registrar (July 5).

Assistant Analyst in the Borough of Southwark—The Town Clerk, Southwark Town Hall, Walworth Road, S.E.17, envelope marked "Assistant Analyst" (July 5).

Research Assistant in the Chemical and Animal Nutrition Research Division, Ministry of Agriculture, Northern Ireland—The Secretary, Civil Service Commission, Stormont, Belfast (July 6).

Assistant Lecturer in Anatomy in University College, Cardiff—The Registrar (July 7).

Adviser in Animal Husbandry in the Department of Agriculture, Malta—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S W 1 (July 7).

Principal of the County Technical College, Guildford—The Chief Education Officer, County Hall, Kingston-upon-Thames (July 10).

A Lecturer and an Assistant Lecturer in Botany in the University of Manchester—The Registrar (July 10).

Assistant Civil Engineers (male) in the Civil Engineer-in-Chief's Department, Admiralty, and H.M. Naval Establishments abroad—The Civil Engineer-in-Chief, Admiralty, London, S W 1, envelope marked "A.C.E." (July 12).

Head of the Mechanical Engineering Department at the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon (July 12).

Geologists on the Geological Survey of Great Britain—The Director of the Survey, Exhibition Road, London, S W.7 (July 31).

Ten Temporary Gazetted Civilian Engineers in the Military Engineer Services, India—The Under-Secretary of State, Military Department, India Office, envelopes marked "C E. Recruitment" (July 31).

Reid Lecturer in Anthropology in the University of Aberdeen—The Secretary (August 31).

Professor of Economics in the University of Adelaide—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1.

Metallurgist (alloy steels) and Two Metallurgists in the Research and Development Department, The Mond Nickel Co., Ltd, Thames House, Millbank, S.W.1—The Manager.

Lecturer in Mathematics in the College of St. Mark and St. John, Chelsea—The Principal.

Lecturers in Economics, Electrical Installation and Engineering Science in the Kingston Technical College—The Principal.

Official Publications Received

Great Britain and Ireland

Annual Report of the Zoological Society of Scotland for the Yea ending 31 March 1937 Pp. 68+8 plates. (Edinburgh: Zoologica Society of Scotland) [26

Air Ministry: Aeronautical Research Committee. Report for th Years 1935 and 1936 Pp. 60+6 plates. (London. H.M. Stationer Office.) 4*s.* net. [26

Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S No. 46: Studies on the Ultimate Composition of Biological Materia Part 1: Aims, Scope and Methods. By David Allardice Webb an William Robert Fearon. Pp 487–504+plate 15. (Dublin: Hodge Figgis and Co; London: Williams and Norgate, Ltd.) 2*s.* [27

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